Universität Hohenheim
Institut für Volkswirtschaftslehre
Fachgebiet Statistik und Ökonometrie I

Essays on Public and Private Antitrust Enforcement

Dissertation
zur Erlangung des Grades eines
Doktors der Wirtschaftswissenschaften
(Dr. oec.)

vorgelegt der
Fakultät Wirtschafts- und Sozialwissenschaften
der Universität Hohenheim

von

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Stuttgart-Hohenheim

2015

Die vorliegende Arbeit wurde von der Fakultät Wirtschafts- und Sozialwissenschaften der Universität Hohenheim als Dissertation zur Erlangung des Grades eines Doktors der Wirtschaftswissenschaften (Dr. oec.) angenommen.

Datum der letzten mündlichen Doktorprüfung: 28. April 2015

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Danksagung

Ich möchte mich zunächst ganz herzlich bei meinem Doktorvater Prof. Dr. Gerhard Wagenhals für die hervorragende Betreuung und Unterstützung in all den Jahren bedanken. Er hat in mir nicht nur die Begeisterung für empirisches Arbeiten geweckt, sondern durch seine stetige Gesprächsbereitschaft und fortlaufende Förderung ganz entscheidend zum Gelingen dieser Arbeit beigetragen. Ebenso danke ich Herrn Prof. Dr. Ulrich Schwalbe für die Betreuung dieser Arbeit und die spannenden Vertiefungsvorlesungen während des Hauptstudiums, durch die mein Interesse an Wettbewerbsökonomik geweckt und die thematische Orientierung dieser Arbeit stark beeinflusst wurde. Frau Prof. Dr. Christine Escher-Weingart danke ich herzlich für die Mitwirkung am Promotionsverfahren.

Weiterhin möchte ich mich bei Ulrich Scheurle und Kai Hüschelrath für ihre Ratschläge und Förderung in den vergangenen Jahren sowie bei dem gesamten "Wettbewerb und Regulierungs" -Team am ZEW, insbesondere bei Sven Heim, für die schöne Zeit in Mannheim bedanken.
Teile dieser Arbeit basieren auf gemeinsamen Artikeln mit Kai Hüschelrath, Ulrich Laitenberger und Eckart Bueren, denen ich für die angenehme und konstruktive Zusammenarbeit sehr danke.

Mein größter Dank gilt meiner Familie, insbesondere meiner Frau Christine sowie meiner Tochter Sophie für die fortlaufende Unterstützung und den Rückhalt in all den Jahren.

Bornheim, Mai 2015 Florian Smuda

Contents

List of Figures

List of Tables

1. Introduction

Cartels are groups of firms who explicitly agree among themselves to coordinate their activities with the objective to raise market prices (Pepall et al., 1999). The coordinated activities of cartels do not necessarily include price-fixing only, but also bid-rigging (public tenders), output restrictions and quotas as well as the allocation of customers, suppliers, territories or lines of commerce (Crampton, 2003). Since all these kinds of activities cause enormous welfare losses for society, they are prohibited and prosecuted in most countries around the world. For Europe, the annual monetary damage caused by cartels has been estimated between 16.8 and 261.22 billion Euro, corresponding to a share between 0.15 and 2.3 percent of the annual European GDP (European Commission, 2007). Given these large damages, the European Commission (hereinafter "EC" or "Commission") aims at an effective prosecution of existing cartels and efficient deterrence of potential future cartel agreements, and has recently initiated important steps towards a more effective public and, in particular, private antitrust enforcement in that respect.

Against this background, the aim of this dissertation is to contribute to the literature on public and private antitrust enforcement by providing four chapters with innovative and policy-relevant contents that allow the deduction of important implications for the enforcement of antitrust law. In particular, econometric and statistical methods are applied and extended in order to explore the price-setting behavior of cartels in Europe and the status quo of cartel deterrence (chapter 2), to provide new insights regarding the quantification of cartel damages of cartel suppliers (chapter 3) and final consumers (chapter 4), and to analyze the relation between cartel breakdowns and merger activity in former cartel industries (chapter 5).

This introductory chapter is structured as follows. Section 1.1 summarizes the economic basics of cartels with a particular focus on the incentives for cartel formation, the stability

of cartel agreements and the detection of cartels using the available literature. It forms the cornerstone necessary to understand the behavior of cartels in general and the challenges of antitrust enforcement in particular. Chapter 1.2 then explicitly focuses on antitrust enforcement by characterizing the main differences between public and private enforcement, their legitimation, their specific aims, and by describing and evaluating the most recent and important competition policy alterations that have stimulated the antitrust enforcement process in Europe. Chapter 1.3 presents the outline of the dissertation and summarizes the findings of each subsequent chapter.

1.1. The Economics of Cartels - A Survey

1.1.1. Incentives for Cartel Formation

In a competitive environment firms are obliged to sell their products at adequate prices and with the required quality to purchasers or consumers. A mismatch between price and quality will redirect demand from the concerned firm to rivals, thereby decreasing its profit. It is therefore the competitive forces that drive product prices and quality to market outcomes that are in the interest of consumers.

Competitors of the same relevant market, however, have incentives to overcome those market forces by coordinating prices and/or output quotas through the implementation of a cartel agreement. The fundamental incentive for firms to enter such an agreement is that they can generate a supra-competitive profit that is higher than the sum of the profits of each potential member absent from collusion. Precisely, in a competitive homogeneous Cournot oligopoly framework a firm maximizes its individual profit and therefore merely focuses on the impact of the quantity decision on its own profit, thereby ignoring the externality it causes towards rivals' profit maximization. This externality is given by the fact that a decrease in the own output quantity leads to an increase in market price, benefiting the remaining Cournot oligopolists in the market as well (Hüschelrath, 2009). In a cartelized setting by contrast, the colluding firms take these effects into account by jointly maximizing the overall profit, which enables them to realize (at least theoretically) the monopoly outcome. As a consequence, less quantity is produced and higher prices are charged by the cartel firms in comparison to the prior competitive situation. In ad-

dition, in the mid and long term reduced product quality and variety, reduced services as well as less innovation are follow-on effects of collusion (Crampton, 2003), resulting in negative welfare effects for society in general and decreased consumer surplus in particular.

1.1.2. Stability of Cartels

The size of the welfare loss evolving due to a cartel crucially depends on two factors, the magnitude the cartel is able to raise prices above the competitive level, and the duration of the infringement. The latter factor is based on the stability of the cartel, which constitutes the key challenge for an existing cartel. The fundamental dilemma cartel firms are confronted with is that each firm has an incentive to deviate from the agreement by increasing the own output quantity and lowering the output price in order to receive a higher profit. However, if each cartelist follows this strategy the collusive equilibrium would immediately change to a competitive state, leaving all firms worse off than in the cartel state (Levenstein and Suslow, 2006). Thus, for a cartel to be stable incentive constraints must be fulfilled, implying that for each firm the expected gain from cheating is lower than the discounted value of the expected future lost cartel profits. In an infinite game these incentive constraints are fulfilled if the discount factor is sufficiently large, making collusion a stable equilibrium. The economic reasoning behind this point is that with a sufficiently high discount factor firms evaluate future expected cartel profits stronger than the short term gain from cheating today and are therefore more willing to sustain the cartel agreement (Motta, 2004). If, however, the game is only finitely played, each cartelist has an incentive to deviate in the last round regardless of the value of the discount factor, leading via backwards induction to the Cournot-Nash equilibrium in each round and therefore not to a stable cartel equilibrium.

Aside from incentive constraints that must be fulfilled for each firm, the credibility of punishment in case of a deviation is decisive to form a stable cartel. If the remaining firms are not credibly willing to punish the deviator by means of lower profits, the cartel can not sustain. The punishment strategies primarily analyzed in economic theory are *trigger strategies* (e.g. Porter, 1983; Green and Porter, 1984) and *stick and carrot strategies* (e.g. Abreu et al., 1986; Abreu, 1988).

Under the former type of strategy the deviation of one firm triggers an infinite-lasting punishment phase in which all other firms chose higher quantities (lower prices) instead of cartel quantities, such as Cournot-Nash quantities. Since all other firms agree on this quantity, the best answer for each firm is to choose the Cournot-Nash quantity as well, making participation in the punishment for each firm rational (Motta, 2004). Green and Porter (1984) show in a dynamic model with uncertainty (firms can observe the market price but do not know the quantities chosen by the other firms), homogeneous products and in which firms set their own production levels, that a trigger strategy can be used to deter deviations from cartel quantities. Precisely, by threatening the other firms to produce Cournot quantities for a fixed period of time after the price has fallen below a specific trigger price[1], a potential deviator has to weigh the short-term profit from deviation against an increased probability that the market price will fall below this trigger level, leading to lower profits under Cournot-Nash quantities (Porter, 1983).

Abreu et al. (1986) and Abreu (1988) show that cartel stability can also be maintained via *stick and carrot strategies*. Under this type of punishment strategy firms even agree on negative profits after deviation and sustain this outcome until all firms take part in it, but immediately return to the collusive outcome as soon as all firms have joined the punishment phase. Their model reveals that collusion is easier obtained when the punishment becomes more severe, leading to the highest cartel sustainability if the discounted profit after cheating is zero (Motta, 2004).

1.1.3. Cartel Detection

In general, the described incentives for cartel formation and the conditions for stability may be fulfilled in most kinds of industries. This raises the question of how existing cartels can be discovered. The methods for detecting cartels can basically be subdivided into *structural* and *behavioral methods* (Harrington, 2008). Structural methods aim at identifying collusion factors that ease the formation and stability of cartel agreements

[1] This trigger price must not necessarily be due to deviation, but might also be the result of a demand shock. See Green and Porter (1984).

(e.g. Ivaldi et al., 2003; Grout and Sonderegger, 2005) and that can be used to identify industries with structures fostering collusion. Rey (2006) classifies these factors into 1) basic structural variables, 2) characteristics of the demand side and 3) characteristics related to the supply side:

1. Basic structural variables

   The *number of competitors* in the market is one of the most important structural variables, since a lower number of firms facilitates coordination and increases the individual shares of the cartel profit (Rey, 2006). Furthermore, *high barriers to entry* eases collusion by preventing market entries from outside firms and increasing the potential cost of deviation in terms of foregone future profits (Ivaldi et al., 2003). Last but not least, *market transparency* and *frequent interaction between the firms* facilitate the identification of deviations and allow quicker reactions (penalizations) to those deviations, thereby fostering both cartel formation and stabilization (Rey, 2006).

2. Demand characteristics

   Market growth is one important demand factor facilitating collusion, because in growing markets deviation is less profitable as future (lost) profits are large in comparison to present (deviation) profits (Rey, 2006). Similarly, the *absence of significant demand fluctuations or business cycles* foster cartel stability, because in a business cycle scenario when market demand is high and expected to fall, the short-term gains from deviation are high in comparison to future foregone profits (Ivaldi et al., 2003; Haltiwanger and Harrington, 1991), making a deviation more profitable. Furthermore, a *low elasticity of demand* makes collusion more profitable, as elevated cartel prices do not lead to large demand decreases (Rey, 2006). Finally, a *low buyer power* facilitates to charge higher prices by the cartel firms, thereby favoring collusion.

3. Supply characteristics

   On the supply side, a high *product homogeneity* fosters cartel stability, because under product differentiation market transparency is reduced and the firm with the better product can gain more from cheating and has less to fear from retaliation (Rey, 2006).

For the same reason low-cost firms and/or high-capacity firms are more tempted to deviate, making *symmetric costs* and *symmetric capacities* two additional important factors facilitating cartel formation and stability (Rey, 2006). Last but not least, *mature industries with stabilized technologies* as well as *multi-market contacts* constitute important supply characteristics. While innovative advantages of a firm over its competitors limit the scope of a potential cartel agreement, multi-market contacts allow more frequent interactions between firms and mitigate potential asymmetries in individual markets (Rey, 2006), both fostering cartel formation and stabilization.

It is worth noting that industries fulfilling those factors must not necessarily be affected by collusion. On the contrary, it is even more likely that most of these industries are not cartelized, as the frequency of collusion in most markets is generally low and the posterior probability of collusion (conditional on all structural variables being fulfilled) is therefore likely to be low as well (Harrington, 2008). The described structural factors should therefore merely be used in a first step to filter out industries in which collusion is more likely, and must then be followed by more detailed industry analysis, leading to behavioral methods of detection. Behavioral methods concentrate on the market impact of collusion as well as the observation of the means or the result of coordination (Harrington, 2008).

With respect to this type of approaches, screening tools play an important role in cartel detection. Screening tools "[...] use commonly available data such as prices, costs, market shares or bids, and apply statistical tools to identify highly improbable or anomalous patterns in the data" (Abrantes-Metz et al., 2010, p. 4). Based on theoretical findings that prices are less variable during a collusive period (e.g. Athey et al., 2004; Harrington and Chen, 2006), those anomalous patterns can statistically be identified by looking at the mean and the variance of a time series of price data. Abrantes-Metz et al. (2006) find evidence that the average weekly price level decreased by 15 percent and the standard deviation of price increased by 263 percent after cartel breakdown, analyzing a bid-rigging conspiracy among seafood processors in the United States. Likewise, Bolotova et al. (2008) find a significantly lower price variance during the Lysine cartel with the help of ARCH and GARCH models. In addition, Hüschelrath and Veith (2012) show on the basis of the

German cement cartel that screening tools can also be used to proactively detect cartels. Applying structural break analysis to a data set of about 340,000 market transactions from customers of German cement producers, they find significant changes in the price structure and conclude that "[...] price screens, if they had been available at the time, could have allowed the larger customers to detect the upstream cartel before the competition authority" (Hüschelrath and Veith, 2012, p. 27).

Another strand of literature on behavioral methods exclusively focuses on the detection of bid-rigging cartels. Porter and Zona (1993) analyze the bidding behavior of cartel and non-cartel firms in auctions for state highway construction contracts. Regressing firm characteristics, such as the distance between the firms and the project, on the logarithm of bids, they find significant differences in the bidding scheme between cartel and non-cartel firms. Whereas non-cartel firms show the expected patterns, e.g. a higher distance increases the bid and the rank order of bids is generally cost based, contradicting results are observed for the sub-sample of cartel firms. In another application, Porter and Zona (1999) compare the bidding behavior of a group of cartel firms to a control group in the Ohio school milk markets using a reduced-form bidding model. Again, they find conspicuous differences between both groups of firms, however, they additionally show that while the non-defendant firms behave in a way consistent with competition, the defendants' behavior can be explained by a model of collusion.

Based on the finding that factors such as asymmetric costs can be used to identify anomalous bidding patterns, Bajari and Ye (2003) formalize two conditions, *conditional independence* and *exchangeability*, that allow to differentiate a collusive bidding behavior from a competitive bidding process. The conditional independence condition states that after having controlled for the impact of all publicly available information on the bids (e.g. the distances between firms and the project), the bids of competing firms may not be correlated. The exchangeability condition requires that the firms do not change their behavior if they are confronted with the same cost structure for themselves and for competing firms. This implies that if publicly available information used by the firms to generate their bids are changed among the firms, the corresponding bids should equally exchange among the firms (Bajari and Summers, 2002). If both conditions are fulfilled, it is possible that the bidding pattern evolved from competition. Conversely, if the conditions are not satisfied,

the hypotheses of a competitive outcome is neglected, making collusion a possible outcome. However, the pitfall of their approach is that even if both conditions are fulfilled, a collusive outcome is nevertheless possible, allowing undiscovered cartels to keep unrevealed. In addition, the hypotheses of competition may also incorrectly be rejected if it is not sufficiently controlled for the cost structure of firms (Bajari and Summers, 2002). To mitigate these problems, Bajari and Ye (2003) suggest an additional test based on the cost structure and markups observed in the industry, which compares the outcomes from a competitive model to the results from two collusive models.

Given the described incentives for cartel formation and the challenges of existing cartels towards stability and detection, the implementation of an efficient and effective antitrust enforcement is crucial for the fight against hardcore cartels. On European level, the EC has recently initiated important steps in that respect, especially by introducing leniency programs and by strengthening the field of private cartel enforcement. The subsequent section focuses on these developments by characterizing the main differences between public and private enforcement, their legitimation, their specific aims, and by describing and evaluating the important competition policy alterations in Europe using the exiting literature on antitrust enforcement. Section 1.3 then describes the outline and contribution of this dissertation to the topic of public and private antitrust enforcement.

1.2. Public and Private Antitrust Enforcement in Europe

1.2.1. Public Enforcement

Public antitrust enforcement is initiated by public authorities with the objective to reveal, punish and deter anticompetitive infringements of antitrust law. On European level, the legitimation for the EC to enforce antitrust law is provided by EC regulation 1/2003 along with Articles 101 and 102 (formerly articles 81 and 82) of the Treaty on the Functioning of the European Union. Article 101 prohibits agreements that restrict or distort competition within the internal (European) market without benefiting society and creating economic progress, such as price-fixing or market sharing. Article 102 prohibits the abuse of a dominant position, which, for example, may consist in market foreclosure. EC regulation

1/2003 refers to articles 101 and 102 (or more precisely, to its older numerations 81 and 82) and makes "[...] explicit provision for the Commission's power to impose any remedy, whether behavioural or structural, which is necessary to bring the infringement effectively to an end, having regard to the principle of proportionality" (European Commission, 2003, section (12)). In addition, national competition authorities who are in charge of enforcing national competition laws are also mentioned in regulation 1/2003 in order to "[...] form together a network of public authorities applying the Community competition rules in close cooperation" (European Commission, 2003, section (15)).

Given the legitimation for public authorities to enforce antitrust law, the process of public enforcement can generally be separated into two steps, a detection step and an intervention step (Hüschelrath and Peyer, 2013). Whereas the former stage aims at separating "[...] forms of suspicious from procompetitive business conducts", the latter stage is targeted at exerting the right type of intervention (fines, behavioral remedies, structural remedies) in order to punish the existing infringement and to prevent future antitrust infringements (Hüschelrath and Peyer, 2013, p. 587). Thus, for complete and successful public enforcement the authorities first have to detect an anticompetitive conduct using the detection methods available to them, and then punish the offender using its investigative and sanctioning powers. During the last two decades, the EC has introduced important alterations with the objective to effectively strengthen the enforcement process at both stages.

Detection stage

The most significant alteration concerning the detection of cartels has been achieved with the introduction of a corporate European leniency program in 1996. The basic idea of the leniency program is to deter future cartel agreements and, in particular, to internally destabilize existing cartels by granting undertakings that are actively involved in a cartel and willing to self-report either total immunity from fines or fine reductions. The question of whether total immunity, a fine reduction or no fine reduction is granted crucially depends on firm specific factors such as the quality of evidence handed to the Commission, the scope of cooperation with the Commission during the investigation process, the position an undertaking takes in case of several leniency applications concerning the same cartel case, or the role of the undertaking within the cartel (e.g. ringleader or passive membership).

The leniency program has been revised in 2002 and 2006 in order to increase deterrence, transparency and legal certainty, and to clarify the rules concerning leniency applications. Hüschelrath et al. (2013) show that the fraction of leniency cases decided by the EC compared to all decided cases has increased substantially between 2000 and 2011, making the leniency program to the most important detection instrument for public antitrust enforcement. Precisely, whereas only 42 percent of the cases decided between 2000 and 2003 are leniency cases, the fraction considerably increased from 63 percent between 2004 and 2007 to 78 percent during the period 2008-2011 (Hüschelrath et al., 2013, p. 4). However, whereas the pure numbers clearly suggest a success of the leniency program as an effective tool for public antitrust enforcement, economic literature finds both positive and negative effects of leniency programs on cartel stability and deterrence.

Starting with the theoretical strand of literature, Motta and Polo (2003) find that, on the one hand, leniency programs might prevent firms from colluding more frequently after an investigation is initiated because revealing information reduces the expected fine. On the other hand, since leniency discounts reduce the expected fine from an ex-ante perspective, leniency programs can also have a pro-collusive effect due to decreased expected costs of collusion.

Spagnolo (2005) shows that the optimal leniency policy is implemented if only the first self-reporting firm receives reward and the level of this reward is given as the sum of all fines paid by the remaining offenders. This is due to the facts that granting fine reductions to more "agents" makes the leniency system exploitable more easily and that higher fines paid by the remaining offenders increase the profit, and thus, the incentive for the first firm to self-report. Spagnolo (2005) additionally identifies three effects (*protection from fines effect*, *protection from punishment effect* and *strategic risk effect*) that may destabilize cartels even under more moderate leniency programs (without rewards), however, still under the assumption that the leniency program is restricted only to the first self-reporting firm, as it is the case in the US but not in the EU. The *protection from fines effect* captures the incentive to cheat if the fine paid by an agent who cheats and self-reports is lower than the fine paid by an agent who defects but does not self-report. The *protection from punishment effect* states that under stricter punishments for repeat offenders, the expected profit of further collusive agreements decreases, thereby limiting "[...] the costs agents are

willing to incur in punishing defections in the first place" (Spagnolo, 2005, p. 5). Finally, the *strategic risk effect* reflects the increase in riskiness of joining a cartel when a leniency program is in place.

Harrington (2008) argues that the results described in the above mentioned articles might be driven by the assumptions that the probability of the cartel being detected and prosecuted without using the leniency is fixed over time (as in Spagnolo (2005)) or is only allowed to take two values (as in Motta and Polo (2003)). By allowing this probability to vary continuously over time his richer model identifies an additional effect which he describes as *race to the courthouse effect*. It characterizes a switch in the model outcome from 'no firms applying for leniency' to 'all firms applying for leniency', thereby resulting in a race to the courthouse. Furthermore, in a recent article Harrington (2013) provides a model in which, different from the articles cited before, firms have private information concerning the likelihood that the antitrust authority effectively prosecutes them. Using this advanced setting he analyzes the post-cartel world after cartel breakdown in which firms minimize expected fines and reveals an additional effect emerging from leniency policy, the *pre-emption effect*. In contrast to the *race to the courthouse effect*, the *pre-emption effect* takes into account a firm's fear that another firm might apply for leniency and therefore itself applies in order to win the race and receive full immunity. In addition, he shows that a more aggressive enforcement policy applied by an antitrust authority increases the probability of conviction, since stronger prosecution increases the likelihood of a firm to apply for leniency and, thus, triggers the pre-emption effect earlier.

Turning to the scarce empirical literature on leniency programs, Brenner (2009) finds evidence of higher information revelation under the 1996 EU leniency program, however, no significant effect of the leniency policy on cartel duration as well the rate of detection. Miller (2009) develops a theoretical model which overcomes the classical problem of not observing active cartels by using a Markov process with stochastic transitions between collusive and competitive industry outcomes. Based on the empirical predictions and moment conditions derived from the theoretical model, he finds empirical support for an increased number of cartel detections immediately after the leniency introduction in the US in 1993 and a significant drop below pre-leniency levels afterwards, confirming the intended effects of leniency programs concerning detection and deterrence. Finally, Zhou

(2013) finds empirical support that the average cartel duration significantly increases in the short run after the 2002 EC leniency revision and significantly decreases below this short run threshold in the long run, thereby confirming his theoretical predictions of improved deterrence and cartel destabilization. The economic reasoning behind these predictions is straightforward. Whereas the short run increase in the average cartel duration can be explained by the fact that marginal cartels that are prone to fast dissolution "[...] would not form at the first place and the ensuing cartel discovery comes from a sample of longer lasting cartels", the decreased average duration in the long run is due to the leniency induced destabilization of formerly stable and long-lasting cartels (Zhou, 2013, p. 9).

Intervention stage

Concerning the intervention stage of public enforcement, the imposition of fines represents the most important enforcement tool in Europe.[2] Following the line of reasoning of Wils (2007), there are several ways in which fines contribute to the enforcement process. First, by imposing monetary sanctions that outweigh the expected gains from price-fixing, a deterrent effect can be created. Second, a well-designed fining policy allows for a differentiation in the level of fines according to the role played by the different firms, thereby increasing the costs of running the cartel. Last but not least, fines can create moral effects that influence the normative commitment of managers to antitrust infringements.

On European level, the most important alteration concerning the imposition of fines has been achieved with the introduction of the European Guidelines on the method of setting fines in 1998 and its revision in 2006. The Guidelines contain detailed information on the fining policy of the EC when exercising its power within the limits of Regulation 1/2003. According to the recent Guidelines from 2006, the Commission applies a two-step procedure when calculating the fine. In a first step, a level of up to 30 percent of the value of sales generated during the last full business year of participation in the infringement in the relevant geographic area is calculated, multiplied by the number of years of participation in the infringement.[3] In addition, a deterrence increase between 15 and 25 percent of the

[2] In the US, imprisonment of managers from cartel offenders represents another important enforcement tool. On pan-european level, however, imprisonment is ruled out although the laws of specific member states, such as France and Ireland, allow imprisonment. In Germany, imprisonment due to the involvement in bid-rigging conspiracies is generally possible.

[3] See European Commission (2006), para 21.

value of sales is added, irrespective of the duration of cartel participation.[4] This calculated value, denoted as basic amount, is then either adjusted upwards or downwards in a second step, depending on whether aggravating (e.g. repeat offenses, refusal to cooperate, role of ringleader or instigator) or mitigating (e.g. effective cooperation, provision of evidence) circumstances exist as well as on general deterrence considerations. However, irrespective of the value calculated by means of this two-step procedure, the final fine may not exceed 10 percent of a firm's total turnover generated in the preceding business year of cartel participation.[5] Finally, leniency discounts as well as bankruptcy considerations are taken into account in order to ensure an offender's economic viability.

The main difference of the 2006 Guidelines compared to the earlier Guidelines from 1998 is that the calculation of fines is now based on the value of sales generated during the infringement, whereas the 1998 Guidelines merely classified the gravity of an infringement as being either minor, serious or very serious, and assigned vague fine ranges to each category.[6] Furthermore, in contrast to the revised Guidelines in which the actual cartel duration is taken into account, the earlier Guidelines classified the duration of each infringement as being either short (less than one year), medium (one to five years) or long (more than five years) and, based on this categorization, added predefined percentage increases to the gravity levels calculated before.[7] Overall, the 2006 Guidelines seem to relate the calculation of fines closer to the economic harm caused by the infringements and they provide a more transparent framework of the fining policy applied by the Commission.

The economic literature evaluating the success of the 2006 Guidelines is scarce. Veljanovski (2007) recalculates the fines imposed by the EC on 57 firms in 14 cases prior to 2006 by applying the calculation process provided by the revised Guidelines from 2006 to these firms. He finds that, using the 2006 Guidelines, the recalculated fines are on average

[4] Id., para 25.

[5] See European Commission (2006), para 32.

[6] For minor infringements, the likely fines are in the range between 1000 and 1 million ECU, for serious infringements between 1 million and 20 million ECU and for very serious infringements above 20 million ECU. See European Commission (1998), section 1.A.

[7] For infringements of short duration no increase is applied, for infringements of medium duration 50 percent in the amount determined for gravity is applied, and for infringements of long durations increases of up to 10 percent per year in the amount determined for gravity is applied. See European Commission (1998), section 1.B.

more than double as high as the actual fines paid by the offenders.[8] Consistent with this finding Combe and Monnier (2009) identify a remarkable increase in the average fine per cartel around the time of the introduction of the revised Guidelines in 2006. Whereas in the years 2006, 2007 and 2008 the average fines per cartel always exceeded 300 million Euros, these values were seldom above 100 million and never above 150 million Euros before 2006. Finally, Connor (2011) descriptively analyzes the changes in size and severity of EC fines over time by comparing the first 13 EC decisions under the 2006 Guidelines with previous decisions. He defines severity as ratio of the imposed fine to affected sales and finds a large increase in severity for the cases under the 2006 Guidelines (76.2 percent versus 11.3 percent of affected sales). In addition, he compares the average severity measure under the 2006 Guidelines with the mean overcharges (55 percent) imposed by the respective cartels and concludes that "[...] the severity of most of the cartel fines under the 2006 Guidelines are well above the likely damages caused in the EU" (Connor, 2011, p. 9).

In sum, the results of theoretical and empirical literature suggest that the recent alterations in EU competition policy have significantly leveraged the antitrust enforcement process in Europe. However, whereas public enforcement primarily aims at punishing the offenders and deterring future infringements, the question of how to compensate private parties who suffered losses from these offenses is not part of public enforcement, asking for private antitrust enforcement.

1.2.2. Private Enforcement

Private antitrust enforcement is initiated by victims of antitrust infringements via private litigation. The main objective of private enforcement is to receive compensation from antitrust infringements. Hence, unlike public enforcement the detection of cartels and the creation of a deterrent effect are not the primary goals of private enforcement. Furthermore, private actions for damages are either initiated as follow-on actions after an existing antitrust infringement has already been detected and convicted through public enforcement, or initiated independently from the process of public enforcement as stand-alone

[8] Interestingly, he also finds that although for a considerable number of firms the recalculated fines are substantially larger, for about 40 percent of the firms the recalculated fines under the 2006 Guideline scheme are even lower compared to the fines actually paid. See Veljanovski (2007), p. 26.

actions (Wils, 2009).

In contrast to the US in which private enforcement of antitrust law already looks back on several decades of experience, the discussion in Europe about private enforcement has only recently been put on top of the agenda of European competition policy. In 2001, the European Court of Justice held in the *Courage vs. Crehan* case that if damage claims would not be open to any individual who suffered losses, the full effectiveness of Article 85 of the Treaty on the Functioning of the European Union "[...] would be put at risk".[9] The European Commission, however, only indirectly considered the aspect of private enforcement in its regulation 1/2003 by merely stating that national courts should be allowed to apply Articles 81 and 82 of the Treaty in full when deciding disputes between private individuals, "[...] for example by awarding damages to the victims of infringements" (European Commission, 2003, section (7)). This vague formulation neither provides a detailed legal framework nor legal certainty for private parties to claim damages. The EC has therefore initiated further steps to encourage the process of private enforcement. In 2005, it published a green paper with the objective to "[...] identify the main obstacles to a more efficient system of damages claims and to set out different options for further reflection and possible action to improve damages actions [...]" (European Commission, 2005, p. 4). This green paper was followed by a white paper released in 2008, in which the Commission proposed specific measures "[...] designed to create an effective system of private enforcement by means of damages actions that complements, but does not replace or jeopardise, public enforcement" (European Commission, 2008, p. 3). The proposed measures include, amongst others, the full compensation of the real value of the loss suffered by victims, collective redress, improved access to evidence for claimants and adequate protection of leniency statements in private actions. Based on these topics discussed in the white paper, the EC finally published a proposal for a directive on damage actions in June 2013, designed to optimize "[...] the interaction between public and private enforcement of competition law" and to ensure "[...] that victims of infringements of the EU competition rules can obtain full compensation for the harm they suffered" (European Commission, 2013, p.3.). The proposal successfully passed the European Council in March 2014.

[9] See Case C-453/99 between Courage Ltd and Bernard Crehan [2001] ECR I-06297, para. 26.

The economic literature on private enforcement has primarily concentrated on the questions whether private enforcement is superior to public enforcement with respect to cartel detection, deterrence as well as the choice of the optimal level of enforcement, whether private enforcement can effectively complement the process of public enforcement, and whether increased incentives for strengthening the field of private enforcement, as recently initiated by the EC, are desirable in Europe from an overall welfare point of view.

Concerning the first two questions, Becker and Stigler (1974) argue that under a system of competitive private enforcement, i.e. only the first private enforcer who detects the infringement receives the fine as reward, the same level of deterrence might be achieved as under optimal public enforcement, however, society could benefit via reduced resources for detection. This view has been questioned by Landes and Posner (1974) who show that competitive private enforcement might also lead to over-enforcement. This is due to the fact that, given a specific level of deterrence, under public enforcement this level can be reached at less costs by reducing the probability of detection but increasing the level of fine. Under private enforcement, however, an increase in the fine level increases the probability of private enforcement due to increased incentives, thereby leading to over-enforcement.

Polinsky (1979) compares the system of competitive private enforcement with monopolistic private enforcement. He finds that any of the two enforcement schemes may be socially preferable, depending on the costs associated which each method as well as the level of external damages. Polinsky (1979) additionally shows that irrespective of relative enforcement costs, when the external damage from the infringement is high, private enforcement leads under most circumstances to less enforcement than public enforcement. The economic intuition behind this finding is straightforward. Under a system of private enforcement a firm will only invest in enforcement if the fine reward outweighs enforcement costs. Under public enforcement, however, the optimal enforcement level might already occur when the fine reward is lower than enforcement costs, especially when the damage is high since it is then optimal to deter many potential violators. But as the fine level cannot be infinitely shifted upwards due to the financial viability of the violator, effective deterrence might require a high probability of detection. This is costly and implies that the break-even point for private parties to sue might therefore not be reached at this level of deterrence.

Finally, McAfee et al. (2008) analyze the tradeoff that private parties are initially more likely to be informed about antitrust infringements and have lower detection costs due to their specific industry knowledge, however, also have increased incentives to use private enforcement strategically against their market competitors to the disadvantage of consumers. Using a game theoretical model, they show that adding private enforcement to public enforcement always increases welfare for society if the court is sufficiently accurate, i.e. rules in favor of the offender when the offender is innocent and against the offender when the offender is guilty. If, however, the court is less accurate, private enforcement only successfully complements public enforcement when the litigation costs of public enforcement are sufficiently high and when legitimate private suits outweigh strategic suits. Turning to the question whether increased private enforcement is desirable in Europe, Wils (2003) dourly argues against private enforcement of antitrust law by stating that there is not even space for private enforcement as a supplementary tool to public enforcement for three reasons. First, according to him public enforcers are equipped with more effective investigative and sanctioning powers because unlike private enforcers, state authorities can not only impose monetary sanctions such as fines, but also director disqualifications and imprisonment. Second, he postulates that private enforcement diverges from the general interest as it is solely driven by private profit motives, thereby leading to inadequate investments, unmeritorious suits and undesirable settlements. Last but not least, Wils (2003) argues that public enforcement is less costly than private enforcement because of the higher degree of specialization, the lower costs of administrative procedures as well as the additional resources that must be spend in order to determine and allocate the damages among private parties. This view has been challenged by Jones (2004) who criticizes misplaced arguments, the lack of empirical evidence, and the type of debate in Wils' (2003) article, which according to him rather suits to a discussion on whether solely a private enforcement or public enforcement system should be chosen. Jones (2004) by contrast stresses the different purposes of private and public enforcement and argues that private enforcement is important as a supplement to public enforcement with respect to the compensation of victims from antitrust infringements. He further debilitates Wils' (2003) arguments against private enforcement by stating that in the EC plaintiffs rather have strong incentives to bring meritorious cases only due to the risk of having to pay costs to

a successful defendant, and by relating to a US study on private antitrust litigation which concludes that "[...] cases were not inordinately lengthy, legal costs were not excessive given the amounts at stake, private cases served an important function, and while there were unmeritorious private cases in the system, there were also meritorious cases that would never have been brought by the government and didn't cost as much as many critics feared" (Jones, 2004, p. 20).

1.3. Outline and Findings of the Dissertation

The preceding sections elucidate the important alterations public and private antitrust enforcement have experienced during the last two decades. New innovations, however, are always accompanied by new questions regarding the intended impact of the measures as well as further potentials for improvement. In particular, given the changes in the EU Guidelines on antitrust fines as well as the increased efforts to facilitate private cartel damage claims, it is questionable whether these innovations have the intended deterrent effects and to what extent the antitrust enforcement process can be further strengthened. This dissertation tries to shed light on these questions. It contributes to the existing literature on public and private enforcement by evaluating the effectiveness and success of specific enforcement methods and by providing new approaches and insights that allow for a more effective public and private enforcement of antitrust law. The subsequent chapters[10] either refer to the topic of public or private antitrust enforcement, although the individual results contain important implications for both enforcement systems. Each chapter concludes with a summary of the main findings and an outlook; the specific contributions as well as policy implications are presented in the concluding chapter 6.

Chapter 2 belongs to the public enforcement literature and analyzes the price setting behavior of cartels in Europe as well as the status quo of cartel deterrence. In the first part of the chapter, the impact of different cartel characteristics and the market environment on the magnitude of cartel overcharges is assessed using a sample of 191 cartel overcharge es-

[10] Note that chapter 4 is based on joint work with Ulrich Laitenberger and chapter 5 is based on joint work with Kai Hüschelrath. Chapter 3 is partly based on a joint article with Eckart Bueren, however, the included content solely represents the own contribution of the author.

timates and several parametric and semiparametric estimation procedures. The mean and median overcharge rates are found to be 20.70 percent and 18.37 percent of the selling price and the average cartel duration is 8.35 years. Certain cartel characteristics, such as cartel experience, cartel membership and the geographic region of cartel operation, influence the level of overcharges considerably. The second part of the chapter then concentrates on the question of whether the 2006 EU Guidelines on antitrust fines provide a sufficiently deterrent effect for cartels. For this purpose, an empirical framework is developed which reveals that from an ex-post perspective the current fining policy of the EC is insufficient for optimal cartel deterrence, suggesting further adjustments.

Chapters 3 and 4 focus on cartel damage estimations and contribute the private enforcement literature. Each chapter refers to one specific private party that might suffer harm from cartels but were mostly overlooked in economic research and public debate so far.
Chapter 3 concentrates on cartel suppliers that sell their products to a downstream price cartel. In the first part of the chapter, it is shown that cartel suppliers may incur losses based on three effects. First, cartel members require fewer input goods from suppliers as a result of agreements to raise prices or restrict production, leading to lower sales (direct quantity effect). This changed demand situation generates two additional effects that can harm a supplier, a cost effect and a price effect. Due to lower demand, suppliers adjust their prices, asking for a different price than that which could be charged in a competitive market environment. In addition, the cost structure of the supplier changes, leading to different costs per unit of output. The second part of the chapter then provides an estimation approach that relies on a modified residual demand model and allows the econometric quantification of all three aforementioned effects.
Chapter 4 deals with final consumers who buy the cartel product either directly from cartel firms or indirectly from cartel purchasers. Final consumers take a special position within a multi-layer market and are particularly in need of protection towards antitrust infringements because they are the last in the chain of production and therefore cannot pass on the cartel induced price increase they suffer. It is shown in this chapter how the damages suffered by final consumers can be empirically quantified. In particular, by using a consumer panel data set with 35.000 transactions and two different estimation

approaches the damage suffered by German consumers due to the European detergent cartel is estimated. The cartel lasted from January 2002 until March 2005 and covered the markets of eight European countries. The three largest producers of heavy laundry detergents, who collect around two thirds of the sales and volume in the German detergent market, were involved in this cartel. The estimations suggest average overcharges between 6.7 and 6.9 percent and an overall consumer damage of about 13.2 million Euro over the period from July 2004 until March 2005. Under the assumptions that the cartel-induced share on turnover is representative for the entire cartel period and all affected markets, the overall consumer damage even accounts for about 315 million Euro. It is further shown that the retailers reacted to the price increases of the cartel firms via price increases for their own detergent products, resulting in significant umbrella effect damages of about 7.34 million Euro.

The results of both chapters contain important implications for private cartel damage claims of cartel suppliers and consumer associations, allowing for a more effective enforcement of antitrust law.

Another important aspect of antitrust enforcement concerns the relationship between cartel breakdowns and merger activity. Former cartel firms might consider mergers as second-best alternative to cartel agreements and therefore try to regain their lost market power after cartel breakdowns by increasing merger activities. In addition, cartel breakdowns might generally trigger structural changes within the affected industries, leading to increased numbers of merger transactions. This hypothesis is statistically proofed in chapter 5. Using information on cartel cases decided by the EC between 2000 and 2011 and a detailed data set of worldwide merger activity, it is shown that the average number of all merger transactions on industry level increase by up to 51 percent when comparing the three years before the cartel breakdowns with the three years afterwards. For the subset of horizontal mergers, merger activity is even found to increase by up to 83 percent. The results (i) suggest that a successful antitrust enforcement process may not stop after cartel breakdown but needs to be continued by means of screenings of the future developments of former cartel industries, and (ii) speak in favor of an effective connection between antitrust enforcement and merger control.

Chapter 6 concludes the thesis by summarizing the main results and emphasizing the contribution of each preceding chapter to the literature on public and private antitrust enforcement. In addition, policy implications as well as new fields of research that arose from the results of the investigated subtopics are described.

2. Cartel Overcharges and the Deterrent Effect of EU Competition Law

During recent decades European antitrust authorities have increasingly focused on the fight against hardcore cartels within the European market. Numerous alterations in European competition law, such as leniency programs or extensions of the fine spectrum, have been implemented with the objective to increase the effectiveness of cartel prosecution and to achieve better deterrence. Initial successes regarding a more effective cartel prosecution can be validated with current statistics of the EC. Whereas 20 cartel cases were decided by the Commission between 1990 and 1999, the number increased more than threefold to 63 cases between 2000 and 2009.[1] On the other hand, this increase in discovered cartels could also result from a rising number of active price-fixing agreements, suggesting that cartels are not impressed by recent adjustments in European competition law and that the aim of optimal deterrence is still not achieved.

One important indicator for the success and effectiveness of collusive agreements are cartel overcharges (Bolotova, 2009). They are defined as the difference between the price during collusion and an artificial competitive benchmark price (the so-called "but for price") and capture the mark-up for purchasers due to collusion. The price overcharge transfers income from purchasers toward cartel members. The higher the price overcharge, the higher the deadweight loss for purchasers and consumers. For antitrust authorities it is therefore of primary interest to have a clear understanding of the price-setting behavior of cartels, and there are several reasons why overcharge analysis can provide valuable insights in this respect. First, knowing different overcharge patterns in dependence of underlying cartel characteristics allows identification of factors fostering cartel success

[1] See the official statistics of the European Commission, available at http://ec.europa.eu/competition/cartels/statistics/statistics.pdf (last visited May 1, 2014).

in terms of overcharge level, cartel life span, and repeated attempts to collude. Second, certain industries and regional markets may be identified in which outstanding overcharges are attained and more in-depth screenings should be implemented. And last, descriptive statistics - in particular average cartel duration and mean overcharge level - can be used in order to assess the success of price-fixing agreements. This enables antitrust authorities to approximate existing fine levels to the point of optimal deterrence.

The empirical literature on cartel overcharges primarily originates from Connor and Bolotova ((2005), (2006), (2008), (2009) and (2010)) and mainly deals with the US and international market. A separate econometric analysis of the European market has not been conducted so far.[2] Using a data set with 191 overcharge estimates solely for the European market, this study bridges this gap. Apart from the geographic region, it also differs with respect to the methodological framework as in addition to the current parametric procedures two semiparametric regression methods are applied.

Specifically, three questions that can be important for antitrust authorities in Europe will be clarified in this chapter. First, it is analyzed which factors the size of cartel overcharges in Europe influence and whether certain cartel characteristics (duration, international or domestic, legal or illegal, number of repeated attempts to collude) as well as the legal and geographic environment of cartel operation have significant impact on the magnitude of overcharges. Second, it is investigated whether changes over time in European antitrust policy (introduction of leniency programs, increase in fine levels) significantly reduced the magnitude of cartel overcharges. During recent decades European antitrust policy has experienced a steady process of growth. The foundation of a common European competition policy was laid down in the Treaty of Rome in 1957 (Carree et al., 2010). Since that date European antitrust law has continuously been revised in order to increase efficiency in cartel prosecution and to improve the deterrent effect. Third, in 1998 the EC introduced Guidelines on the method of setting fines for the first time. These Guidelines were revised in 2006 to increase the deterrent effect. It is evaluated whether the current fining policy of the EC with its Guidelines is sufficient for effective cartel deterrence.

[2] It is worth noting that Connor and Lande (2006) analyze European overcharges in one section of their article. However, their analysis is descriptive and targets implications for fining policies in the European Union and United States. The present study therefore constitutes the first detailed analysis of European overcharges that uses multivariate approaches and also captures regional differences within Europe.

The chapter is structured as follows. Section 2.1 contains basics on cartel overcharges and summarizes the existing literature. Information about the data set and the case selection procedure are given in section 2.2 and descriptive statistics are presented in section 2.3. The estimation results are discussed in section 2.4. Section 2.5 deals with the question of whether the current existing fine level of the EU Guidelines is sufficient for effective deterrence. Section 2.6 concludes with a summary of the findings and an outlook.

2.1. Cartel Overcharges

Cartels are anticompetitive agreements between rivals who collectively attempt to control market prices and/or output quotas. The fundamental incentive for firms to take part in collusive agreements is that they can generate a supra-competitive profit that is higher than the sum of the profits of each potential member absent from collusion. The cartel success in terms of monetary reward thereby crucially depends on two factors, the duration of the period the cartel is able to raise prices above the competitive level without being discovered by antitrust authorities, and the magnitude in which but for profits are exceeded. The latter factor is reflected in the cartel overcharge, which is defined as the difference between the price during collusion and an artificial competitive benchmark price. The benchmark price captures the price purchasers would have been paid without a collusive agreement in the concerned market and is therefore not observable.[3]

In the context of empirical analysis, cartel overcharges are usually not used directly, but in terms of a relative measure. Bolotova et al. (2008) distinguish between two overcharge rates, where the first is calculated as a ratio of the price overcharge to the price during collusion (formula 1) and the second as a ratio of the price overcharge to the benchmark price (formula 2):

$$OvRate(1) = \frac{P_{collusion} - P_{benchmark}}{P_{collusion}} \times 100$$

$$OvRate(2) = \frac{P_{collusion} - P_{benchmark}}{P_{benchmark}} \times 100.$$

As both approaches depend on the same parameters and only differ regarding the price in

[3] For a summary of different quantitative methods for estimating this "but for" price, see, e.g., Davis and Garcés (2010).

the denominator, both formulas can basically be used for estimation purposes. However, the first one has at least two important advantages over the second. First, overcharges calculated with formula 1 have an upper boundary of 100 percent, while overcharges computed with formula 2 would partly yield values far above 100 percent. Second, the mean overcharge calculated with formula 1 can be directly compared with the level of cartel sanctions defined in European antitrust law. These sanctions are calculated as a proportion of the value of affected sales, which allows a deduction of evidence concerning the deterrent effect of the existing fine level (Bolotova, 2009). Due to these advantages of formula 1 over formula 2, the first overcharge rate is used in the course of this chapter.

The existing literature on cartel overcharges can be subdivided in an empirical and a more theoretical oriented part. The theoretical strand of literature - not further considered here - focuses on cartel overcharges as the starting point for damage quantification in the context of competition law enforcement.[4] By comparison, empirical surveys on cartel overcharges primarily originate from Connor and Bolotova ((2005), (2006), (2008), (2009) and (2010)). These surveys yield mean (median) overcharge rates between 20.71 and 28.88 (17.10 and 20) percent, depending on the type of overcharge rate, the data used and the case selection procedure. Regarding the impact of cartel characteristics and the market environment on the magnitude of overcharges, all estimations mainly show a consistent tendency. International cartels impose significantly higher overcharges than domestic cartels. Cartel duration and cartel market share also seem to influence the magnitude of overcharges positively. On the other hand, overcharges enforced by bid-rigging or guilty cartels are not significantly different from overcharges attained by non bid-rigging or legal cartels. Moreover, their results suggest that overcharges realized in the US and European markets are lower than in the reference market (rest of the world) and that the lowest overcharges are associated with the latest antitrust law period.

In this investigation the same data basis as in the articles by Connor and Bolotova is used, but there are at least three important differences that should be mentioned. First, this study solely concentrates on the European market, whereas Connor and Bolotova either use US overcharges or overcharges from all over the world. A separate analysis for the European market is important as it enables the capture of regional variations in Europe. This

[4] See, e.g., Verboven and van Dijk (2009), Han et al. (2008), as well as Basso and Ross (2010).

facilitates identification of geographic areas within Europe where surpassing overcharges are attained and thus contain lucrative framework conditions for cartels. Second, a separate European study allows comparing the mean overcharge level enforced by cartels in the European market with the existing fine level according to the current EU Guidelines. Such a comparison will be used in order to decide whether the sanctions are sufficient for optimal deterrence or further adjustments are indispensable. And third, in addition to current parametric estimation methods, two semiparametric procedures (Censored Least Absolute Deviations, Symmetrically Censored Least Squares) are used in this study in order to account for non-normality problems of the error terms. In addition, comparing the results between parametric and semiparametric procedures as well as among semiparametric methods enables robustness checks regarding significance and validity of the results.

2.2. Data Set and Case Selection Procedure

For this study part of the data provided by Connor (2010) in Tables 1 and 2 of the Appendix in his article is used. The original data set contains 1517 overcharge estimates referring to 381 product markets. The data were collected from approximately 600 sources and refer to the period between 1770 and 2009. They originate from court and Commission decisions, OECD reports, peer-reviewed journals, books, dissertations, government reports and other sources. In most cases, these sources already contain overcharge calculations; in the rest of the cases, Connor used price data to estimate them on his own. The cartel overcharges were calculated using different methods (before-and-after, yardstick, and so forth) and are stated as overcharge rates pursuant to formula 2 (ratio of the price overcharge to the benchmark price). To analyze cartel overcharges for the European market, only a part of this data is used and the following case selection procedure is applied.

First of all, solely those cartel overcharges are selected that relate to the European market.[5] In most cases, the geographic location of the cartel participants coincides with the concerned market.

[5]The European market is composed of member states of the European Union and countries that geographically belong to Europe (Switzerland, Norway, Iceland, and so forth).

Furthermore, the original data set contains two types of overcharge estimates, average and peak overcharges. The latter usually refer to the most successful period during cartel activity. In accordance with Bolotova (2009), the average level of overcharge is chosen, as it represents the cartel impact over the full period of conspiracy.[6] Since the overcharges are stated as overcharge rates pursuant to formula 2, they were transformed into overcharge rates as percentage of price during collusion (formula 1).[7]

Analogous to Bolotova (2009) and Bolotova et al. (2008), every observation in the sample represents one cartel episode, whereas one cartel episode is regarded as an uninterrupted period of collusion with a corresponding set of rules and membership. It is possible that some cartels are represented by more than one cartel episode and therefore contribute multiple observations to the data set. Reasons for this are temporary breakdowns due to opportunistic behavior of cartel members, changes in the market environment or changes in the internal structure of cartel agreements (Bolotova, 2009). Consequently, it is assumed that the overcharges of several episodes of the same cartel differ due to theses aspects, and therefore each cartel episode is treated as one observation unit in the data set.[8]

For some cartel episodes several overcharge estimates are available. This is due to the fact that the same cartel episode was analyzed by a number of authors or multiple estimation methods were used in a single survey. In such cases the median overcharge estimate was selected. Altogether, the data set consists of 191 overcharge estimates for the European market. Apart from the geographic region and magnitude of overcharges, the Appendix Tables from Connor (2010) also contain information on cartel membership (domestic or international), cartel legal status (illegal or legal), cartel beginning and ending dates, and whether it is a bid-rigging cartel or not. All this information is included in the data set and used in the upcoming descriptive statistics and econometric analysis.

[6] There are a few cases in which only peak overcharges are available. In order to compile a data set for Europe as large as possible, these peaks were checked in detail and, finally, ten were incorporated into the sample. These observations do not represent outliers.

[7] Apart from the mentioned advantages of formula 1 over formula 2, this is also useful for another reason. Before the transformation, the minimum, maximum, mean, and median overcharge values were 0, 450, 33.44, and 21 percent; afterward, these values are 0, 81.82, 20.7, and 18.37 percent. In other words, the distribution of cartel overcharges is less skewed after the transformation.

[8] For econometric estimations the observations were clustered among cases. The overall data set consists of 191 overcharge estimates that refer to 129 cartel cases.

2.3. Descriptive Statistics

Table 2.1 contains descriptive statistics for the entire data set. The mean cartel overcharge in the European market is 20.70 percent and the median is 18.37 percent of the selling price. Regarding cartel durability the average cartel duration is 8.35 years and the corresponding median is 5 years. The shortest cartel merely existed a few weeks and the longest survived almost 71 years.

Table 2.1.: Descriptive statistics

Variable	Mean	S.D.	Variable	Mean	S.D.
Overcharge (%)	20.70	15.63	Eastern Europe	0.01	0.10
Duration	8.35	11.10	Southern Europe	0.06	0.23
Experience	0.52	1.30	Northern Europe	0.07	0.25
Domestic	0.48	0.50	P1 (until 1945)	0.41	0.49
Bid-rigging	0.20	0.40	P2 (1946-1956)	0.08	0.27
Legal	0.28	0.45	P3 (1957-1977)	0.08	0.28
Europe	0.33	0.47	P4 (1978-1989)	0.10	0.29
United Kingdom	0.31	0.46	P5 (1990-2009)	0.33	0.47
Western Europe	0.22	0.42			

The average cartel experience in terms of the number of repeated attempts to collude is 0.52.[9] 48 percent of the cartels are domestic in membership and 52 percent are international. In this survey a cartel is assigned to the domestic group if all members belong to the same country. If two or more members originate from different countries, the cartel is considered international. 20 percent of the observations in the sample represent bid-rigging cartels and 28 percent legal cartels. Legal cartels are those that predate antitrust laws or that were authorized by a government authority; illegal conspiracies in contrast are those that were found or pled guilty (Bolotova, 2009).

The geographical distribution of the observations is as follows. One-third of the overcharges refer to several European countries or alternatively to several member states of the European Union and 31 percent to the United Kingdom. Overcharges that relate to one single country within Western Europe represent 22 percent of the data. Of these, solely 80 percent are allotted to Germany and France. The rates for single countries within Northern, Southern, and Eastern Europe are 7, 6, and 1 percent.[10]

[9] The number of repeated attempts to collude (experience) for one observation is calculated as the number of cartel episode of the underlying observation minus one.

[10] The allocation in Western, Eastern, Northern and Southern Europe is based on the Classification of the

In order to evaluate the success of European antitrust policy, five periods of time were defined. Every single period represents a more effective and severe antitrust law in comparison to its predecessor and each observation is assigned to the period in which the beginning date of the cartel episode lies.[11] 41 percent of the cartel episodes start in the period until 1945 and 33 percent in the period between 1990 and 2009. With 8 and 10 percent the remaining overcharges are almost evenly spread among periods 2 (1946 to 1956), 3 (1957 to 1977), and 4 (1978 to 1989).

As the overcharge estimates were collected from numerous different sources, it is essential to check the origins more detailed in order to ensure adequate data quality (see Table 2.2).

Table 2.2.: Data sources

Variable	Mean	S.D.	Variable	Mean	S.D.
Book/Monograph	0.22	0.42	OECD	0.07	0.25
Journal	0.13	0.34	Nat. ant. auth.	0.12	0.33
Paper	0.09	0.29	Several sources	0.10	0.30
EC	0.21	0.41	Other sources	0.06	0.23

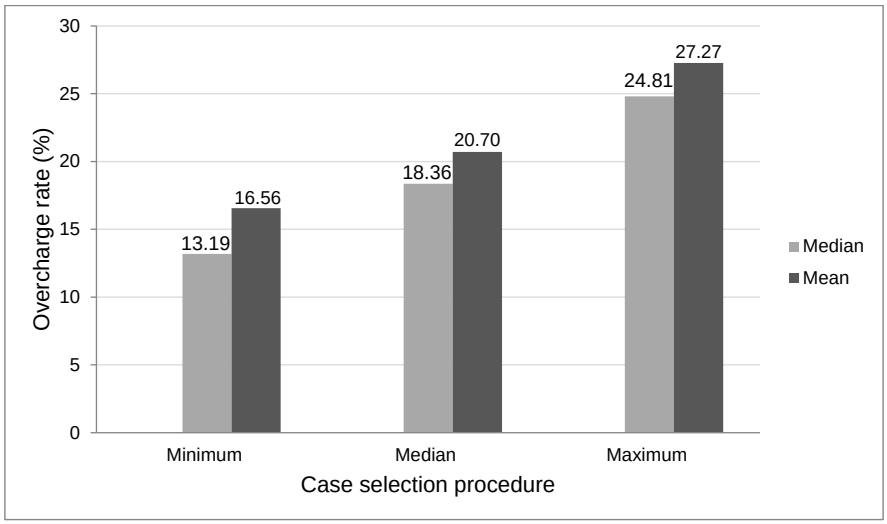
22 percent of the overcharge estimates were collected from books and 13 percent originate from articles of scientific journals. Articles from scientific institutions, reports by the EC, and OECD articles represent 9, 21, and 7 percent, and national antitrust authorities provide 12 percent of the observations. 10 percent of the data come from several sources and cannot explicitly be allotted to one category.[12] The remaining observations derive from other sources (presentations on conferences, speeches, and so forth) and merely represent 6 percent. Hence, altogether at least 84 percent of the data either originate from scientific sources or other reliable institutions, indicating that the quality of the underlying data basis is sufficient for estimation purposes.

United Nations Statistics Division. The only difference is that the UK is treated separately and not as part of Northern Europe.

[11] The periods will be discussed in detail in chapter 2.4.1.

[12] This is due to the fact that the median overcharge is used if several overcharge estimates are available for one cartel episode. Thus, in case of an even number of overcharge estimates for a single episode, the median is calculated out of two values and these usually originate from different sources.

Figure 2.1.: Mean and median overcharge rates for different case selection procedures



As previously mentioned, the mean and median overcharge values (20.70 and 18.37 percent) are based on the median principle in the course of the case selection procedure. That is, the median value has been selected when multiple overcharge estimates for a single episode were available. To illustrate the impact of the case selection procedure on the magnitude of mean and median overcharge rates, Figure 2.1 contains these values for the minimum and maximum case selection procedures.

If the minimum estimate is chosen instead of the median (minimum principle), the mean and median cartel overcharges for the European market amount to 16.56 and 13.19 percent of the selling price. Conversely, if solely peak overcharges for Europe are chosen (maximum principle), the corresponding values are 27.27 and 24.81 percent. The use of the median principle in this survey can be justified in that it describes the cartel impact more suitably. Minimum and maximum principle would probably underestimate and overestimate the true impact.

Figure 2.2 illustrates the Kernel density estimation as well as the distribution of the overcharge rates in 5-percentage-point ranges. As with increasing overcharge intervals the number of observations tends to decline, the distribution can generally be characterized as left skewed. 30 observations are associated with the smallest interval between 0 and 5 percent. Of these, 15 observations have zero values, indicating that approximately 8 percent of ineffective cartel episodes existed in which cartelists were not able to raise prices above the competitive level. With 162 observations (85 percent), most of the overcharge

rates fall within the range between 0 and 35 percent. The interval with the highest overcharge rates (80 to 85 percent) merely contains 2 observations, in which 81.82 percent of the selling price is the maximum value.

Figure 2.2.: Distribution of overcharge intervals and kernel density estimation

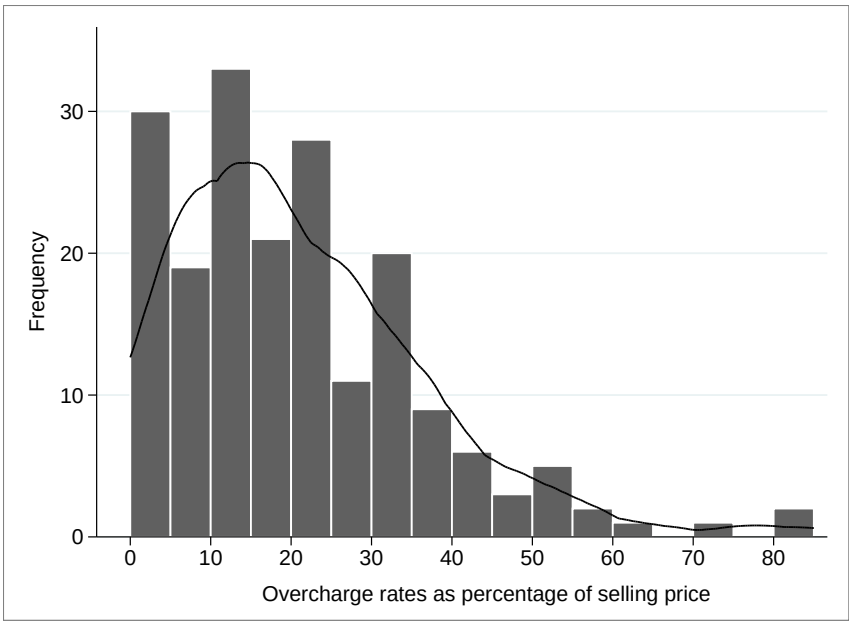


Figure 2.3 illustrates the mean overcharges depending on different cartel characteristics. With 20.61 and 20.73 percent, the difference in the magnitude of mean overcharges between bid-rigging and non bid-rigging cartels is negligible. The mean overcharge rate of illegal conspiracies (21.42) is 2.59 percentage points higher than for legal cartels (18.83). This seems surprising as legal cartels predate antitrust laws or were authorized by a government authority, and illegal cartels in contrast cannot impose exorbitant overcharges without drawing the attention of antitrust authorities to themselves. Nevertheless, illegal cartels are confronted with additional costs in order to coordinate their behavior in secret, and this could be reflected in the higher overcharge rate. The most obvious difference regarding the magnitude of the overcharge rate is cognizable between domestic (16.39) and international (24.71) cartels. The latter ones imposed overcharges that are more than 8 percentage points higher than their domestic counterparts and 4 percentage points higher than the average overcharge rate of the entire sample. This confirms previous findings that international cartels are particularly harmful for purchasers and consumers.

Figure 2.3.: Mean overcharge rates by cartel type

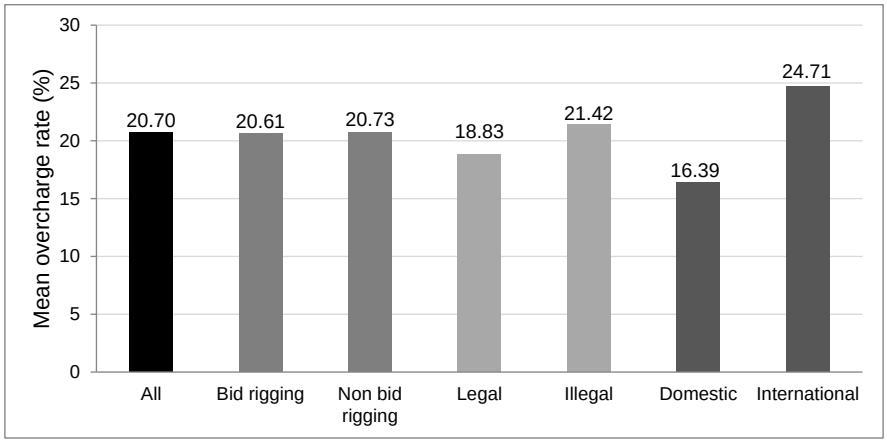


Figure 2.4.: Mean overcharge rates and average cartel durations within different geographic regions

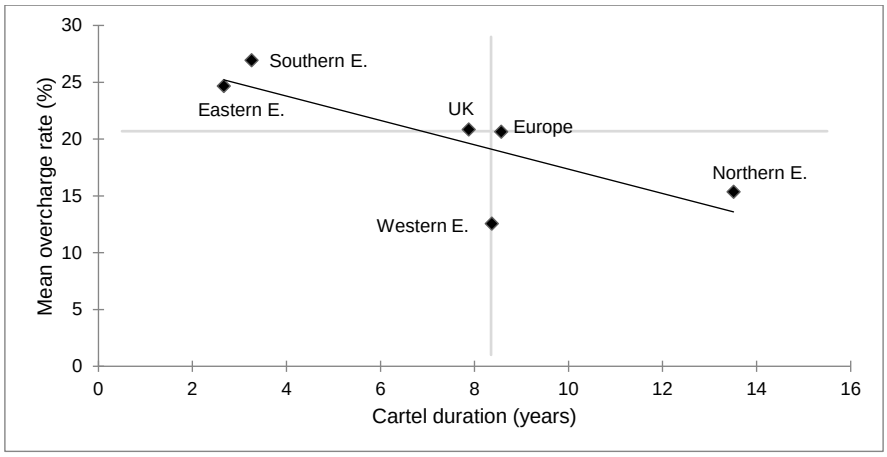


Figure 2.4 summarizes the mean overcharge rate and average cartel duration within different geographic regions of Europe.[13] As shown in Figure 2.4, in Southern and Eastern Europe the highest overcharges emerge (26.94 and 24.67 percent).[14] Simultaneously, the cartel duration in these regions is clearly below average (3.26 and 2.67 years). On the other hand, Northern Europe shows up the longest average cartel duration (13.51 years) and coevally the second lowest overcharge rate (15.36 percent). These results suggest that high overcharges alert antitrust authorities early on and vice versa.[15]

[13] In this Figure Europe contains all observations of single countries within Western, Eastern, Northern and Southern Europe, as well as those observations that refer to several European countries (excluding the UK).

[14] Due to the small number of observations for Northern Europe, the result for this area should be considered with caution.

[15] This is also reflected in the trend line, which shows a negative slope.

Western Europe is characterized by the lowest mean overcharge rate (12.56 percent) and a cartel duration almost according to the average (8.37 years). Thus, if one were to measure cartel success in terms of cartel duration and overcharge level, cartels in this region seem to have the most unfavorable framework conditions. The comparison between Europe and the United Kingdom shows that the mean overcharge rate in both regions is almost identical and the variation in the average cartel duration merely yields 0.69 years (8.57 years for Europe and 7.88 years for the UK).

2.4. Econometric Analysis

2.4.1. Empirical Model and Hypotheses

In order to analyze the impact of different cartel characteristics as well as the legal environment on the magnitude of cartel overcharges for the European market, the following model is estimated:

$$OvRate_i = \alpha + \beta C_i + \gamma P_i + \varphi G_i + \epsilon_i.$$

The dependent variable is the overcharge rate according to formula 1 and depends on several vectors, each containing a number of independent variables. C_i is composed of two continuous and three binary variables representing cartel characteristics. These include cartel duration, cartel experience, cartel membership, whether the cartel is legal or not and whether it is a bid-rigging cartel or not. P_i consists of four binary variables representing four antitrust law periods and describing the evolution of European antitrust law. Vector G_i contains five binary variables characterizing different geographic regions within the European market (Western Europe, Eastern Europe, Northern Europe, Southern Europe, and the United Kingdom).[16]

[16] It is worth noting that a set of industry dummy variables controlling for differences in market structures is not included. This is due to the fact that including them results in insignificance for almost all coefficients and an F-test yields that the set of industry binary variables is not jointly significant. Furthermore, comparing the two model specifications (with and without industry dummies) regarding different information criterions (BIC, AIC, CAIC) as well as applying a Likelihood-ratio test confirms that the latter version should be used.

Cartel Characteristics

Cartel duration is one indicator for the stability and effectiveness of collusive agreements. The longer a cartel operates without being discovered by antitrust authorities or facing a cartel breakdown (internally), the more successful it is. In principle the relation between cartel duration and magnitude of overcharges is conceivable in both directions. On the one hand, it is assumed that cartels with longer lifetimes tend to realize lower overcharges as reservation in price policy reduces the probability of detection. Furthermore, with increasing cartel duration the danger of market entries of new competitors increases. Due to the continuously high price level, rivals may try to catch demand by underselling the cartelized product. Hence, the cartel could temporarily be forced to revise the price downward in order to prevent market entries. On the other hand, cartels with a longer life span are more experienced and can have a stronger impact on the price variance control than a less successful and stable cartel (Bolotova, 2009). This would indicate a positive relation between cartel duration and overcharge rate. Nevertheless, the estimated coefficient is expected to be negative.

International cartels are likely to obtain higher overcharges than domestic cartels. Resulting from the bounded legal power of domestic antitrust authorities, cartels with members from two or more different countries are more difficult to prosecute than their domestic counterparts (Bolotova, 2009). Moreover, international cartels often eliminate import competition that domestic cartels are subjected to. On the contrary, due to the geographic distance and cultural differences, international cartels could be faced with communication and coordination problems and this probably counteracts success (Bolotova, 2009). Altogether, the estimated coefficient for domestic cartels is expected to be negative.

Collusive agreements on the basis of public tenders (bid-rigging cartels) are expected to attain higher overcharges than other types of collusive conducts. Members of bid-rigging cartels can use the reported information in order to monitor the behavior of the other participants and to detect cheating (Bolotova, 2009). This improves cartel stability and cartel success and the corresponding coefficient is therefore expected to be positive.

In contrast to illegal conspiracies, legal cartels need not conceal their behavior from antitrust authorities. Hence, it can be assumed that legal cartels impose higher overcharges

than those that operate illegally. On the contrary, illegal cartels are confronted with additional costs in order to coordinate their behavior in secret. These higher costs could be reflected in higher overcharges and this would counteract the first effect. In summary, no significant difference between legal and illegal cartels regarding the magnitude of overcharges is expected.

Cartels often experience more than one cartel episode and the number of repeated attempts to collude indicates cartel stability and efficiency in that regard.[17] Another attempt to collude signifies that the cartel has not been successful in raising the price to the targeted level in the preceding period(s) (Bolotova, 2009). Therefore, the sign of the estimated coefficient regarding cartel experience is expected to be negative.

Legal environment

Apart from cartel characteristics, it must be assumed that the legal environment influences the magnitude of overcharges. The legal environment is taken into account by means of two factors, the geographic region and the date of collusion.

Concerning the geographic region, overcharges are expected to be lower in countries with more severe antitrust laws and more efficient antitrust authorities, as cartels in these regions find less attractive framework conditions for their machinations and are stronger deterred by comparison. Within Europe, antitrust authorities located in Germany, France, and the United Kingdom are commonly seen as the most developed and progressive ones. Following this reasoning, the overcharges in Western Europe and the United Kingdom are expected to be significantly lower, and the overcharges attained in Southern and Eastern Europe to be significantly higher than the overcharges of the reference group. For Northern Europe no significant difference from reference group overcharges is expected. The reference group is represented by overcharges that refer to several countries within Europe and that cannot be explicitly attributed to one of the before mentioned regions.

In order to evaluate the success of European antitrust policy, five periods of time were defined. Every single period represents a more effective and more severe antitrust law regime in comparison to its predecessor. During the first period of time (until 1945), cartels

[17] Reasons for temporary breakdowns are e.g. opportunistic behavior of cartel members, changes in the market environment or changes in the internal structure of cartel agreements (Bolotova, 2009).

could almost act undisturbed in Europe as effective antitrust authorities existed neither in single European countries nor at a pan-European level. Hence, the highest overcharges are expected in this period and it represents the reference group for the following antitrust law regimes.

The second period between 1946 and 1956 is characterized by initial antitrust ideas that were established by law within single European countries. In Germany this happened in 1947 and in the United Kingdom not before 1956 (Connor, 2010). The Treaty of Paris, which established the European Coal and Steel Community in 1951, can also be allotted to this period. Apart from the main objective to create a common market for these products, Articles 60, 65, and 66 also included prohibitions of discrimination, cartels, and mergers (Schmidt, 2005).

The starting point of the third period (1957 to 1977) is 1957, in which the Treaty of Rome followed on the Treaty of Paris. With this convention, the European Economic Community was established, and it is considered to be the foundation date of European competition policy. This is reflected in Article 3(1)(g) of the Treaty, which defines as one of the main objectives the accomplishment of a system ensuring that competition in the internal market is not distorted (Carree et al., 2010). Aside from that, the German Bundestag passed the Act against Restraints of Competition (GWB) in 1957 and one year later the German Federal Cartel Office was established. Furthermore, the first illegal cartel was successfully convicted by the EC in 1969 (Connor, 1999).

The fourth period between 1978 and 1989 is characterized by a considerable increase of discovered cartels. While only five cartels were punished by the EC in the seventies, the number rose to 16 cases during the eighties (Connor, 1999). The year 1989, in which the European Council passed the Merger Control Regulation, constitutes the end of this period.

The latest antitrust law regime spans from 1990 to 2009 and contains numerous alterations in European antitrust law that have been implemented with the objective to increase the effectiveness of cartel prosecution and to achieve better deterrence. They include amongst others the European leniency program, which has been introduced in 1996 and closer adjusted to its US counterpart in 2002, and the European Guidelines on the method of setting fines, that have been introduced in 1998 and revised in 2006. Furthermore, this

period is characterized by a well-directed focus of decision making on the basis of recent findings in theoretical Industrial Organization, leading to a "more economic approach" in European competition law.

Under the assumption that each antitrust law regime represents a less favorable and more deterrent environment compared to its predecessor(s) and that cartels react to these changes via price restraints, the signs of the estimated coefficients for periods 2, 3, 4, and 5 should be negative and decreasing relative to the reference period 1 (until 1945). On the other hand, it is also plausible that some firms are deterred by these antitrust law changes and therefore refuse cartel participation at all, whereas those who agree deliberately respond to increasing fines by rising overcharges in order to make expected profits more lucrative. This would suggest a positive impact. Altogether, it is expected that the first effect dominates, indicating a decreasing trend in the overcharge level over time.

2.4.2. Estimation Procedures and Data Issues

For the estimation of the empirical model two parametric (OLS, Tobit) and two semiparametric (CLAD, SCLS) procedures are used. As eight percent of the overcharges are corner solutions with zero values, Tobit seems to be an appropriate alternative to OLS. However, Tobit needs homoscedastic and normal distributed errors, and testing these assumptions results in violations. To account for these problems, Censored Least Absolute Deviations and Symmetrically Censored Least Squares are used as alternatives to Tobit. The CLAD estimator is only based on the "zero median" assumption and therefore neither needs homoscedasticity nor normal or symmetric distributed errors for consistency. SCLS by contrast is restricted to error terms symmetrically distributed around zero, which implies that both median and mean are zero (Chay and Powell, 2001).[18]

Furthermore, due to the type of data used in this survey, there are at least two problems that should be discussed. First, the sample solely contains overcharges that were selected by the author and that refer to discovered cartels on which information is available. Therefore, the data set has features of a nonrandom sample and this could bias results. Undiscovered cartels are likely to attain lower overcharges and do not attract

[18]For contextual and technical details on CLAD and SCLS, see, Powell (1984) and Powell (1986).

the attention of antitrust authorities to themselves for that reason.[19] Hence, the mean overcharge level of this sample is probably greater than in a perfect random sample.

The second issue concerns omitted variables. As the overcharges originate from numerous different sources, it is difficult to collect information about the same explanatory variables for each case. This means that several variables that are likely to affect the magnitude of overcharges (number of members, market share) are omitted and this could also bias estimation results via endogeneity.[20]

Due to the illegal nature of cartels and the general problem of gathering information about them, these issues must be accepted. Nevertheless, the results should be considered with caution and the focus should rather lie on the signs and significance of the estimated coefficients than on the exact magnitude.

2.4.3. Estimation Results

Table 2.3 summarizes the estimation results.[21] The OLS results suggest that more experienced cartels attain lower overcharges. On average, another attempt to collude decreases the magnitude of overcharges by 1.37 percentage points, even though this effect is only significant at the ten-percent level using a one-sided test. The negative sign confirms the expectation, as a higher number of repeated attempts to collude implies less stability and therefore less cartel success.

Domestic cartels achieve overcharges that are almost 8 percentage points lower than overcharges obtained by international cartels. This effect is highly significant and confirms the expectation that international cartels with participants located in different countries show a clearly higher overcharge pattern and are therefore particularly harmful for consumers. Moreover, estimation results indicate that bid-rigging cartels attain overcharges that are

[19] It is worth noting that this does not necessarily mean that undiscovered cartels are less successful. In particular, since a lower overcharge level should decrease the probability of detection by an antitrust authority, undiscovered cartels may even be more successful due to the longer life span.

[20] For example, the number of cartel members (omitted variable) is assumed to be negatively correlated with cartel duration (endogenous variable). Coincidentally, the number of cartel members is also assumed to be negatively correlated with the magnitude of overcharges. Thus, cartel duration is overestimated in the present survey.

[21] Standard errors are reported in parentheses. For OLS, robust standard errors were generated. The standard errors for CLAD and SCLS were calculated using bootstrap techniques (1000 repetitions). In order to make OLS and Tobit results comparable, the average marginal effects are reported for Tobit. As one observation represents one cartel episode and not necessarily one cartel case, the observations were clustered among cases.

Table 2.3.: Estimation results

Variable	OLS		Tobit		CLAD		SCLS	
Duration	-0.04	(0.10)	-0.06	(0.11)	-0.01	(0.16)	-0.12	(0.24)
Experience	-1.37*	(0.97)	-1.32*	(0.97)	-1.43*	(1.10)	-1.28	(3.34)
Domestic	-7.78***	(3.45)	-8.39***	(3.47)	-9.37**	(4.82)	-13.41*	(9.95)
Bid-rigging	4.71*	(3.69)	5.25*	(3.72)	6.01*	(3.90)	5.57	(5.45)
Legal	3.67	(4.60)	2.36	(4.63)	5.26	(5.54)	6.49	(6.73)
P2 (1946-1956)	-8.00	(7.23)	-7.28	(7.26)	-9.72*	(7.08)	-12.30	(15.13)
P3 (1957-1977)	0.56	(3.76)	1.64	(3.52)	3.21	(5.70)	4.17	(10.58)
P4 (1978-1989)	-1.03	(4.43)	-0.86	(4.58)	3.65	(7.91)	-1.50	(11.53)
P5 (1990-2009)	-1.27	(4.34)	-1.11	(4.18)	1.65	(6.49)	-0.16	(11.12)
Western Europe	-12.39***	(3.13)	-13.60***	(3.25)	-15.17***	(4.26)	-16.15***	(6.00)
Eastern Europe	-3.09	(7.41)	-3.60	(7.00)	-	-	-2.83	(7.37)
Northern Europe	-9.08***	(4.28)	-9.68***	(4.42)	-11.32***	(5.66)	-6.86	(8.29)
Southern Europe	-2.77	(9.28)	-3.81	(9.45)	-1.22	(11.59)	-5.62	(7.86)
United Kingdom	3.00	(5.03)	3.15	(4.97)	4.10	(7.41)	9.26	(8.14)
Constant	26.80***	(4.41)	-	-	23.76***	(6.51)	25.19***	(12.65)
R^2	0.21		0.22		0.15		0.35	

***significant at 5% (two-sided), **significant at 10% (two-sided),*significant at 10% (one-sided)

4.71 percentage points higher than those of non-bid-rigging cartels.[22] On the contrary, there is no significant difference between cartels that were found or pled guilty and legal cartels. The impact of cartel duration on the magnitude of overcharge rate is also not statistically significant. It seems that the mentioned effects cancel out each other to such an extent that the negative impact (a higher overcharge rate increases the probability of detection and lowers cartel duration) does not prevail as expected.

Regarding different antitrust law regimes, the results contradict expectations. Although periods 2, 4, and 5 show negative signs, the estimated coefficients are not statistically significant. Thus, more severe antitrust regulations do not seem to lead to reservation in the price-setting behavior of cartels. This finding is surprising and indicates that cartels acting in Europe are not deterred by recent adjustments of national and pan-European antitrust laws. However, as mentioned before one could also argue that exactly these fine adjustments in preceding years encouraged cartel participants to increase their overcharge level. As the fine level becomes higher, some firms might decide either to reject collusion completely (optimal deterrence) or to start collusion and demand exorbitant overcharges

[22] Although this effect is only significant at the ten-percent level using a one-sided test, it is worth noting that descriptive statistics show an increasing overcharge level of bid-rigging cartels over time. Furthermore, a separate estimation using a subsample of more modern cartels (from the latest three antitrust law periods) results in a highly significant coefficient for bid-rigging.

in order to outweigh expected punishments. Following the latter reasoning as well and taking both arguments together, the insignificant changes in the overcharge level during the five antitrust law periods are not unexpected. Nevertheless, one should keep in mind that the change in the magnitude of overcharges is only one indicator for deterrent effects of antitrust law adjustments. Other factors such as cartel stability in terms of cartel duration, number of repeated attempts to collude, or internal uncertainties due to leniency programs must be taken in to account as well. In this context it is worth noting that both cartel duration and repeated attempts to collude decreased noticeably in the latest two antitrust law periods, indicating destabilization and deterrent effects of antitrust law changes over time.

Cartel overcharges considerably differ regarding the geographic region of cartel operation. Overcharges that refer to single countries within Western Europe are 12.39 percentage points lower on average than overcharges of the reference group, and the corresponding coefficient is highly significant. A similar result is observed for single countries within Northern Europe. It seems that antitrust authorities and antitrust laws in these two regions are more effective by comparison. In contrast, overcharges attained in single countries within Southern Europe, Eastern Europe, or the United Kingdom are not significantly different from reference group overcharges. Cartels in these locations seem to have more attractive framework conditions by comparison. Testing the null hypothesis of no statistically significant differences among overcharges attained in these five geographic markets results in rejection (p-value = 0.000). Altogether, the geographic market of cartel operation within Europe seems to be an important determinant of the overcharge level.

The results of the Tobit estimation merely show marginal differences to OLS. Both significance and values of the estimated coefficients mostly coincide with OLS, which implies that the eight percent of corner solution outcomes only have little impact. Nevertheless, Tobit estimation requires homoscedastic and normal distributed error terms for consistency, and both assumptions are violated. CLAD and SCLS are therefore used as alternatives to Tobit. Both estimation procedures need neither homoscedasticity nor normal distributed errors for consistency, and the results slightly differ from the parametric estimation procedures. The standard errors rise, which is probably due to the resampling method (bootstrapping). As a consequence, significance of some explanatory variables

(especially SCLS) decreases.

The conspicuous differences in the magnitude of coefficient estimates between parametric and semiparametric procedures as well as between CLAD and SCLS can be used as a sort of specification check following Chay and Powell (2001). The CLAD estimators serve as benchmarks in that regard, as they need neither homoscedasticity nor symmetrically and normal distributed errors for consistency. The differences in the magnitude of estimates between CLAD and SCLS on the one side and Tobit Maximum Likelihood estimation on the other side suggest that non-normal errors are one source of bias in the Tobit results. The conspicuous deviations between CLAD and SCLS further imply that asymmetric distributed errors also lead to misspecifications in Tobit and SCLS estimations. Nevertheless, comparing the values of the estimated coefficients between OLS, Tobit, CLAD and SCLS, all procedures show the same tendency. With the exception of two insignificant coefficients (periods 4 and 5), the signs of all explanatory variables coincide and significance of OLS, Tobit, and CLAD is limited to the same group of regressors. Consequently, meaningful statements regarding the impact of cartel characteristics and the legal environment on the magnitude of overcharges can be deduced. The exact values of the estimators, however, should not be overinterpreted due to the data and specification issues mentioned above.

2.5. Evaluating the Deterrent Effect of EU Competition Law

The adjustments of European antitrust law during recent decades have been implemented with the main objective to increase the effectiveness of cartel prosecution and to achieve better deterrence. Especially the introduction of leniency programs and the increase in fine levels since 1996 were targeted on a destabilizing impact on existing cartels and a more deterrent effect for potential future cartel agreements. At this point it is important to evaluate whether the current fining policy of the EC with the EU Guidelines is sufficient for optimal deterrence or not.

In general, it is not straightforward to answer the question of optimal deterrence since a number of observable and unobservable factors must be taken into account. However, with given information on the overcharges attained by cartels in the European market and the given penalty levels according to the EU Guidelines, this chapter sheds some light on

this issue by comparing the gains from price-fixing with expected punishments from an ex-post perspective.

Before the evaluation approach is presented in section 2.5.3, the subsequent section briefly repeats the fine calculation process applied by the EC with its 2006 Guidelines, followed by an analysis of the current fining policy of the Commission with the Guidelines in section 2.5.2.

2.5.1. The Calculation of Fines according to the 2006 EU Guidelines on Antitrust Fines

Although the Guidelines suggest that the calculation of fines follows a two-step approach, the actual procedure is better characterized by a three-step approach. In a first step, the Commission calculates a base fine which is composed of two factors, the gravity factor and the additional amount. The gravity factor is up to 30 percent of the value of affected sales generated by a colluding firm in the relevant market during the last full business year of cartel participation, multiplied by the number of years of participation.[23] The gravity factor varies depending on the severity of the infringement, however, for hardcore cartels the upper end of the scale is generally set. The additional amount is between 15 and 25 percent of the value of affected sales but irrespective of the duration of cartel participation.[24]

Given the base fine calculated out of the value of affected sales, gravity factor and additional amount, in a second step various adjustments are made which either increase or decrease this basic amount. The factors taken into account in this step are aggravating (e.g. repeat offenses, refusal to cooperate, role of ringleader or instigator) and mitigating (e.g. effective cooperation, provision of evidence) circumstances as well as a specific increase for deterrence, which may be set by the Commission to "[...]ensure that fines have a sufficiently deterrent effect[...]".[25] The final amount of the fine in due consideration to these factors may not exceed the legal maximum of 10 percent of the total turnover generated by the firm during the preceding business year of cartel participation.[26] However,

[23] See European Commission (2006), para 21.
[24] Id., para 25.
[25] Id., para 30.
[26] Id., para 32.

different than the name implies this final amount does not necessarily coincides with the final fine imposed by the Commission.

In a third step, leniency discounts are granted, provided that a firm successfully applied for leniency. Depending on specific factors settled in the leniency notice, the leniency reduction for a firm may result up to full immunity in terms of a 100 percent fine reduction. In addition, in exceptional cases when a firm is inable to pay the fine because the punishment would seriously jeopardise the economic viability of the undertaking, further fine reductions may be granted.[27]

2.5.2. The Fining Policy of the European Commission with the 2006 EU Guidelines

Given the numerous different factors influencing the fine calculation process under the 2006 Guidelines, it is worth analyzing to what extent the Commission makes use of the full possible fine spectrum. For this purpose a data set with all cartel cases decided by the EC between the introduction of the Guidelines[28] and 2012 is employed, and the most important results can be summarized as follows.

First, the case analysis reveals that there is not one single case in which the EC simultaneously set the maximum levels of base fine (30 percent) and additional amount (25 percent), indicating that the full fine spectrum of the base fine has never been exploited so far. Second, given the information in the decisions regarding the values of base fines, cartel durations, gravity factors and additional amounts it is possible to recalculate for 70 percent of the firms the maximum possible base fines the Commission could have imposed, and to compare these values with the final fines the Commission actually imposed after all the adjustments (aggravating and mitigating circumstances, specific deterrence increase, leniency discounts) were made. Precisely, given the fine calculation process described before, the affected sales for a specific firm can be counted back as

$$Sales = \frac{Fine_{basic}}{[(gravity\,factor \times cartel\,duration) + additional\,amount]}.$$

Complete information on the right hand side variables are available for 70 percent of the

[27] See European Commission (2006), para 35.

[28] Although the Guidelines were officially introduced in 2006, the first case in which the Commission used the new Guidelines (Professional videotapes, case no. 38432) was decided in November 2007.

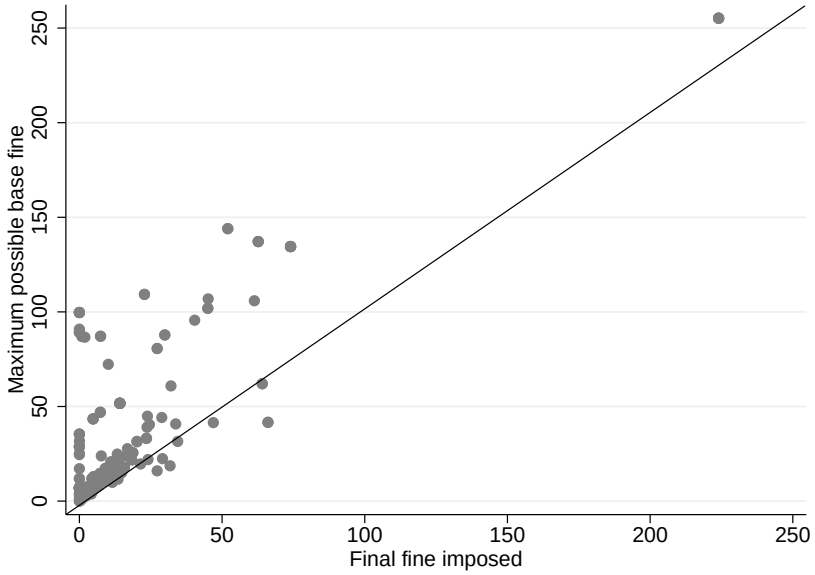
firms, which allows to recalculate the maximum possible base fines for these offenders as

$$Fine_{basic}^{max} = (0.3 \times Sales \times cartel\,duration) + (0.25 \times Sales),$$

where 0.3 and 0.25 represent the maximum possible values of gravity factor and additional amount, respectively.

Figure 2.5 plots the values of maximum possible base fine and imposed final fine for those firms for which the difference between both values not exceed 100 million Euro.[29]

Figure 2.5.: Recalculated maximum possible base fines and imposed final fines for firms punished according to the 2006 EU Guidelines



As shown in Figure 2.5, in the vast majority of cases the imposed fines are lower than the recalculated maximum base fines. Precisely, 94 percent of the firms received lower final fines and the average granted discount amounts to 41 million Euro. This corresponds to a 57 percent reduction of the maximum possible base fine on average. On the other hand, firms for which the imposed final fines exceed the recalculated maximum possible base fines only represent 6 percent of the observations, and the average base fine increase merely amounts to 6.8 million Euro, corresponding to an average relative increase of 26 percent.

[29] These observations correspond to 92 percent of the firms. Observations with differences higher than 100 million Euro are excluded in order to avoid a distortion in the graphical illustration. For all of the observations not included in the Figure, the difference is higher than 100 million Euro and positive, implying that the underlying firms are not deterred.

In sum, the results suggest that in an overwhelming majority of cases the Commission does not even impose the maximum level of base fine but rather grants substantial discounts to it, however, if the maximum base fine is exploited, this increase is comparatively slight.

2.5.3. Evaluation Approach and Results

Given these findings, the evaluation approach presented in this section is based on the comparison between the gains from price-fixing in terms of the overcharges achieved by cartels in Europe, and the expected punishment cartelists have to fear if they assume that the Commission might impose the maximum level of base fine, which - as illustrated in the previous section - is only rarely the case.

Before the approach is formally described, there are three underlying assumptions that should be discussed. First, in order to make it possible to take the expected punishment into account, a reasonable probability of detection must be determined. Economic theory suggests that only 10 to 33 percent of illegal cartels are caught. Connor and Lande (2006) cite several surveys that state probabilities of detection between 10 and 33 percent. A survey by Combe et al. (2008) for the European market results in probabilities between 12.9 and 13.3 percent.[30] They use a sample consisting of data for all cartels that have been convicted by the EC since 1969. In order to make the evaluation approach as conservative as possible, the upper value identified in economic literature (0.33) is used. The second assumption concerns the value of affected sales and implies that the average annual cartel turnover generated during the collusive period equals the cartel turnover generated during the last active business year.[31] Although the exact values probably differ in reality, the deviations are likely to be rather small, thereby only marginally influencing the results. In addition, due to the comparatively high probability of detection assumed, this deviation effect should be more than overcompensated. Last but not least, it is worth mentioning that the evaluation approach provides an ex-post analysis for detected cartels only. In general, firms ex-ante assess whether it is lucrative to join a cartel agreement by comparing the gain from price-fixing with expected punishments. Researcher, however, can

[30] Note that these values are annual probabilities of getting caught, conditional on being detected. Hence, the values represent upper bounds of the true probability of detection.

[31] If, e.g., a cartel is active for 4 years, than the assumption implies that the average turnover generated during the entire 4 years corresponds to the turnover generated during the (last) fourth year.

merely observe the ex-post outcomes of detected cartels in terms of overcharges and cartel durations. This information can be used in order to analyze whether those firms could basically be deterred from an ex-post perspective, given the current fining policy of the EC with its Guidelines. Hence, although the approach might find that some cartels are not deterred, it is important to keep in mind that those cartels that are not observed - because they are deterred or still undetected - can not be taken into account.

The formal approach can be described as follows. Let π be the probability of detection, $P_{collusion}$ the price during collusion, x the amount of sold goods, $OvRate(1)$ the average overcharge rate over the entire cartel period based on formula 1 derived above, and φ the maximum possible base fine level per year of cartel operation, which is defined as a proportion of the value of affected sales according to the EU Guidelines. For the existing fine level to deter firms from collusion, the gain from price-fixing must be smaller than the expected fine. Hence,

$$\frac{P_{collusion} - P_{benchmark}}{P_{collusion}} \times (P_{collusion} \times x) < \pi \times \varphi \times (P_{collusion} \times x) \tag{2.1}$$

must be fulfilled, where

$$\varphi = 0.3 + (0.25 \div \textit{cartel duration}).$$

The left-hand side of inequation (2.1) represents the annual gain from price-fixing and is calculated as the average cartel overcharge during the entire cartel period, multiplied by the average annual cartel turnover.[32] The expression on the right-hand side of inequation (1) corresponds to the maximum expected base fine cartelists have to pay for each year of cartel participation and is calculated as the probability of detection π, multiplied by the maximum base fine level φ according to the Guidelines. φ is composed of the upper limit of gravity factor (0.3), which is imposed per year of cartel participation, and the upper limit of additional amount (0.25), which is irrespective of cartel duration and therefore divided by the duration in order to receive its fraction per year. Since these percentage values are applied to the value of affected sales during the last active business year, φ is multiplied by the respective sales.

[32] Note that the first term on the left hand side of formula (1) equals the average overcharge rate as a percentage of selling price defined in section 2.1 ($OvRate(1)$). Reducing the cartel price would yield the absolute annual gain from price-fixing, that is, $100 \times (P_{collusion} - P_{benchmark}) \times x$.

Reducing the sales on both sides of inequation (2.1) and setting in the probability of detection of 0.33 as well as the expression for φ, the deterrence condition simplifies to

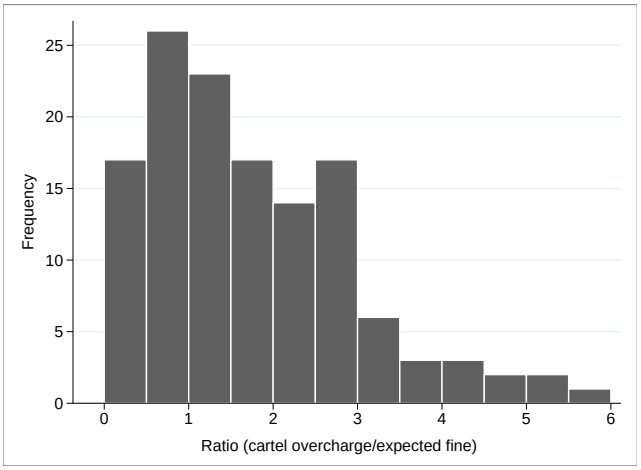
$$OvRate(1) < 0.33 \times [0.3 + (0.25 \div cartel\,duration)]\,, \tag{2.2}$$

which can be further rearranged to the following deterrence ratio:

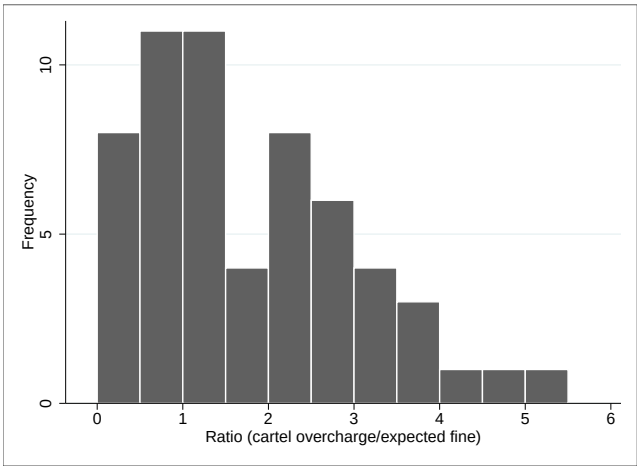
$$\frac{OvRate(1)}{0.33 \times [0.3 + (0.25 \div cartel\,duration)]} < 1\,. \tag{2.3}$$

As inequation (2.3) reveals, the only information needed in order to apply the deterrence condition to real cartel cases are cartel durations and average cartel overcharge rates. Figure 2.6 illustrates the distribution of deterrence ratios applied to a) all illegal cartels as well as b) all illegal cartels that were active between 1990 and 2009 from the overcharge data set described in section 2.2.

Figure 2.6.: Ratios of cartel overcharges to expected fines



(a) All illegal cartels



(b) Modern illegal cartels (1990-2009)

It is observable that for the majority of cases the deterrence ratios are larger than one, indicating that most cartels are not deterred by the fining policy of the EC with the Guidelines. In particular, for the overall sample containing all illegal cartels, 67 percent of the overcharges exceed expected punishments; for the subsample of more modern cartels the fraction is 64 percent. Hence, almost two out of three cartels are not deterred, even though the calculations are based on a high probability of detection and the maximum possible base fine levels, which, as discussed in the previous section, have only rarely been imposed by the EC so far. For 37 (45) percent of all (modern) cases the ratios are even larger than 2, implying that those cartels are not deterred even if the maximum possible base fine would have been doubled due to, for example, recidivism. The upward

adjustments of the base fines set by the Commission, however, have never exceeded 100 percent in reality so far. According to Veljanovski (2011) "[...] only one firm (Akzo in Calcium Carbide) was surcharged 100 percent for four previous offenses, which could have attracted a maximum uplift of 400 percent" (Veljanovski, 2011, p. 889). Importantly, for this firm the maximum base fine level was not imposed by the Commission, suggesting that more than one third of the cartels from the sample are definitely not deterred from an ex-post perspective. This is remarkable and confirms the insufficient status quo of cartel deterrence. If one were to target on deterring those firms from collusion, the probability of detection, the levels of sanction or both parameters must be increased substantially.
A similar result regarding the insufficient deterrent effect of EU antitrust fines can be attained following an approach of Connor and Lande (2006). As described in section 2.5.1, the European Guidelines restrict the fine level in that the final fine can only amount to a maximum of 10 percent of the total turnover generated in the preceding business year. Calculating with a probability of detection of 33 percent and the mean values of cartel overcharge (21.9 percent) and cartel duration (5.7 years) of the subsample of modern illegal cartels, the optimal fine for an average cartel should amount to $(3 \times 5.7 \times 21.9\%) = 374.49\%$ of the affected sales. Such a level of fine, however, seems to be unattainable with the limitation to 10 percent of the total turnover in the preceding business year only. In sum, the incentives to take part in collusive agreements still appear to be too high in order to achieve optimal deterrence.

2.6. Summary of Findings and Outlook

This chapter provides empirical evidence that certain cartel characteristics as well as the geographic location of cartel operation are important determinants of the overcharge level in the European market and that from an ex-post perspective, the current existing fining policy of the Commission with its EU Guidelines is insufficient for effective cartel deterrence.
The mean and median overcharge rates are 20.70 and 18.37 percent of the selling price and the average cartel duration is 8.35 years. International cartels impose higher overcharges than domestic cartels. Cartel experience in terms of repeated attempts to collude

influences the magnitude of overcharge rate negatively; the opposite effect is observed for bid-rigging cartels. Overcharges achieved in Western and Northern Europe are significantly lower, and overcharges attained in Southern Europe, Eastern Europe, and the United Kingdom are not significantly different from reference group overcharges. Cartels operating in the two latter regions therefore seem to have more attractive framework conditions for their illegal behavior. Results on the success of European antitrust policy during recent decades are contrary to expectation. This study does not find empirical evidence that more severe antitrust regulations led to reservation in the pricing policy of cartels. Nevertheless, for unambiguous statements regarding this point other factors such as cartel duration and cartel stability - not discussed here - should be taken into account as well. Last but not least, empirical evidence suggests that the current existing fine level of the EU Guidelines is too low in order to effectively prevent firms from cartel participation. Cartel sanctions should be based on the principle of deterrence, implying that expected punishments should outweigh the gains from price-fixing. With given information on overcharge levels and cartel durations of recent illegal cartels in Europe as well as results on the probability of detection from other sources, this chapter comes to the conclusion that this is not the case, suggesting further adjustments.
The policy implications and specific contributions of this chapter to the literature on public and private antitrust enforcement can be read in the concluding chapter 6.

Given these findings on the price-setting behavior of cartels in Europe and the insufficient status quo of cartel deterrence, one of the most essential tasks for improved antitrust enforcement is to influence the cost-benefit analysis of potential cartel firms in a way that collusion becomes the worst option in the set of available choices. This can be achieved by increasing the probability of detection, the level of sanctions or, in the best case, both parameters. With respect to increased sanctions, one promising option might be to strengthen the process of private enforcement. Precisely, by facilitating private parties to claim compensation payments for their suffered harm, an additional, unpredictable amount is added to the fine imposed by the EC, thereby negatively influencing an offenders cost-benefit analysis. However, for the calculation of compensations it is important to understand the determinants influencing the size of damages and to have sophisticated

approaches that allow for the estimation of cartel damages. The subsequent two chapters concentrate on these issues by providing innovative approaches and by showing how the damages suffered by private parties can be empirically quantified. Each chapter focuses on one particular party economic theory and public discussion have mostly overlooked so far: cartel suppliers and final consumers. Whereas chapter 3 graphically and formally analyzes the damages of direct and indirect cartel suppliers and presents an innovative approach for the quantification of it, chapter 4 uses existing estimation approaches to illustrate how consumer panel data can be used for the quantification of monetary damages suffered by final consumers.

3. Estimating Cartel Damages of Direct and Indirect Cartel Suppliers

The estimation of cartel damages is one of the most important tasks of private antitrust enforcement. This is due to the fact that unlike public authorities who calculate cartel fines based on a percentage of the value of affected sales in the relevant market and therefore only indirectly relate their fines to the true harm caused by the cartel, private parties are obliged to proof the exact harm they suffered from cartels in the course of private damage claims. Economic research has already intensively explored various methods for the quantification of private cartel damages, even though primarily concentrated on direct and indirect cartel purchasers so far. Given the two judgments of the European Court of Justice in the *Courage vs. Crehan* and *Manfredi* cases, stating that any individual who suffered harm should have the right to claim damages before national courts, it is appropriate to extend the scope of potential victims and to explore damage estimation approaches for them as well.

This chapter focuses on this topic by analyzing the damages suffered by direct and indirect cartel suppliers and by providing an econometric estimation approach that allows for the quantification of this harm.

The chapter is structured as follows. Section 3.1 illustrates the various potential parties within a vertical chain of production that might suffer cartel damages and briefly summarizes the related literature. Section 3.2 graphically and formally analyzes the damages of direct and indirect suppliers, followed by section 3.3 in which the estimation approach is presented. The chapter concludes with a summary of the findings and an outlook in

section 3.4.

3.1. Cartel Damages in a Vertical Production Chain

A vertical chain of production can be characterized as a multi-level process in which a homogenous good is produced and each layer of the supply chain adds some value to it. The top level firms for example exploit the raw materials needed and sell them to firms at the second layer. The output price of the first layer firms equals the input price the parties at the second layer have to pay. Those firms of the second layer use the raw materials to work on them and to sell them in an altered form at a higher price to firms of the third layer. This goes on until the final product is finished and sold to final consumers, who engross the lowest level.

Cartel formation in one layer of such a production chain leads to numerous effects in the layers up- and downstream the cartel stage as well as in neighboring production chains. Figure 3.1 illustrates the parties operating in these layers and that could therefore be affected by a cartel agreement.

1. Direct and indirect purchasers:

   The purpose of price-fixing for the participating firms is to increase their profits and this is generally achieved by coordinating prices and quantities, approaching the monopoly situation. For direct purchasers this usually results in higher input prices in comparison to a competitive situation in the upstream layer. Hence, the direct damage suffered by this party is the cartel overcharge, defined as the difference between cartel price and the hypothetical price they would have paid without a collusive agreement upstream.

   The input price increase direct purchasers are faced with might stimulate them to adjust their own output price upwards. Indirect purchasers can therefore be confronted with higher prices as well, although no direct business relation to the cartel participants exists. In this context, it is important to check whether direct and indirect purchasers partly or fully passed on the suffered price increases to their own customers downstream because neglecting the passing-on effects could ensue incentives for enrichment under certain circumstances. A direct or indirect

purchaser could claim damages although he fully passed on the input price increase to his own customers, thereby unjustifiable benefiting from price-fixing. It is worth mentioning that these price increases are generally accompanied by falls in demand (output effects), which counteract the direct price effects and must also be taken into account in order to fully determine the true harm suffered by these parties.

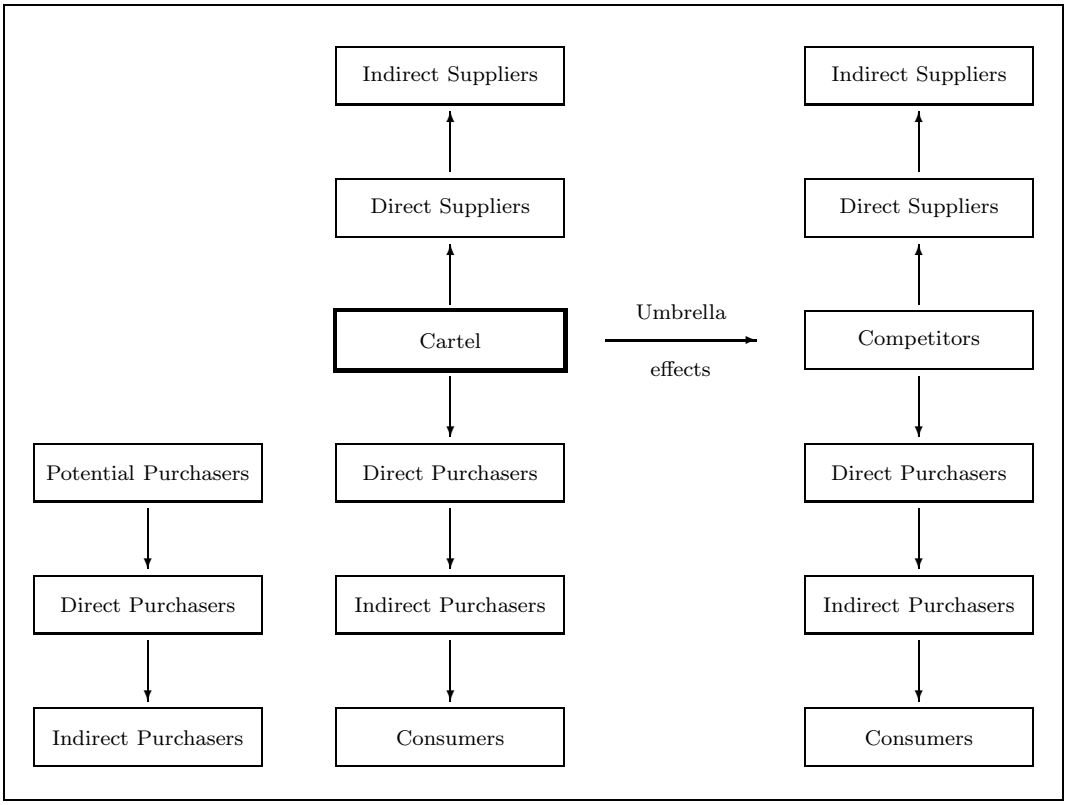


Figure 3.1.: Potentially affected parties by a cartel

2. Potential purchasers:

   Another party that could be affected by cartel agreements are potential purchasers. Due to the higher price resulting from price-fixing, some firms downstream the cartel layer might decide to replace the cartel product by some substitute. Hence, these firms would have bought the cartel good instead of the substitute if the price had stayed on the competitive level. The direct damage suffered by this party is then defined as the difference between the price of the substitute and the hypothetical price of the cartel good under competition. If this price increase is partly or fully passed on, direct and indirect purchasers of this party are identically overcharged as direct and indirect cartel purchasers of the cartel firms. Damage claims are more

challenging in these cases as the potential purchasers have to proof that they in fact would have bought the good from cartel participants in an hypothetical situation of upstream competition.

3. Direct and indirect suppliers:

   In case of direct suppliers one has to distinguish between (i) a buyers' cartel exercising buyer power towards suppliers and (ii) a classical hardcore cartel coordinating their own quantities and/or output prices. In case of a buyers' cartel, the involved firms would use its buyer power to exercise downward pressure on the upstream prices, resulting in price undercharges for direct suppliers. With respect to the second case, since the cartel induced price increase from a hardcore cartel is generally accompanied by demand restrictions for the cartelists, direct cartel suppliers are affected by this demand restriction due to less inputs that are needed by the cartelizing firms to produce the lower output. The direct effect suffered by direct suppliers is therefore given by a reduction in sales rather than by a price effect. This chapter abstracts from buyer cartels and concentrates on the latter case as it emerges more often in practice.

   Indirect suppliers are also affected by reduced sales since the decrease in demand suffered by direct suppliers induces them to decrease their input demand as well. Hence, indirect suppliers might be damaged in the same manner as direct suppliers, although no direct business relation to the cartel exists. The output restrictions for both direct and indirect suppliers in turn lead to changes in the output prices and cost functions. These follow-on effects either increase or attenuate the overall damage.[1]

4. Competitors:

   Competitors in the same relevant market outside the cartel might slip under the cartel umbrella and profit from the high price level via own price increases and output restrictions (umbrella effect). Consequently, direct and indirect suppliers and purchasers of these firms might suffer damages in a similar way as the parties up- and downstream the cartel layer. Although it is straightforward to estimate

[1] The follow-on effects and their impact on the overall damage will be discussed in detail in the subsequent section.

umbrella effects (see chapter 4), it is difficult to claim damages of a competitor's purchaser or supplier due to the indirect relation to the cartel stage and the burden of proof lying on the claimants.

5. Final consumers:

   The last group that could be affected by cartel agreements are final consumers. They constitute one special case of indirect purchasers because they cannot pass on the price increase they suffer. Depending on how much of the price increases already were absorbed in intermediate layers, consumers may either be exposed to the entire direct purchasers overcharge (in case of perfect competition at the intermediate layers) or to no price increase at all.

From an economic point of view all these parties could basically be harmed by cartels in some form, even though it is challenging to provide solid evidences of cartel induced damages in reality, especially for those parties that are not directly in contact with cartel participants such as potential purchasers or competitors. This might also be the reason why economic literature has primarily dealt with cases of direct and indirect purchasers so far.

Hellwig (2006) graphically analyzes cartel damages of direct and indirect purchasers in markets where all buyers are either final costumers or downstream monopolists. He theoretically extends his analysis to the case when direct buyers are competing with each other and discusses the questions of legal liabilities and the assessment of causation for each case. Han et al. (2009) use a vertical market model with multiple layers to show amongst others that the total welfare loss resulting from price-fixing does not depend on the stage in the chain of production in which the cartel is active, but conversely that the magnitude of the direct cartel overcharge depends on the location of the cartel. Verboven and van Dijk (2009) decompose the direct purchaser's lost profits in three parts (overcharge, pass-on effect, output effect) and derive discount rates to the price overcharge for various models of imperfect competition. Basso and Ross (2010) use a model with three layers to analyze the relationship between the true economic harm caused by cartels and the measures of damages applied by courts. Contradicting the results of Verboven and

van Dijk (2009), they argue that the overcharge may constitute substantial underestimates of the true total harm suffered by direct and indirect purchasers and thereby assert that the application of a passing-on defense in price-fixing cases may not be justified. Another strand of literature concentrates on specific methods for quantifying cartel damages.[2] The similarity of all these articles is that they solely focus on direct and indirect purchasers as the affected parties from price-fixing. However, as illustrated in Figure 3.1 there are various other parties that might suffer damages, above all cartel suppliers who are located in inversed manner towards the cartel stage as purchasers and therefore in a similar business relation with the cartel firms. The subsequent section takes a detailed look at the cartel damages they might suffer.

3.2. Damages of Direct and Indirect Cartel Suppliers

3.2.1. Graphical Analysis

To illustrate the determinants of supplier damages, assume a monopolist that produces with increasing marginal costs $MC(x)$ and sells his product to a number of downstream firms. For simplicity, let the monopolist's selling price equal the downstream firms' input costs[3] (Figure 3.2)[4]. At the outset, the firms downstream the monopoly layer compete. The monopolist confronts the downward sloping linear inverse demand function $p(x)_1$ and the marginal revenue function $MR(x)_1$. Maximizing his profits, he sells in equilibrium quantity x_1 at price p_1.

[2] See, e.g., Brander and Ross (2006), Nieberding (2006), McCrary and Rubinfeld (2014), Davis and Garcés (2010), Friederiszick and Röller (2010), van Dijk and Verboven (2008) as well as Paha (2011).

[3] This abstracts from additional costs for other inputs necessary to process the product such as electricity or labor. This simplifies the analysis, however, does not change the fundamental results.

[4] This Figure is similar to Han et. al (2009) who illustrate the case of an "undercharge" in a model with numerous layers up- and downstream the cartel stage.

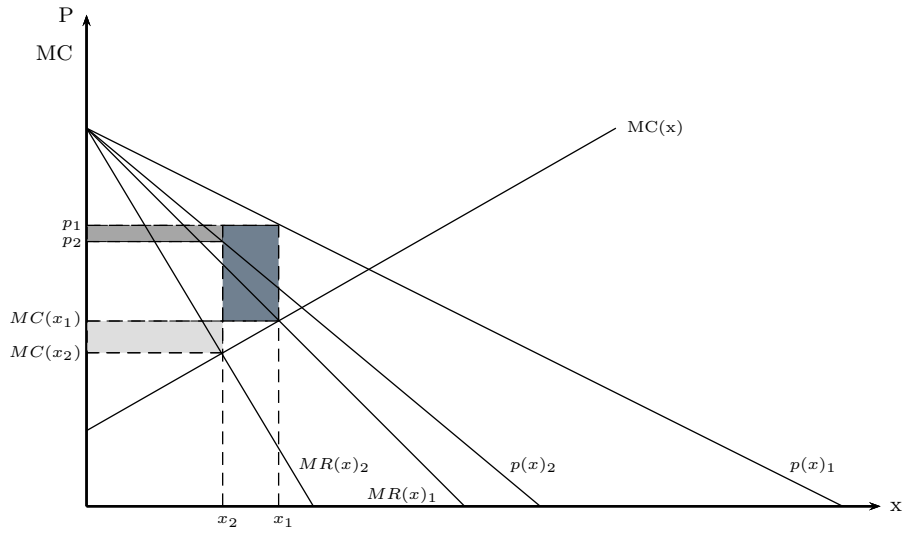


Figure 3.2.: Damage suffered by a direct cartel supplier (monopolist) in a two layer market

If the monopolist's customers start to collude on their product market, i.e. jointly maximize their profits, they charge a higher price and sell less of their output.[5] The supplier monopolist faces an ensuing fall in demand, turning his inverse demand curve inward and yielding the function $p(x)_2$.[6] The monopolist's new optimum, x_2 and p_2, is characterized by lower demand, a lower selling price, and lower marginal costs. Accordingly, his losses are determined by three effects:

1. A direct quantity effect $(x_1 - x_2)(p_1 - MC(x_1))$ due to the cartel members' lower input demand, illustrated by the darkly shaded rectangle between x_1 and x_2. The effect equals the difference between the supplier's sales volumes under downstream competition and collusion, multiplied by his price-cost margin under competition. The direct quantity effect is generally positive and accounts for the main part of supplier damages.

2. A price effect $(p_1 - p_2)x_2$, graphically illustrated by the greyly shaded rectangle between p_1 and p_2. It equals the difference of the monopolist's output price under

[5] Downstream the cartel, there may be only one layer of cartel purchasers or several layers with direct and indirect purchasers. The situation downstream the cartel is not specified as the focus of this section lies on the damages suffered by a direct cartel supplier.

[6] Note that the inverse demand function does not shift, but turns inwards in case of a sellers' cartel because it is assumed that the cartel members' maximum willingness to pay for inputs does not change due to collusion. Thus, graphically, the intercept of the inverse demand function remains the same. By contrast, a buyers' cartel would reduce its participants' willingness to pay and thereby cause an inward shift of the inverse demand curve.

downstream competition and collusion, multiplied by the quantity sold to the cartel. In the simplified setting above, the price effect is positive. Generally, depending on the circumstances it might also be negative or zero (Han et al., 2009, p.7).

3. A cost effect $(MC(x_1) - MC(x_2))x_2$ as a result of the supplier's lower production costs, illustrated by the lightly shaded rectangle between $MC(x_1)$ and $MC(x_2)$. The cost effect consists of the difference between the supplier's marginal costs when producing the output x_1 under downstream competition and x_2 under collusion, multiplied by the actual sales volume. Depending on the cost function, it may either be positive, negative or zero.[7]

In total, the harm suffered by a direct cartel supplier amounts to

$$D = [(x_1 - x_2)(p_1 - MC(x_1)) + [(p_1 - p_2)x_2] - [(MC(x_1) - MC(x_2))x_2].$$

In the simplified model above, the cost reduction due to lower production outweighs the lower selling price ("undercharge") and counteracts the direct effect from a lower sales volume. It would thus be inappropriate and overstate the supplier's harm to measure damages by looking only at the direct quantity effect. It is worth noting, however, that if marginal costs are constant, price and cost effects vanish, and only a direct quantity effect occurs.[8]

The analysis is now extended to the case in which two monopoly layers exist upstream the cartel layer. On the top layer one monopolist produces some product, which is used by another monopolist as input on the second layer. The output price of the top level monopolist therefore equals the input price the second layer monopolist has to pay. After one or several production steps the product is then sold to several firms operating at the third layer. These firms use the product as input for their own manufacturing process and are going to collude later on. Thus, the setup coincides with a situation of double marginalization, followed by an initially competitive situation at the third layer. The

[7] In this example with increasing marginal costs, the effect is positive. Assuming constant marginal costs, the cost effect would completely vanish. In case of increasing economies of scale, the effect could also be negative, then increasing the overall damage.

[8] This situation is graphically illustrated in Appendix A. For a formal proof of this aspect, see Han et al. (2009).

objective is to identify the effects and damages that both - direct and indirect - monopolists are faced with after the firms on the third layer start a collusive agreement.

The situation is graphically illustrated in Figures 3.3 and 3.4. Starting from an initially competitive situation between the firms on the third layer, the direct cartel supplier is confronted with the downward sloping inverse demand function $p(x)_1^D$, in which D indicates that the function corresponds to the downstream monopolist and the suffix 1 symbolizes the initially competitive situation. The corresponding marginal rent curve $MR(x)_1^D$ is characterized by the same intercept but twice the slope. Note that due to the vertical structure of the two monopolists, the marginal rent curve of the downstream supplier equals the inverse demand function of the upstream monopolist, indicating $MR(x)_1^D = p(x)_1^U$. The marginal rent curve $MR(x)_1^U$ therefore results from twice the slope of $MR(x)_1^D$. The upstream monopolist produces with increasing marginal costs $MC(x)$ and his equilibrium values are x_1 and p_1^U. As the downstream monopolist uses the output of the upstream monopolist as input and it is abstracted from other marginal costs, the price p_1^U equals the marginal costs of the downstream supplier MC_1^D. Profit maximization leads to the equilibrium values x_1 and p_1 for the downstream monopolist. Thus, in the initially competitive situation the firms on the third layer demand quantity x_1 and pay p_1 per unit (Figure 3.3).

Given this starting point, the impact of cartel formation between the firms at the third layer on the direct and indirect suppliers' profits is now analyzed. Joint profit maximization of the colluding firms yields a higher output price and a lower output quantity in comparison to the competitive situation. Thus, both downstream and upstream monopolists as direct and indirect cartel suppliers are confronted with a fall in demand as less inputs are required by the cartel members to produce the lower output. This drop in demand is graphically illustrated by an inward turn of the downstream monopolist's inverse demand curve, leading to function $p(x)_2^D$. This modification is followed by corresponding shifts of $MR(x)_1^D$ to $MR(x)_2^D$ and $MR(x)_1^U$ to $MR(x)_2^U$, respectively. Equilibrium values of the direct supplier are now given by quantity x_2 and output price p_2.

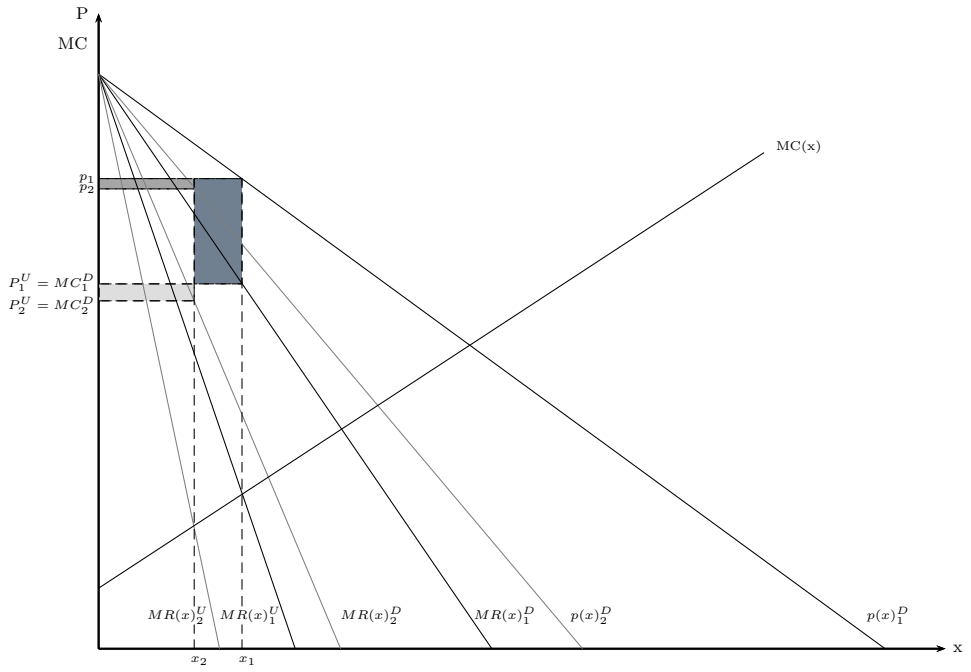


Figure 3.3.: Damage suffered by a direct cartel supplier (monopolist) in a three layer market

The damage suffered by the direct cartel supplier is illustrated in Figure 3.3 and identical to the case analyzed before. The direct quantity effect equals the reduction in demand due to downstream collusion and corresponds to the area of darkly shaded rectangle between x_1 and x_2. Price undercharge and cost effect are illustrated as greyly and lightly shaded rectangles and jointly counteract the direct quantity effect. The overall damage suffered by the direct cartel supplier (downstream monopolist) therefore amounts to

$$D = [(x_1 - x_2)(p_1 - MC_1^D)] + [(p_1 - p_2)x_2] - [(MC_1^D - MC_2^D)x_2].$$

The damage suffered by the indirect cartel supplier is illustrated in Figure 3.4. The equilibrium values before and after downstream collusion are x_1 and p_1^U as well as x_2 and p_2^U, respectively. They result from standard profit maximization and the fact that due to the situation of double marginalization in combination with linear inverse demand and the assumption of a one to one input-output relation on each layer, the marginal rent curve of the direct supplier serves as inverse demand function for the indirect supplier.

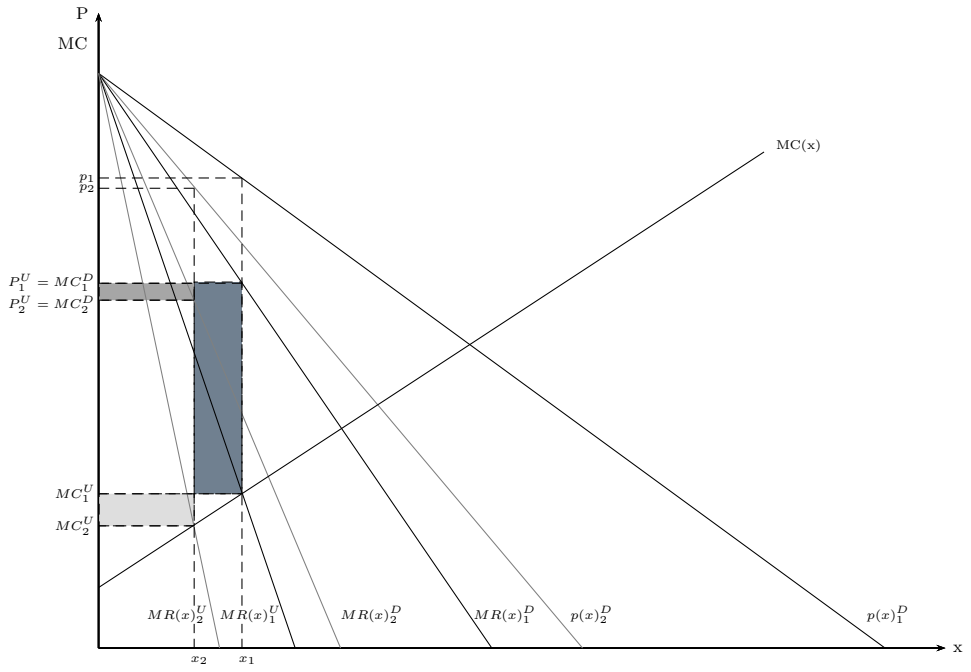


Figure 3.4.: Damage suffered by an indirect cartel supplier (monopolist) in a three layer market

The indirect cartel supplier is confronted with the same three effects as the direct supplier. First, the quantity effect reflects the lost profits due to the reduction in demand and is illustrated as darkly shaded rectangle between x_1 and x_2. In comparison to the direct cartel supplier, the size of this damage is higher as the price-cost margin earned by the upstream monopolist exceeds the per unit revenue of the downstream monopolist. Second, the decrease in demand causes a change in the output price of the indirect cartel supplier and is illustrated as greyly shaded rectangle between p_1^U and p_2^U. In this context, it is worth noting that this price undercharge equals the cost effect the downstream monopolist enjoys. This is due to the fact that the upstream monopolist itself acts as direct input supplier for the downstream monopolist. Thus, the price reduction suffered by the upstream monopolist concurs with the savings in costs of the downstream monopolist. Third, reduced demand leads to a decrease in production costs. This cost saving effect counteracts the suffered quantity and price effects and is visible as lightly shaded rectangle between MC_1^U and MC_2^U. If one would assume an additional layer upstream the current level, this cost decrease would again coincide with the price undercharge suffered by the upstream party. The overall damage of the indirect cartel supplier amounts to

$$D = [(x_1 - x_2)(p_1^U - MC_1^U)] + [(p_1^U - p_2^U)x_2] - [(MC_1^U - MC_2^U)x_2].$$

In the given setup the overall damage suffered by the indirect cartel supplier exceeds the loss of the direct cartel supplier. However, depending on cost and demand conditions as well as on the assumptions regarding the input-output relation on each layer, deviations from this result are naturally possible.[9]

3.2.2. General Formal Framework

While the examples of supplier monopolists are special cases, the general case with several firms on each layer is practically more relevant. The effects introduced above also exist in such a scenario. To illustrate, assume a vertical production chain comprising two layers upstream the cartel, which all have a one-to-one input-output-relation. On the top layer, m identical firms (indirect cartel suppliers) produce a non-substitutable good with constant marginal costs c. They sell it at a unit price q to n identical firms in the second layer (direct cartel suppliers). The n firms process the good and sell it at unit price p to identical firms in the third layer. Abstracting from additional costs, the selling price q of the m first layer firms equals the marginal costs of the n second layer firms. Total industry output is given as

$$X = mx_{j1} = nx_{i2},$$

where x_{i2} and x_{j1} are quantities of a representative firm i and j on the second and first layer, respectively. Total output corresponds to the demand of the firms at the third layer, who are assumed to initially compete and subsequently collude.[10] The upstream selling prices are given as $q(X)$ and $p(q(X))$: The output price at the second layer $p(q(X))$ depends on input costs $q(X)$, which depend on overall quantity X. Let the equilibrium values under competition be

$$X^* = \sum_{i=1}^{n} x_{i2}^* = \sum_{j=1}^{m} x_{j1}^*,\ q^* = q(X^*),\ p^* = p(q(X^*))$$

[9] A numerical example of the situation illustrated in Figures 3.3 and 3.4 can be found in Appendix A.

[10] It is assumed that all firms either collude or compete. Firms are therefore assumed not only to be identical with respect to production costs and other firm characteristics, but also to take concurrent decisions about whether to form a cartel.

and under collusion

$$\tilde{X} = \sum_{i=1}^{n} \tilde{x}_{i2} = \sum_{j=1}^{m} \tilde{x}_{j1},\ \tilde{q} = q(\tilde{X}),\ \tilde{p} = p(q(\tilde{X})).$$

For simplicity, p^* and q^* are used as shortcuts for $p(q(X^*))$ and $q(X^*)$ and the arguments of the equilibrium values are dropped in the following. The losses two representative firms j and i in the first and the second layer incur because of the downstream sellers' cartel equal the difference between their profits under competition and collusion. The respective profits of a representative direct cartel supplier i amount to

$$\pi_{i2}^* = (p^* - q^*)x_{i2}^* \text{ and } \tilde{\pi}_{i2} = (\tilde{p} - \tilde{q})\tilde{x}_{i2}.$$

Subtracting $\tilde{\pi}_{i2}$ from π_{i2}^* and rearranging parameters yields his lost profits:

$$\triangle\pi_{i2} = [(x_{i2}^* - \tilde{x}_{i2})(p^* - q^*)] + \tilde{x}_{i2}(p^* - \tilde{p}) - \tilde{x}_{i2}(q^* - \tilde{q})\ .$$

Likewise, the profit of a representative indirect cartel supplier j before and after collusion is

$$\pi_{j1}^* = (q^* - c)x_{j1}^* \text{ and } \tilde{\pi}_{j1} = (\tilde{q} - c)\tilde{x}_{j1},$$

yielding cartel induced losses of

$$\triangle\pi_{j1} = [(x_{j1}^* - \tilde{x}_{j1})(q^* - c)] + \tilde{x}_{j1}(q^* - \tilde{q})\ .$$

Table 3.1 summarizes the damages of both direct and indirect suppliers and decomposes them into the quantity-, price- and cost effects described above:

Table 3.1.: Decomposition of damages

Direct Supplier	$\triangle\pi_{i2} = [(x^*_{i2} - \tilde{x}_{i2})(p^* - q^*)] + \tilde{x}_{i2}(p^* - \tilde{p}) - \tilde{x}_{i2}(q^* - \tilde{q})$
Quantity effect	$(x^*_{i2} - \tilde{x}_{i2})(p^* - q^*)$
Price effect	$\tilde{x}_{i2}(p^* - \tilde{p})$
Cost effect	$\tilde{x}_{i2}(q^* - \tilde{q})$
Indirect Supplier	$\triangle\pi_{j1} = [(x^*_{j1} - \tilde{x}_{j1})(q^* - c)] + \tilde{x}_{j1}(q^* - \tilde{q})$
Quantity effect	$(x^*_{j1} - \tilde{x}_{j1})(q^* - c)$
Price effect	$\tilde{x}_{j1}(q^* - \tilde{q})$
Cost effect	-

Given this decomposition of damages in the general framework, three aspects should be noted. First, as in the scenario of a supplier monopolist, lower input demand by cartel members may cause either higher upstream prices, lower prices or no price change at all. However, irrespective of the model specific assumptions, the most obvious strategic reaction of direct and indirect suppliers to decreasing demand is to lower their own output prices in order to mitigate and counteract the loss in demand. Second, assuming that $m = n$ and $\tilde{x}_{i2} = \tilde{x}_{j1}$, the price effect of the indirect supplier and the cost effect of the direct supplier exactly match. The direct supplier loses from lower sales but takes advantage of lower input costs. The indirect cartel supplier does not face a cost effect if marginal costs are constant at the top layer and is therefore more vulnerable to the direct quantity effect. Third, the number of firms on each upstream layer strongly influences suppliers' damages. Assuming Cournot competition, the direct quantity effect sustained by one cartel supplier is decreasing in the number of symmetric cartel suppliers in the market. As a result, the follow-on effects on prices and costs are also decreasing in the level of competition on the upstream layers.

3.3. Econometric Estimation of Supplier Damages

Given the determinants of supplier damages discussed above, this section provides an estimation approach that allows for the quantification of all three effects.

Concerning the direct quantity effect, it is necessary to estimate a supplier's specific decrease in sales volume due to the downstream cartel. This can be done by estimating a residual demand model for this specific supplier that takes the emergence of the cartel into account. The residual demand function captures the demand a specific supplier faces

after the reaction of all other supplier-firms is taken into account.[11] Hence, the residual demand function accounts for the strategic interdependency between competing suppliers, i.e. the fact that a change by one firm prompts the other firms in the same (e.g. supplier-) market to adjust their prices as well. It is assumed that the demand a cartel supplier i faces in the market for its product (the input for the cartelized good) is given by

$$x_i = D_i(p_i, \mathbf{p_{-i}}, \mathbf{d}, C), \tag{3.1}$$

where p_i is the unit price firm i charges for its product, $\mathbf{p_{-i}}$ a vector of prices charged by all other competitors, $\mathbf{d}$ a vector of demand shifters and C a cartel binary variable measuring demand changes due to the emergence of a downstream cartel. The first order condition of profit maximization provides the best-reply function of firm i,

$$p_i = R_i(\mathbf{p_{-i}}, \mathbf{d}, \mathbf{I}, q_i, C), \tag{3.2}$$

where $\mathbf{I}$ represents a vector of industry specific cost variables and q_i firm specific costs of firm i. The best-reply function denotes the optimal output price for firm i for given prices of all other firms.[12] Likewise, the vector of best-reply functions of all other firms is given as

$$\mathbf{p_{-i}} = R_{-i}(p_i, \mathbf{d}, \mathbf{I}, \mathbf{q_{-i}}, C). \tag{3.3}$$

Substituting vector (3.3) into firm i's demand function (3.1) yields the residual demand function for firm i:

$$x_i^r = D_i^r(p_i, \mathbf{d}, \mathbf{I}, \mathbf{q_{-i}}, C). \tag{3.4}$$

Note that since prices and quantities are jointly determined, the residual demand function

[11] The residual demand model was proposed by Baker and Bresnahan (1988) with the objective to estimate market power of firms in product differentiated industries. This section merely describes the main steps and features of this approach as presented by Motta (2004), however, adjusted with respect to the existence of a downstream cartel.

[12] The underlying assumption of this approach is that supplier i behaves like a Stackelberg-leader in the supplier market.

must be estimated with a two-stage-least-squares instrumental variable (IV-) estimation. A suitable instrument for p_i is q_i, because firm specific costs of firm i are generally correlated with p_i but uncorrelated with the residuals (Motta, 2004). The econometric implementation of the second stage of an IV-estimation of the residual demand function (3.4) is then given as follows:[13]

$$x_{i,t}^r = \beta_0 + \beta_1 \widehat{p_{i,t}} + \beta_2 C_t + \beta_3^{'} \mathbf{d_t} + \beta_4^{'} \mathbf{I_t} + \beta_5^{'} \mathbf{q_{-i,t}} + u_{i,t}. \tag{3.5}$$

$\widehat{p_{i,t}}$ is the estimated price obtained from the first stage IV-estimation[14], C_t a binary variable equal to one during the cartel period and zero otherwise, and $\mathbf{d}$, $\mathbf{I}$ and $\mathbf{q_{-i,t}}$ vectors of exogenous variables that affect demand, industry specific cost variables and firm specific cost drivers from firms other than firm i.

The approach used to determine the quantity effect is equivalent to the before-and-after method for overcharge estimations. In the present context, it compares pre- and/or post cartel sales to the sales of the supplier during collusion, relying on the assumption that the competitive situation in the market but for the cartel would have evolved similar to the situation before and/or after collusion. The estimation therefore requires data of the respective variables from the cartel period as well as the non-cartel period.[15]

The average output reduction incurred by the cartel supplier per period during cartelization is now given by the estimated coefficient $\widehat{\beta_2}$, and the harm associated with the quantity effect (as described in the previous section) amounts to

$$\left[\sum_{t=1}^{T} \widehat{\beta_2} C_t\right] [p^* - c^*]. \tag{3.6}$$

The first term sums up the output decreases over the entire cartel period, and is then multiplied by the price-cost margin earned by the cartel supplier in the counterfactual

[13] Note that the model is not specified as a a panel data model but as a time series model. As before, the subscripts i and $-i$ indicate whether the respective variables refer to firm i or all other firms. The subscript t indicates the time dimension (weekly, monthly or yearly).

[14] In the first stage of the two-stage-least-squares IV estimation, p_i is regressed on q_i as well as all other right-hand side variables included in the second stage. Although not specified here, the first stage regression results also constitute a test for whether p_i is correlated with q_i, i.e. whether q_i can be used as instrument for p_i. For a detailed description of instrumental variable estimation, see Wooldridge (2003).

[15] For a more detailed description of the before-and-after approach as well as other econometric methods for estimating cartel overcharges, see, e.g., Davis and Garcés (2010), pp. 347-380.

competitive scenario.

The price-cost margin can be estimated by means of supplier i's residual demand elasticity, as will be shown during the following analysis of the remaining determinants of a supplier's overall damage, the price and cost effect.[16] These effects shown in Table 3.1 are given by

$$\tilde{x}_{i2}(p^* - \tilde{p}) - \tilde{x}_{i2}(q^* - \tilde{q}), \tag{3.7}$$

which can be rewritten as

$$[(p^* - q^*) - (\tilde{p} - \tilde{q}))]\, \widetilde{x_{i2}}. \tag{3.8}$$

Expression (3.8) corresponds to the difference between the supplier's price-cost margin under competition and under collusion, multiplied by the quantity sold to the cartel members during collusion. To quantify the price and cost effect, it is therefore necessary to estimate the price-cost margin of the supplier for both regimes. This can be done by means of firm i's Lerner Index of market power, given as

$$L_i = \frac{p_i - q_i}{p_i} = -\frac{1}{\varepsilon_i^r}, \tag{3.9}$$

where ε_i^r denotes the residual demand elasticity faced by supplier i in the supplier market. The Lerner Index relates the firm's mark-up to the price charged by the firm. In case of perfect competition in the supply market, the Lerner Index is zero, suggesting that no price and cost effects occur. With increasing market power the Lerner Index increases up to the theoretical maximum value of 1 under monopolization.

The residual demand elasticities for both periods of time (collusion and non-collusion) can be received by estimating a slightly different version of the residual demand model described above (equation (3.5)):[17]

$$ln\, x_{i,t}^r = \beta_0 + \beta_1 \widehat{ln\, p_{i,t}} + \beta_2 C_t + \beta_3 \widehat{ln\, p_{i,t}} C_t + \beta_4^{'} \mathbf{d_t} + \beta_5^{'} \mathbf{I_t} + \beta_6^{'} \mathbf{q_{-i,t}} + u_{i,t}. \tag{3.10}$$

[16] Alternatively, the price-cost margin could also be approximately determined with the help of accounting data.

[17] Again, model (3.10) reflects the second stage of an IV-estimation. For information on the first stage regression, see footnote 14.

The only difference to model (3.5) is that both quantity and instrumented price of the supplier are in logarithm and that an additional interaction term between instrumented price and cartel-time dummy ($\widehat{ln\, p_{i,t}} C_t$) is included. The residual elasticity of demand during and outside the cartel period for supplier i is now given as

$$\varepsilon_i^r = \frac{\partial ln\, x_{i,t}^r}{\partial \widehat{ln\, p_{i,t}}} = \beta_1 + \beta_3 C_t, \; with \; C_t = \begin{cases} 1 & during\, the\, cartel\, period \\ 0 & during\, the\, competition\, period. \end{cases}$$

The estimated demand elasticities in the cartel and the non-cartel period combined with price data of the cartel supplier make it possible to calculate price-cost margins, which can then be used to jointly calculate the price and cost effect as defined in expression (3.8).[18] The estimated price-cost margin during the competitive period additionally completes the calculation of the direct quantity effect as stated in (3.6).

In principle, the approach described in this section could also be applied to a group of firms, for instance a group of (supplier-) claimants. One then would have to treat this group as one single firm in the market and estimate the residual demand for the entire group. However, such an approach is subject to at least one important disadvantage. Unlike purchasers who are generally exposed to the same price effect, cartel suppliers might encounter substantially different quantity effects. To illustrate, assume that the cartel members decrease their input demand by 10 percent due to the infringement. They might then either reduce their input demand equally by 10 percent with respect to each supplier, or cut demand to a greater extent or even to quit the business relationship with respect to certain suppliers only. In an extreme case, this might even entail a larger input demand from other suppliers in order to receive bulk discounts. Hence, unlike in the case of an average overcharge, it is critical to suppose that a general decrease in residual demand of 10 percent harms all suppliers equally by a 10 percent reduction in sales. If this assumption is not warranted, separate estimations for each supplier are preferable.

[18] It is worth mentioning that the price-cost margins of cartel and non-cartel period might not be significantly different, especially when the quantities sold by the supplier to cartel firms merely represent a small fraction of his total output or when the degree of competition in the supplier market is high. In such cases one should rather abstract from price and cost effects and primarily concentrate on the direct quantity effect.

3.4. Summary of Findings and Outlook

This chapter analyzes the determinants of damages sustained by direct and indirect cartel suppliers due to a downstream price cartel and provides and estimation strategy for the quantification of the harm. The graphical and formal analysis reveals that cartel suppliers may incur losses based on three effects. First, cartel members require fewer input goods from suppliers as a result of agreements to raise prices or restrict production, leading to lower sales (direct quantity effect). Thus, in contrast to the customers of cartel firms who suffer losses from higher prices, suppliers are typically harmed by lower demand for input goods. This changed demand situation generates two additional effects that can harm a supplier: a cost effect and a price effect. Due to lower demand, suppliers adjust their prices, asking for a different price than that which could be charged in a competitive market environment. In addition, the cost structure of the supplier changes, leading to different costs per unit of output. Depending on the supplier's cost and demand functions, these secondary effects can either mitigate or intensify the losses due to the direct quantity effect. Based on these findings, an estimation technique is developed that relies on a modified residual demand model. The approach enables the econometric quantification of the three aforementioned effects responsible for cartel damages suffered by suppliers.
The policy implications and specific contributions of this chapter to the literature on public and private antitrust enforcement can be read in the concluding chapter 6.

The subsequent chapter continues with cartel damage estimations, however, focuses on another party that has been missed out so far in the discussion on private antitrust enforcement: final consumers. But in contrast to the innovative formal approach derived for cartel suppliers, the proceeding in chapter 4 differs in that familiar estimation approaches commonly used for the quantification of purchaser damages are applied to a consumer panel data set of a recent cartel case.

4. Estimating Consumer Damages in Cartel Cases

While cartel damages of purchasers are already widely discussed in both academia and practice, consumer harm has only played a minor role in the context of cartel damages claims so far.[1] This is due to obvious reasons. The damage suffered by an individual consumer generally falls below the legal expenses needed to receive a compensation. Furthermore, in contrast to firms, final consumers are not obliged to keep receipts and are therefore often neither able to prove the fact that they bought the cartel product during the collusive period, nor at which price. This is especially the case when considering groceries, where several cartels have recently been discovered.[2] Last but not least, current European competition law does not favor class-action lawsuits which would allow to effectively bundle the individual claims of final consumers and could at least partially overcome some obstacles.

Despite these hurdles, during recent years the question of legal standing of consumer associations in the course of private damage claims has increasingly attracted attention within the European Commission.[3] The "European Consumer Consultative Group" (ECCG), a sub division of the EC for end consumer interests, adopted an opinion on private damages actions in November 2010. It contains several proposals to improve private damages ac-

[1] One example is the French mobile phone cartel, in which the French consumer association "UFC Que Choisir" attracted around 12.500 consumers for an (in the end unsuccessful) opt-in damage claim. In the UK, the consumer association "Which!" also claimed damages against JJB Sports, however, only 130 consumers joined the claim. See Bien (2013).

[2] Remarkable examples are the three German cases coffee roasters (2010), chocolate manufacturers (2012) and most recently flour (2013).

[3] The starting point was the EC green paper (European Commission (2005)) on damage claims, in which one section explicitly deals with the defense of consumer interests and raises the question whether special procedures for bringing collective actions and protecting consumer interests should be available. This view was emphasized in the subsequent white paper (European Commission (2008)), in which the EC states "[...] that there is a clear need for mechanisms allowing aggregation of the individual claims of victims of antitrust infringements" (European Commission, 2008, p.4).

tions by consumer associations, amongst others (i) the facilitation of the burden of proof for consumer organizations and (ii) the assurance of redress for all consumers. In this context, the ECCG states that "[...] innovative and practical solutions to the calculation of damages are needed to replace the often impossible task of calculating the exact loss."[4] In particular, the ECCG argues that "[...] it should be possible to rely on a reasonable estimate of an overcharge."[5]

Against this background, this chapter contributes to the current discussion by describing how final consumer damages can be quantified empirically. In particular, the damage suffered by German consumers due to the European detergent cartel is econometrically quantified. The cartel lasted from January 2002 until March 2005 and covered the markets of eight European countries. The three largest producers of heavy laundry detergents, who collect about two thirds of the sales and volume in Germany, were involved in this cartel (European Commission, 2011). The estimation is based on survey data of consumer transactions provided by *The Nielsen Company*. The data set covers the last nine months of the cartel period and additionally 15 months after the breakdown of the cartel, which will be used as competitive counterfactual benchmark.

The estimations reveal average overcharges between 6.7 and 6.9 percent and an overall consumer damage of about 13.2 million Euro over the period from July 2004 until March 2005. Under the assumptions that the cartel-induced share on turnover is representative for the entire cartel period and all affected markets, the overall consumer damage even accounts for about 315 million Euro. The results further suggest that retailers reacted to the price increases of the cartel firms via price increases for their own detergent products, resulting in significant umbrella effects. The damage due to this umbrella pricing is quantified to a total of about 7.34 million Euro.

The chapter is structured as follows. The subsequent section 4.1 reviews the theoretical background of cartel damages and describes the potential harm that could emerge on final consumer stage. Section 4.2 summarizes the cartel case under scrutiny and provides a description of the data set. Section 4.3 then describes the estimation approach and the calculation of the overall damage of German consumers. The chapter concludes with a

[4] See European consumer consultative group (2010), section 2.3.
[5] Id.

summary of the main results and an outlook in Section 4.4.

4.1. Related Literature

The quantification of cartel damages is usually not straightforward. Especially when considering multi-layer markets in which one product is used as input in the production process of the adjacent stage, it is demanding to examine and allocate the various effects that percolate through the up- and downstream layers after cartel formation (see chapter 3). In general, the emergence of a cartel at some stage of such a supply chain leads to a higher price and less output in comparison to the prior competitive situation. That is, purchasers are confronted with higher input costs and may react to this change via own price increases, leading to further passing-on effects in the downstream layers. These price increases are generally accompanied by demand restrictions ("output effects") that detract firm specific profits.[6] If one were to estimate the overall harm of cartelization, all these effects must be taken into account.[7]

Within such a multi-layer market, final consumers take a special position as they can not pass on the price increase they suffer. Thus, they can either accept the loss in consumer welfare or change their buying behavior and buy cheaper substitutes. Those substitutes, however, may itself be overpriced due to possible umbrella effects, implying that consumers are particularly in need of protection towards antitrust infringements.

Starting with the theoretical strand of literature, Han et al. (2008) show that the loss in consumer surplus is composed of two parts, the overcharge effect that equals the price increase of the product from the adjacent layer above multiplied by the quantity purchased, and the output effect which reflects foregone consumer purchases due to the higher price. They further analyze the impact of the level of competition at one layer on the magnitude of the passing-on effect as well as the size of the consumer damage relative to the direct purchaser overcharge. If perfect competition exists on each downstream layer, the incidental price increase of cartelists is completely passed on to final customers. The overall damage suffered by them can then even be larger than the direct purchaser overcharge.

[6] See Van Dijk and Verboven (2008) for a more detailed description of the different effects.

[7] More precisely, one would further have to include the damages of cartel suppliers and potential purchasers as well. For a detailed analysis of the different parties affected by cartelization, see chapter 3.

Conversely, if there is substantial market power in the intermediate layers, the direct purchaser overcharge overestimates consumer harm.

Boone and Mueller (2012) use a market model with three layers to analyze the distribution of overall harm in terms of lost profits and lost consumer welfare between cartel purchasers and final consumers for the cases of homogenous and heterogeneous products. They find that the consumer harm share (CHS) is negatively related to (i) the industry aggregate price-cost margin and (ii) the pass-through elasticity, which measures the percentage change in output price in response to a one percent increase in input costs. In addition, they find that the CHS is independent of the number of downstream firms that are directly affected by cartelization.[8]

In sum, theoretical literature shows that in vertically related markets final consumers might face substantial cartel damages even if several intermediate layers are interposed between cartel stage and final consumers. The size of the damage, however, depends on the number of intermediate layers and their corresponding levels of competition. The lower the number of intermediate layers and the higher the degree of competition, the higher the price overcharge for final consumers. Given the detergent market considered in this chapter, there are generally two intermediate layers placed between cartelists and consumers: wholesalers and retailers, which are typically integrated. Hence, effectively there is only one intermediate layer, suggesting that higher cartel prices are directly passed on to the retailers. Furthermore, the degree of competition in the retailing market is considered to be high.[9] Retailers set prices based on the wholesale price but increased by a margin, which reflects the costs of retailing. Thus, a substantial fraction of the cartel induced cost increase might have been passed on to finals consumers, suggesting remarkable damages.

Turning to the empirical strand of literature, various articles have either analyzed the determinants of cartel overcharges within different geographic regions (e.g. Connor and Bolotova, 2006; Bolotova et al., 2008; Bolotova, 2009) and industries (e.g. Bolotova et al., 2005), or explored the price overcharges enforced by cartelists in specific price-fixing

[8] Additional literature is available on cartel damages and passing-on effects in vertically related markets such as Kosicki and Cahill (2006), Verboven and van Dijk (2009) and Basso and Ross (2010). However, their articles do not explicitly deal with final consumer damages but rather focus on direct (indirect) purchasers.

[9] So far, the ongoing German sector inquiry did not reveal any competition issues.

cases (e.g. Bolotova et al., 2008; Hüschelrath et al., 2012). Those articles, however, exclusively concentrate on direct purchaser overcharges and ignore the price setting reaction of competitors, which might result in significant umbrella damages. This chapter bridges both of these gaps in the empirical literature as the price overcharges suffered by final consumers are estimated, taking into account the competitive behavior of the non-cartel firms in the relevant market. The chapter thereby provides new insights with respect to the quantification of cartel damages and allows the deduction of important conclusions that are important for the current discussions on umbrella pricing and private damages claims of consumer associations.

4.2. Description of the Cartel Case and the Data Set

4.2.1. The European Washing Powder Cartel

Procter & Gamble (Ariel and Lenor brands), Unilever (Coral brands) and Henkel (Persil brands) are the leading producers of washing powder in Europe. According to the EC, these three firms formed a cartel from at least January 2002 until March 2005, which was aimed at stabilizing market positions and at coordinating prices in violation of EU and EEA antitrust rules (European Commission, 2011a). The agreement covered the markets in Belgium, France, Germany, Greece, Italy, Portugal, Spain and the Netherlands and concerned heavy-duty laundry detergent powders used in washing machines (European Commission, 2011b). The cartel started when the companies implemented an initiative through their trade association to improve the environmental performance of detergent products (AISE initiative).[10]

After cartel breakdown in 2005 and three further years of silence, Henkel applied for leniency at the EC in 2008 and revealed the anticompetitive practices. The EC started inspections in June 2008 and subsequently, Procter & Gamble and Unilever also applied for leniency under the EU Leniency Notice (European Commission, 2011b).

On 13 April 2011, the EC fined Procter & Gamble and Unilever a total of 315.2 million

[10]The AISE environmental initiative is a voluntary initiative across different countries of the EEA. It targets amongst others on taking into account environmental considerations in the design of laundry detergent products and packages. The AISE's "Code of good Environmental Practices" specifies concrete goals in this regard, e.g. a 10 percent reduction per capita packaging material tonnage consumption.

Euro.[11] Henkel received full immunity in terms of a 100 percent fine reduction because it was the first to inform the EC. Procter & Gamble and Unilever were granted leniency reductions of 50 and 25 percent, respectively. Moreover, they also benefited from a 10 percent reduction due to their agreement for a settlement procedure that allowed the EC to simplify and reduce the length of the investigation (European Commission, 2011b). Thus, the information about the workings of the cartel given in the decision document is scarce. The Commission does not provide any information regarding the reasons for the cartel breakdown.

According to the EC the three firms were involved in various anticompetitive practices that have been coordinated in the course of meetings during the AISE environmental initiative. First, they agreed on indirect price increases, comprising that prices were not reduced when the product volume or the number of wash loads per package was downsized, or when the products were compacted in terms of reduced weight (European Commission, 2011b). Furthermore, benefits and cost savings from reduced raw materials, packaging and transport costs were collectively refused to pass on to consumers (European Commission, 2011b). Second, the three cartelists agreed on a direct price increase at specific markets towards the end of 2004. These anticompetitive markups were realized via price leadership, in which the market leader pretended and implemented the excessive pricing pattern first and the other firms followed (European Commission, 2011b). Last but not least, Henkel, P&G and Unilever collectively restricted their promotional activity by excluding specific types of promotions during the implementation of the different phases of the environmental initiative (European Commission, 2011b).

In the course of this chapter the focus primarily lies on the former anticompetitive practice. That is, the indirect price increases that were realized during the cartel period are estimated and analyzed, followed by the quantification of the monetary damage suffered

[11] It is worth noting that in December 2011 the French competition authority fined a similar cartel for price-fixing of washing powders, tablets and liquids in the French market between 1997 and 2004. Importantly, in addition to Colgate-Palmolive the participating firms were Henkel, Unilever and P&G. The chronology of events suggests that the discovery of both cartels is closely related: In May 2008, Unilever applied for leniency at the French competition authority and only eight weeks later a leniency application by Henkel received the French regulator. After two further weeks Henkel applied for leniency at the EC, Unilever, however, waited with its leniency application at the EC until October 2009. Hence, whereas Henkel received full immunity in the pan-European case and was fined by the French competition authority for its offense in the French market, Unilever got full immunity in the French case but was fined by the EC for its participation in the EU case.

by consumers.

4.2.2. Data Set

The econometric estimation is based on a consumer panel data set for the detergent category provided by *The Nielsen Company*. About 16.000 German customers report which products they have bought on a daily basis. The data set is at the product code level and includes characteristics like washing purpose, package type and size, detergent consistency, scent and concentration. For consumers, typical sociodemographic variables and a scaling factor for representativeness are given.

The data set contains information on 1.145 different product codes, reflecting the heterogeneity of detergent products. The detergents can be distinguished with respect to light-duty, heavy-duty, wool, cold and drape detergent; additional product characteristics are sensitive, color, unconcentrated and concentrated detergents. Regarding the consistency, it is further possible to differentiate between powder, liquid, tabs, wash nuts and gel. According to the EC the cartel only targeted at heavy-duty detergents in powder form. The data set is therefore restricted to this distinct subcategory, resulting in 35.000 observations that are attributed to 494 different product codes and 27 brands.

With respect to the classification of brands, the following three groups of brands can generally be distinguished:

1. Cartel brands: Products of Henkel, Procter & Gamble and Unilever
2. Competitive private brands by the retailers[12]: e.g. Tandil from Aldi
3. Competitive manufacturer brands

It can be assumed that the non-cartel firms in the same relevant market somehow react to the price-setting behavior of the cartel firms via price adjustments of their own detergent products. They may either slip under the price umbrella of the cartel and increase prices for their products in order to profit from higher price-cost margins, or they may decrease prices with the objective to further stimulate the redirection of demand in favor of their

[12]It is worth noting that private brands are often produced by the major manufacturers, which, in the given case would be the cartel firms. Inquiries, however, revealed that this is not the case in the detergent market.

own market shares. In order to investigate whether such an umbrella pricing is observable in the detergent market, the (before-and-after) overcharge estimation is applied separately to all three groups of brands. This additionally allows the identification of a possible reference (brand-) category, which can be used for difference-in-differences estimations.
Another aspect worth discussing is the level of data aggregation in the course of damage estimations. The used data are on a highly disaggregated level in terms of single purchase acts of the observed consumers. This has mainly two reasons. First, the product is highly differentiated and the various product characteristics of washing powder lead to price differences between product categories. When using aggregated prices and analyzing their changes, one can not distinguish between substitution effects and price changes on the product level. Second, in aggregated figures information on the numerous discounts that consumers obtain due to promotional activities are lost, which can bias the estimation. Due to theses issues, single purchase acts are used as observation unit and the data are not further aggregated on a weekly or monthly basis.
The observed time period is from July 2004 until June 2006. Following the decision of the EC, March 2005 is defined as the end of the cartel. Thus, the data set covers the last nine months of the cartel period and additional 15 months of the post-cartel period. It is worth noting that after a cartel breakdown prices might not immediately return to the competitive level. In particular, following Harrington ((2004a), (2004b)) cartels may try to stay on a higher price path after cartel breakdown by implementing some forms of tacit collusion. This would result in an overestimation of the but-for price and a corresponding underestimation of the overcharge. The overcharge estimates are therefore conservative and should provide lower bounds of the real overcharge.

4.2.3. Descriptive Statistics

Table 4.1 summarizes descriptive statistics of the data set.[13] 58 percent of the purchase acts during the entire observation period concern cartel firm products and 39 percent of the observations refer to retailer brands. By contrast, manufacturer brand products

[13] Variables that refer to the period of collusion are marked with *CP* (cartelperiod). At this stage the given statistics are not representative since panel participation varies over time. The descriptive statistics of all *CP* variables must therefore be interpreted with caution. For the overcharge estimation, however, this is negligible as long as purchase acts are randomly drawn.

contribute 3 percent of the data.

Table 4.1.: Descriptive statistics

Variable	**Mean**	**Std. dev.**
Price/kg	1.98	0.78
Cartel brands	0.58	0.49
Retailer brands	0.39	0.49
Manufacturer brands	0.03	0.17
Cartel brands (CP)	0.19	0.39
Retailer brands (CP)	0.12	0.32
Manufacturer brands (CP)	0.01	0.10
Promotion	0.29	0.45
Gimmick	0.07	0.26
Concentrated	0.62	0.49
Color	0.34	0.47
Sensitive	0.03	0.18
Packaging: Box	0.33	0.47
Packaging: Bag	0.54	0.50
Packaging: Carry pack	0.13	0.33
Package size	2.97	2.30
Package size(sq)	14.07	23.06
$n = 35.225$		

The shares of purchase acts during collusion are 19, 12 and 1 percent for cartel, retailer and manufacturer brands, respectively. Hence, 32 percent of all purchase acts in the data set occurred during collusion, which is consistent with the 9 out of 24 months of the observation period.

29 percent of all detergents were sold in at least one form of promotion, that is, a price-flag, feature, handbill or display. As for most observations those different activities occur simultaneously, they are combined in the control variable *Promotion*. The binary variable *Gimmick* captures whether the product was sold with a giveaway and accounts for 7 percent of the transactions.

Regarding product characteristics, 62 percent of the purchase acts concern *concentrated* and 34 percent *color* detergent. *Sensitive* detergents by contrast merely represent 3 percent of the data. In concentrated detergents the effective amount of detergent is higher, which in turn leads to a higher price. With respect to the type of packaging, most detergents are bought in *refill bags* (54 percent), followed by *boxes* (33 percent) and *carry packs* (13 percent).

The average per kilogram price of powdered laundry detergent is 1.98 Euro. The per

kilogram price varies considerably between 60 cents for the cheapest and 6.33 Euro for the most expensive product. The average package size of detergents in the data set is 2.97 kilogram. As Figure 4.1 reveals, the average per kilogram price non-linearly declines in package size. In order to see whether this nonlinear pattern is still observable if it is controlled for different product characteristics, both the *package size* and its square are included as independent variables in the model.

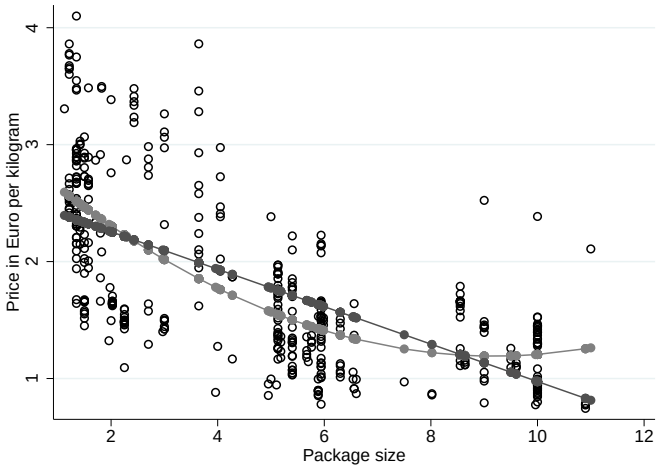


Figure 4.1.: Linear and quadratic fit of price vs. package size

Table 4.2 summarizes price statistics for the cartel products as well as for competitive manufacturer and retailer brands during and outside the cartel period.[14] In general, cartel products are the most expensive ones, followed by retailer and competitive manufacturer brands. For cartel brands, both average and median per kilogram prices are slightly higher during the period of collusion. By contrast, the mean prices of retailer and competitive manufacturer products are lower during the cartel period. However, whereas the price reduction of retailer brands is negligible, competitive manufacturer brands are considerably cheaper during collusion. This is at least partly due to the fact that input costs distinctly decreased during the cartel period and increased afterwards, thereby reducing production costs for all (cartel and non-cartel) detergent producers.

[14]Variables that refer to the non-collusive period are marked with *NCP* (non-cartel period).

Table 4.2.: Price statistics (in Euro/kg) during cartel and non-cartel period

Price	**Mean**	**Median**	**Std. dev.**	**Min**	**Max**
Cartel Brands (NCP)	2.28	2.41	0.85	0.64	6.32
Cartel Brands (CP)	2.33	2.46	0.87	0.67	5.91
Manufacturer Brands (NCP)	1.45	1.03	0.76	0.61	3.70
Manufacturer Brands (CP)	1.34	0.85	0.83	0.60	3.79
Retailer Brands (NCP)	1.55	1.55	0.23	0.60	3.76
Retailer Brands (CP)	1.54	1.60	0.19	0.76	2.43
All	1.98	1.62	0.78	0.60	6.33

4.3. Overcharge Estimation

4.3.1. Estimation Methods

The most challenging issue in the quantification of cartel damages lies in the identification of a suitable counterfactual situation, describing how the market outcome would have evolved in a competitive environment. Econometric damage estimation mainly follows either the so called "before and after", the "yardstick" or the "difference-in-differences" approach (Oxera, 2009). The former method compares for the same market pre- and/or post-cartel prices to the prices paid by purchasers during collusion. It is assumed that the competitive situation in the market during the cartel would have been similar to the situation before and/or after collusion. Regressing the price of the concerned product on a binary variable for the cartel period and a number of control variables allows to determine the average cartel induced price increase during collusion and, thus, the identification of a suitable benchmark price. The damage is then calculated as difference between the observed cartel price and the corresponding but-for price, multiplied by the quantity of the product sold in the cartel period (Davis and Garcés, 2010). The yardstick method uses data on the cartelized market and specific yardstick markets that are comparable to the cartel market in terms of demand and cost factors as well as product characteristics, but not affected by cartelization. That is, one uses for instance the same product market in other countries as benchmark for the same time period.

The difference-in-differences approach combines the two formerly described methods. It compares the price changes of the cartel products with benchmark products during and outside the cartel period in order to identify anticompetitive price deviations. Following

Oxera (2009), the basic idea of this approach can be described as follows:

Figure 4.2.: Difference-in-differences approach

	Non-cartel period	Cartel period	Overcharge estimation
Cartel firms	A	B	$(B-A)-(D-C)$
Non-cartel firms	C	D	

Let A and B be the average prices charged by the cartel firms outside and during the cartel period for the cartel product, and C and D the average prices charged by non-cartel firms for the same product outside and during the cartel period. The difference (B-A) then reflects the price change of the cartelized product between cartel and non-cartel period. As this difference may not be completely driven by the cartel but at least partly due to other factors, the difference (D-C) is used as benchmark. It reflects the price change of the same product produced by non-cartel firms between both periods of time. As both cartel and non-cartel firms should be confronted with the same market and input cost variations over time, the difference in the differences (B-A)-(D-C) should separate those factors and capture the cartel caused price increase.[15]

In the following section, a before-and-after model is estimated not only for the cartel brands, but separately for all three groups of brands. This allows to identify whether retailer brands and/or competitive manufacturer brands are suitable reference categories for a subsequent difference-in-differences estimation. Precisely, both non-cartel brand categories only provide a suitable control group if - after having controlled for all relevant price drivers - a significant price reaction for these products during the collusive period is not observed. If, however, a significant price reaction is observed, this would suggest that the non-cartel firms reacted to the price increase of the cartel firms via price adjustments for their own products (umbrella effects), implying that these products are inappropriate as reference group (since the "true" cartel induced price increase would be biased).

4.3.2. Before-and-After Approach: Implementation and Results

The before-and-after approach is implemented in a reduced-form framework and given by the following panel data model:

[15] This approach is based on the assumption that cartel and non-cartel firms react similarly to demand, supply and market changes in terms of adaptions in their product prices.

$$log(p_{it}) = \beta_0 + \beta_1^{'} Characteristics_i + \beta_2^{'} Costs_t + \beta_3^{'} Retail_{it} + \beta_4 Cartel_t + \varepsilon_{it}.$$

In all of the estimations the dependent variable is the logarithm of the price for one kilogram heavy-duty detergent of a specific product type i at time t.[16] The relative price is used instead of the full package price because even for the same brand up to five different package sizes are observed during the observation period. Thus, using the price per quantity makes products more comparable, eases interpretation and additionally allows to account for the fact that the cartel agreed on indirect price increases rather than on fixed overcharges. Furthermore, the logarithm instead of the absolute value of the kilogram prices is used as it allows to measure relative effects of the independent variables. Concerning retailer margins, it can be assumed that retailers rather add an amount relative to the wholesale price instead of a fix sum; the same applies for discounts. The price differences of detergents are explained by their characteristics, cost development over time, the conduct of the retailers and the effect of the upstream cartel.[17]

Cross-sectional product characteristics

Cross-sectional product characteristics are expected to be important determinants of price differences between product types.[18] Included characteristics are indicator variables for *color*, *sensitive* and *concentrated* detergents, respectively. In addition, binary variables for the type of *packaging* as measures for packaging costs are included and it is controlled for *package size* and its square as it can be observed that smaller packages are sold at an over-proportionally higher per kilogram price; this can coevally be explained by price discrimination of second degree and economies of scale. Last but not least, fixed effects for the various types of products are included, reflecting the fact that products might have

[16] Note that at this point separate models for cartel, retailer and competitive manufacturer brands are estimated. Different product types therefore refer to the same main brand but differentiated with respect to package size, package type as well as further product characteristics (e.g. color, sensitive and concentrated detergents).

[17] It is worth noting that it is not controlled for demand drivers in the regressions. As the consumption of washing powder is relatively stable per household and over time, the overall demand is not expected to change fundamentally in the long term. In the short term, however, consumers might be sensitive with respect to price changes and special offers. Those substitution effects nevertheless primarily occur between products that are similarly perceived by consumers, which should coincide with the brand categorization.

[18] It should be noted that the reduced form approach can not separate whether the characteristics' effect on price stem from the demand or the supply side as only the net effect is observed.

a different popularity due to differing advertising intensities. In addition, the fixed effects control for different margins of the manufacturers as well as differences in production and marketing costs.

Time-varying factors

To control for non-cartel induced price differences over time, six cost measures are included, capturing input and production costs for the detergent producers. These are monthly price indices for *palm oil*, *raps oil*, *rock phosphate*, *industrial power*, *chemical base materials* and *retail prices* provided by the German Statistical Office and the platform *Index Mundi*.[19] As the detergents are not produced at the same day they are sold, the logarithm of all of these variables lagged by one month is included.

Retailers conduct

Considering the retailers conduct, it is accounted for different retailer margins and costs by including binary variables for each of the 15 biggest chains represented in the data set. The reference chain is given by *LIDL* as consumers can find both manufacturer and retailer brands there. The chain fixed effects are not interacted with the cartel period indicator variable because retailer margins and costs do not seem to change due to the upstream cartel.[20] For retailer brands, all chain indicator variables are set to zero. This is due to the fact that most retailers only sell one retailer brand in the detergent category, resulting in perfect collinearity with the brand fixed effects. Furthermore, one can conceptually argue that there is only one margin which is already accounted for by the fixed effects of the product types.

The binary variable *Promotion* is additionally included and controls for the fact that some products were occasionally promoted via price tags, features and handbills or separately displayed. Last but not least, the binary variable *Gimmick* is included into the regression, which is equal to one if a product was sold with a give-away.

[19] Index Mundi collects detailed country statistics, charts, and maps compiled from multiple sources, see http://www.indexmundi.com .

[20] The inclusion of the interactions results in insignificant coefficients for all terms. Testing for joint significance also results in favor of the null hypotheses of no joint significance.

Cartel effect

To measure the overcharge caused by the cartel, the binary variable $Cartel_t$ is incorporated into the model. The variable is equal to one during the cartel period and zero otherwise, and the corresponding estimated coefficient captures the average percentage price change during the cartel period compared to the competitive phase.

Table 4.3 summarizes the results of the before-and-after estimation[21] for all three groups of brands.[22] The indicator variables for concentrated, color and sensitive detergent do not significantly influence the logarithm of the per kilogram price of cartel products. By contrast, significant higher prices are observed for sensitive retailer brands (32.7 percent) and concentrated competitive manufacturer brands (23.6 percent). With respect to the package size, the results confirm the expected non-linear pattern for all three groups of brands. Furthermore, whereas the type of packaging does not seem to influence the relative prices of cartel and competitive manufacturer brands, retailer brands sold in bags are significantly higher priced than in boxes (7.36 percent). In addition, on average promotional activities decrease the per kilogram prices by 10.6 percent (cartel and comp. man. brands) and 1.40 percent (retailer brands), respectively. Cartel products sold with gimmicks do not show a significantly different price than products without gimmicks, however, competitive manufacturer detergents sold with gimmicks are significantly lower priced.[23] Turning to the mean effect of the cartel on prices, a significant positive overcharges for cartel and retailer brands is observable, but no significant price increase for competitive manufacturer brands during the period of collusion. On average, cartel products are 6.72 percent higher priced during the collusive period than in the competitive state after cartel breakdown. The overcharge of retailer brands (2.63 percent) additionally indicates that retailers indeed reacted to price changes by the market leaders via own price adjustments, leading to significant umbrella effects during collusion. Hence, using retailer brands as

[21] The model was also estimated without fixed effects. Omitting fixed effects, however, biases the overcharge estimate as there is a cartel-independent heterogeneity among brand prices. This even becomes more crucial in the difference-in-differences setting. Standard errors also differ significantly in the case without fixed effects, indicating substantial heteroscedasticity and serial correlation of the error terms. To account for these issues, robust and clustered standard errors are used.

[22] As the dependent variable is transformed by the logarithm function, the (percentage) marginal effects must be calculated as the exponentiated coefficients minus one (not reported in the table).

[23] The data do not contain retailer brand products that were sold with gimmicks.

Table 4.3.: Before-and-after estimation results

Variable	**Cartel brands**		**Retailer brands**		**Comp. man. brands**	
Concentrated	0.073	(0.065)	0.006	(0.013)	0.212***	(0.026)
Color	0.008	(0.008)	-0.015	(0.016)	-0.003	(0.010)
Sensitive	-0.001	(0.008)	0.283***	(0.024)	-0.004	(0.032)
Package size	-0.178***	(0.016)	-0.175***	(0.048)	-0.260***	(0.009)
Package size(sq)	0.009***	(0.001)	0.010*	(0.005)	0.014***	(0.001)
Packaging: Bag	0.033	(0.029)	0.071***	(0.012)		
Packaging: Carry Pack	-0.031	(0.017)	-0.001	(0.055)	0.068	(0.013)
Gimmick	-0.026	(0.020)			-0.056***	(0.018)
Promotion	-0.112***	(0.008)	-0.014*	(0.007)	-0.112***	(0.010)
Chem. base mat. (L1)	0.150	(0.259)	-0.664***	(0.086)	-1.616***	(0.309)
Retail prices (L1)	1.244**	(0.515)	1.853***	(0.324)	7.085***	(2.013)
Industrial power (L1)	1.190**	(0.447)	0.560***	(0.125)	2.291***	(0.679)
Palmoil (L1)	0.289***	(0.048)	0.181***	(0.035)	0.143	(0.169)
Rapsoil (L1)	0.019	(0.051)	0.129***	(0.014)	-0.118	(0.075)
Rock Phosphate (L1)	-0.135*	(0.065)	-0.250***	(0.047)	-0.283	(0.323)
Cartel period	0.065***	(0.010)	0.026***	(0.005)	0.027	(0.023)
Constant	-12.027***	(2.979)	-8.338***	(0.866)	-33.682***	(7.875)
Chains	Yes		No		Yes	
Brands	Yes		Yes		Yes	
Observations	20.352		13.813		1.060	
Adj. R^2	0.80		0.57		0.76	

*** Significant at 1%, ** Significant at 5%, * Significant at 10% level

Robust and clustered std. errors (among brands) reported in parentheses

control group in a difference-in-differences estimations would result in an underestimation of the true damage. However, apart from the fact that competitive manufacturers did not react to elevated cartel prices with own price changes, there are several other reasons why they constitute a more appropriate benchmark group than retailers. First, the price setting of cartel brands and competitive manufacturer brands is comparable since in both product groups, producer margins as well as retailer margins are imposed, whereas retailer brand products merely include a retailer margin. Second, cartel brands and manufacturer brands are promoted similarly as the producing firms do costly national advertising in order to build up a certain image. Private retailer brands by contrast are commissioned by the retailers via subcontracts and do not get advertised in public media. Finally, while private retailer brands are only sold in the corresponding stores they are produced for, both cartel brands and competitive manufacturer brands are generally offered in all kinds of shops. Due to these aspects as well as the fact that a significant overcharge of competitive manufacturer brands is not observable, this brand category is used as product

counterfactual in the subsequent difference-in-differences estimation. This additionally provides a robustness check with respect to the results. A large deviation in the results between both approaches would either indicate that the before-and-after model is flawed due to missing explanatory variables, or that the benchmark brand in the difference-in-differences estimation does not constitute an appropriate product counterfactual.[24] On the other hand, if both approaches reveal similar cartel overcharges, it can be concluded that the before-and-after model is already sufficiently specified and accounts for all relevant price drivers. In particular, it implies that there are no substantial unobserved effects a reference product group can control for and that might have been omitted in the before-and-after estimation.

4.3.3. Difference-in-Differences Approach: Implementation and Results

In order to implement the difference-in-differences estimation, the before-and-after model from the previous section is extended by the interaction term *cartel_brands*cartel_period*. It captures the price increase of cartel firms during the period of collusion compared to the price development of the benchmark brands (competitive manufacturers). Precisely, the estimated coefficient of the underlying interaction term corresponds to the above mentioned price difference in the differences of cartel and competitive manufacturer brands during and outside the cartel period. Table 4.4 summarizes the results.

The estimation reveals no general significant price change between the collusive and the competitive period. However, relative to the reference group of manufacturer brands who capture the competitive pricing behavior over time, a significant overcharge of 6.93 percent for cartel brands can be observed, which is close to the 6.72 percent overcharge from the previous before-and-after estimation. This suggests that the before-and-after model is already sufficiently specified in the sense that competitive manufacturer brands do not add additional explanatory power to the development of per kilogram prices over time.

[24] Conversely, this is equivalent to saying that either the before-and-after model is correctly specified, i.e. accounts for all relevant price drivers, or that the difference-in-differences model preforms better as the benchmark brand adds significant explanatory power with respect to the price variation over time.

Table 4.4.: Difference-in-differences estimation results

Variable	Ref. group: Man. brands	
Concentrated	0.072	(0.063)
Color	0.007	(0.007)
Sensitive	-0.003	(0.007)
Package size	-0.183***	(0.016)
Package size(sq)	0.009***	(0.001)
Packaging: Bag	0.030	(0.028)
Packaging: Carry Pack	-0.026	(0.016)
Gimmick	-0.025	(0.019)
Promotion	-0.113***	(0.008)
Chem. base mat. (L1)	0.074	(0.245)
Industrial power (L1)	1.230**	(0.397)
Retail prices (L1)	1.639**	(0.565)
Palmoil (L1)	0.276***	(0.045)
Rapsoil (L1)	0.011	(0.044)
Rock Phosphate (L1)	-0.121*	(0.059)
Cartel period	-0.001	(0.037)
Cartel_brands*cartel_period	**0.068***	**(0.036)**
Constant	-13.593***	(3.054)
Chains	Yes	
Brands	Yes	
Observations	21.412	
Adj. R^2	0.80	

*** Significant at 1%, ** Significant at 5%, * Significant at 10% level
Robust and clustered (among brands) std. errors reported in parentheses

4.3.4. Quantification of Consumer Damages

Given the overcharge estimates of the before-and-after estimation, this section now turns to the quantification of consumer harm. Since each cartelist offers numerous products of washing powder that differ regarding package type and size (and therefore also with respect to the per kilogram price), the absolute overcharge for each single product type is individually calculated in a first step. However, as the dependent variable is in logarithm, the estimated coefficients may not be directly multiplied by the paid prices, but it is necessary to estimate an auxiliary regression in order to get a consistent adjustment factor.[25] In a second step, each purchase act is weighted by the representativeness of the buying household in order to extrapolate the damages for the entire German population. For this

[25]Following Jensen's inequality, the expected logarithm of price and the logarithm of the expected price do not coincide ($E(log(p)) \neq log(E(p))$). Hence, it is necessary to predict $log(p)$ using the estimated model, calculate the exponential of it and use it as explanatory variable for a regression on the real price itself, without a constant. The calculated adjustment factors for the cartel and retailer regressions are 1.0274 and 1.0038, respectively. See Wooldridge (2002) for further information on this approach.

purpose, scaling factors that were provided along with the data set are used.[26]

Since the previous estimations revealed that the retailers reacted to the price increase of the market leaders via price adjustments of their own detergent products, the monetary effect of this umbrella pricing is also calculated. Table 4.5 summarizes the respective results.

Table 4.5.: Consumer harm and umbrella effect between July 2004 and March 2005

	Cartel damage	Umbrella effect
Overcharge (%)	6.72	2.63
Damage (m Euro)	13.210	1.738
Turnover in CP (m Euro)	183.471	63.693
Damage as % of CP Turnover	7.20	2.73

The results suggest that the overall monetary consumer damage caused by the three cartel firms in the relevant product category between July 2004 and March 2005 amounts to 13.210 million Euro. Compared to the turnover generated by the cartel firms during this period in the respective product category, the damage corresponds to 7.20 percent of the turnover.

Under the assumptions that both cartel pricing and consumer behavior during these last nine months of collusion are representative for the entire cartel period, the overall damage suffered over the entire cartel period from January 2002 until March 2005 even amounts to 55.775 million Euro.

It is important to note that this calculated damage solely refers to the German detergent market. According to the EC, eight further European markets such as France, Spain or Italy were affected by the cartel. Following the decision document of the EC, the total annual cartel member sales in the eight affected countries sum up to about 1.385 billion Euros for the relevant category (European Commission, 2011b). Calculating 7.20 percent for 38 months would then result in an overall consumer damage of 315.78 million Euro.[27]

[26] Unfortunately, the original scaling factors provided by Nielsen were related to only one point in time. Due to the high number of panel entries and exits of households over time, it is not possible to use them directly. However, owing to the high accuracy of the scaling factors and given information on panel entry and exit dates, it is possible to recalculate adjusted factors on a weekly basis. In total, the recalculated scaling factors sum up to 39.11 Mio., which coincides with the number of German households during the years 2004 and 2005.

[27] This assumption is obviously critically and would not hold before court. However, this assumption is made in order to illustrate the dimension of consumer damages due to the cartel. In practice one would nevertheless have to use data for all affected markets as well as the entire cartel period in order to quantify the exact overall damage.

Interestingly, this number is pretty close to the 315.2 million Euro fine imposed by the EC in 2011.

Turning to the umbrella pricing, this effect amounts to 1.738 million Euro for the last nine months of the cartel agreement. Under the assumption that the reaction of the retailers during this period is representative for the entire cartel duration, the umbrella effect amounts to 7.34 million Euro. Although not directly caused by the cartel firms, this harm leads to an additional decrease in consumer welfare, raising the overall monetary damage for consumers in Germany to a total of 63.115 million Euro.

4.4. Summary of Findings and Outlook

Motivated by the current discussion whether special procedures for bringing collective actions to protect consumer interests should be available in the EU, this chapter focuses on how consumer panel data can be used in order to estimate overcharges and to quantify consumer damages from price-fixing agreements. The estimations for the European detergent cartel reveal average overcharges between 6.7 and 6.9 percent and an overall consumer damage of 13.2 million Euro in Germany over the period from July 2004 until March 2005. Under the assumptions that the pricing behavior of cartelists and buying behavior of consumers during the last nine months of cartelization are representative for the entire cartel period, the overall consumer damage even accounts for about 55.7 million Euro. If it is further assumed that the estimate is relevant for all affected markets, the overall damage sums up to about 315 million Euro. In addition, the analysis provides empirical evidence for the existence of umbrella pricing as the estimation results show significant overcharges attained by non-cartel firms during the collusive period. The monetary consumer damage due to this umbrella effect amounts to 1.7 million Euro during the last nine months of the cartel period and, under specific assumptions, to 7.3 million Euro over the entire cartel period.

The policy implications and specific contributions of this chapter to the literature on public and private antitrust enforcement can be read in the concluding chapter 6.

After the analysis of cartel damage estimations for the purpose of private antitrust enforce-

ment in chapters 3 and 4, the subsequent chapter contributes to the public enforcement literature again. It focuses on the question whether cartel breakdowns trigger structural changes within the affected industries, thereby leading to increased numbers of merger transactions. The underlying hypotheses is that - after the breakdown of a cartel - the former cartel members might try to regain their lost market power by an increased merger activity in order to strengthen their industry market positions in the newly competitive state. In addition, non-cartel firms who operate in the same industry and observe the detection of the cartel might be induced to react to these changes as well, resulting in a merger wave in the respective industry shortly after the cartel breakdown. With respect to the process of public antitrust enforcement, such a behavior would indicate that successful public antitrust enforcement may not stop after litigation, but that the future development of cartel affected industries should be screened in order to prevent cartel-like market outcomes through increased merger activity in general and mergers between former cartelists in particular.

5. Cartel Breakdowns and Merger Activity

After the breakdown of cartels, anecdotal evidence[1] often points towards an increased merger activity in the respective industries, thereby raising the question whether mergers must be considered as a potential 'second-best' alternative to cartels. Generally, such a potential substitute relationship between cartels and mergers is not a recently gained insight. On the contrary, after cartelization was prohibited by the Sherman Act in the United States in 1890, companies started to merge with their rivals, thereby contributing to the development of the first great merger wave (Bittlingmayer, 1985; Mueller, 1996). After realizing that mergers became a 'second-best' alternative to cartels – as part of the general desire of firms to increase market power and reduce competitive pressures – law makers in the US reacted by the adoption of the Clayton Act in 1914 which introduced – among other procedures – an ex-ante merger control, aiming at prohibiting (or remedying) mergers with anticompetitive potential.

Although nearly a century has passed by since the birth of merger control, the underlying key motivations are still valid and relevant. Both national and international cartels still exist and mergers remain a threat for (re)gained competition after the detection of such serious infringements of competition law. Although modern merger control procedures are likely to foreclose the implementation of the most anticompetitive mergers (e.g., between former cartelists), merger reactions to cartel breakdowns must still be considered as both possible and desirable, first and foremost due to their potential role in reducing competitive pressures in the post-cartel world – but also as an important instrument to facilitate necessary changes in industry structures in the post-cartel world.

Against this background, this chapter investigates the impact of cartel breakdowns on merger activity. Merging information on cartel cases decided by the EC between 2000 and

[1] See Cosnita-Langlais and Tropeano (2013), and Kumar et al. (2012).

2011 with a detailed data set of worldwide merger activity, descriptive results suggest that, first, the average number of all merger transactions increase by up to 51 percent when comparing the three years before the cartel breakdowns with the three years afterwards. Second, for the subset of horizontal mergers, merger activity is found to increase even more – by up to 83 percent – after the cartel breakdowns. The results indicate that competition authorities should consider mergers as potential 'second-best' alternative to cartels when enforcing antitrust law and that the future development of cartel affected industries should be screened after cartel breakdowns in order to prevent cartel-like market structures in the mid and long run.

The chapter is structured as follows. The subsequent section 5.1 sheds light on the interaction between cartelization and merger activity by studying merger activity before and after a cartel breakdown. Section 5.2 presents the empirical analysis. Subsequent to the detailed description of the construction of the data set, this section subdivides the reporting of the empirical results into two sub-sections. While the first sub-section concentrates on all mergers after cartel breakdowns, the second redoes the analysis for the subset of horizontal mergers. Section 5.3 discusses the challenges of an econometric implementation of the research question and section 5.4 concludes with a review of the key insights.

5.1. Interaction between Cartelization and Merger Activity

This section starts with a discussion of the interaction of both competitive strategies (cartels vs. mergers) in general and merger activity before and after a cartel breakdown in particular. Existing research focusing on these questions is quite limited. From a theoretical perspective, Mehra (2007) sees cartels and (horizontal) mergers as alternative arrangements to increase profitability and argues that the choice between the two forms is determined by factors such as the structure of industry, organization of firms and, last but not least, existing antitrust laws. In a conjectural variation model, she shows that in the absence of cartel fines a firm always prefers a cartel to merger when the latter does not involve any efficiency gains. She further shows that when there is perfect competition among the competitive fringe, firms do not have incentives to form a cartel and they merge only if there are efficiencies involved.

In a recent article, Kumar et al. (2012) are searching for explanations why – despite the inherent stability problems – firms might still prefer cartels over mergers. In addition to explanations relating to the reduced capital requirements for cartels compared to mergers (Stigler, 1950)[2] or expected diseconomies from merger (Bittlingmayer, 1985), they show that such a behavior can be rational (i.e., profit-maximizing) as long as customers are uncertain as to whether non-merged firms are operating as a cartel or not.

From an empirical perspective, Bittlingmayer (1985) provides evidence for a substitute relationship between cartels and mergers for the United States. Inspired by the observation that companies started to merge with their rivals after cartelization was declared illegal by the Sherman Act in 1890 – culminating in the first big merger wave – he particularly investigates the question why firms preferred cartelization over merging in the first place. Starting from the observation that many cartelized industries were characterized by high fixed costs, a small number of firms and cyclical demand, he argues that cartels simply were a cheaper form of organization compared to mergers, partly because coordination was only needed in times of low demand. Inspired by the work of Bittlingmayer (1985), Kumar et al. (2012) present further descriptive evidence of merger activity after collusive episodes in the ten largest US manufacturing industries around the time of the adoption of the Sherman Act. Interestingly, they find evidence of substantial post-cartel merger activity in eight out of the ten industries.

Turning from the review of the existing literature to a general assessment of the interaction between cartel breakdowns and mergers, in the following, it is assumed both the existence of cartel and merger enforcement in a certain jurisdiction and the focus particularly lies on two periods in the cartel lifecycle: during cartelization and after cartelization. The 'during cartelization' period starts with the implementation of a cartel agreement. As cartels can only be considered as stable if most (larger) firms are participating in it, reduced incentives to merge can be expected. However, mergers might still take place (a) between cartelists,

[2]This is particularly true if it is considered that cartels typically (have to) include most (or even all) larger firms in the respective industry (in order to make it a profitable endeavour) while mergers typically take place between two firms only, i.e., while cartels allow a coordination of competition parameters among most or even all major players, mergers typically refer to a substantially smaller market share in the respective industry. Even if capital constraints are assumed to be non-binding, it would still be difficult in the short and medium run to implement a couple of subsequent mergers among all those major players in the respective industry (which would be necessary to mimic the market performance of a cartel).

e.g., in order to discipline a cartel breaker, (b) between cartelists and non-cartelists, e.g., in order to acquire a firm which refused to join the cartel or (c) between (smaller) non-cartel members, e.g., in an attempt to bundle powers against the cartel.

The 'after cartelization' period is the most crucial one for the purposes of this study. Several qualitative arguments speak for a general increase in merger activity after a cartel breakdown. First, the breakdown of the cartel must be understood as a shock for the respective industry in the sense that cartel-related structures (and profits) are gone, thereby implying a detailed thinking on suitable 'second-best' strategies to regain profitability. While horizontal mergers can be an important tool to improve the relative position of the acquirer in the post-cartel world, vertical mergers might aim at securing important input goods (upstream), important customer channels (downstream), or might facilitate upstream collusion in the post-cartel world (Bittlingmayer, 1985; Nocke and White, 2007). Second, due to the end of the cartel, less efficient firms might run into financial problems, making them suitable targets for an acquisition by competitors (and causing structural changes in the industry). Third, after the cartel breakdown, cartel breakers may be acquired as a measure of punishment, possibly in an attempt to either reinstate the cartel or to switch to some form of tacit collusion afterwards.

Despite all these arguments for an increase in merger activity after cartel breakdowns, it is important to remark that the interaction between cartels and mergers can also be inverted in the sense that in the process of merging two companies, an involvement in a cartel is detected by the merging firms and subsequently reported – often under the leniency program – to the competition authority. Although the EU has experienced several of such cases in the past, it is on the one hand reasonable to assume that the majority of cartels are still detected by alternative methods. On the other hand, even if a particular merger has been the trigger for a cartel breakdown, most of the arguments for an increased merger activity mentioned above stay valid, thereby still suggesting an increase in merger activity in the post-cartel world.

5.2. Cartel Breakdowns in the European Union and Merger Activity

In this section the relationship between EU cartel breakdowns and subsequent merger activity is descriptively analyzed. The section starts with a detailed description of the construction of the data set, followed by the presentation of the empirical results. In a first step, the number of all merger transactions in the three years before and after the cartel breakdowns in the respective industries are analyzed, followed by the same analysis for the subset of horizontal mergers in a second step.

In both sections, it is differentiated between three types of geographical scope of the mergers. In addition to an investigation of worldwide merger activity, the respective results are also reported for the subsets of mergers in which either one EEA (European Economic Area) firm was involved or in which both parties were based in the EEA. Although it is reasonable to assume that the effect of European cartel breakdowns on mergers is strongest within the EEA, the still growing internationalization of markets does not rule out the possibility that a European cartel breakdown might motivate, e.g., a Canadian and an US firm to merge their businesses.

5.2.1. Construction of the Data Set

The data set used in this study was constructed by two separate raw data sets.

The first data set contains information on all cartel cases decided by the European Commission between 2000 and 2011. The data were collected from decisions and press releases published by the EC in the course of its investigations and combine case-specific as well as firm-specific information. On the case level, information such as cartel type, cartel duration, number of cartel members, affected industry, relevant geographic market(s) and imposed overall fines are available. Regarding firm-specific data, information on the individual length of cartel participation, the level of fines imposed by the EC, whether the firm applied for leniency and the value of fine reductions following a successful leniency application are given. Furthermore, specific factors that are relevant for the calculation of the fine such as, e.g., aggravating and mitigating circumstances or repeat offenses are available. In sum, the data set combines information on 73 EC cartel cases and 464 cartel

members.[3] Table 5.1 displays an excerpt of the descriptive statistics of the data set.

Table 5.1.: Descriptive statistics of the cartel raw data set

Variable	Mean	Median	Std. dev.	Min	Max
Number of firms per case	5.73	5	3.38	2	17
Cartel duration (total, in months)	101.91	74	77.94	3	419
Cartel duration (firm specific, in months)	89.16	70.5	66.79	3	419
Total fine per case (m Euro)	207.32	108.61	263.37	0.45	1383.9
Individual fine per firm (m Euro)	36.19	11.55	79.78	0	896
Fine reduction per firm	0.236	0.1	0.311	0	1
Share of leniency cases	0.926	1	0.26	0	1
Leniency collaboration rate per case	0.685	0.75	0.327	0	1

As shown in Table 5.1, the average number of cartel firms is 5.73 and the average overall cartel duration is 102 months (8.5 years). The median values of both factors are 5 firms and 74 months (6.17 years), respectively. The average firm-specific length of cartel participation is 89 months (7.43 years), which is close to the overall cartel duration and suggests that cartels are generally stable in terms of the number of participating firms. Regarding cartel fines, the average fine per case imposed by the EC between 2000 and 2011 amounts to 207 million Euro. It varies between 450,000 Euro imposed in the Luxembourg brewer case and 1.38 billion Euro in the Car glass cartel. 93 percent of the cases show leniency applications and, on average, 68.5 percent of the firms in each case applied for fine reductions as part of the program. The average fine reduction per firm – which is not necessarily due to a leniency application but could also relate to, e.g., the inability to pay larger fines – is 24 percent of the initial base fine imposed.

For the study of merger activity, the *Zephyr* database provided by Bureau van Dijk is used. The *Zephyr* database includes detailed information on worldwide mergers and acquisitions such as deal type, transaction volume as well as target, acquirer and vendor financials and further details. The raw data set does not include all transactions from *Zephyr* but rather restricts the number of deals according to the following selection procedure. First, only completed mergers or acquisitions from cartel-affected industries at

[3] It is worth noting that one cartel member is not necessarily represented by one single firm in the data set. In cases in which several firms are jointly liable for the infringement, such a 'group of companies' is treated as one observation unit.

NACE[4] three- or four-digit level are selected. Second, only those industries for which merger information was available three years before until three years after the respective cartel breakdowns are kept. Third, industries in which several cartels emerged in the observation period were dropped in order to avoid a problematic overlapping of observations.[5] Applying these selection criteria results in 5244 mergers related to 24 industries on NACE three- or four-digit level. Table 5.2 displays an excerpt of the descriptive statistics of this data set.[6]

Table 5.2.: Descriptive statistics of the merger raw data set

Variable	Mean	Median	Std. dev.	Min	Max
Mergers	0.010	0	0.101	0	1
Acquisitions	0.990	1	0.101	0	1
Deal value (m Euro)	322.660	13.765	4625539	0.01	189951
Mergers with EEA involvement	0.161	0	0.368	0	1
Mergers within EEA only	0.373	0	0.484	0	1
Mergers outside EEA	0.423	0	0.494	0	1
Horizontal M&A	0.331	0	0.471	0	1
Vertical or conglomerate M&A	0.669	1	0.471	0	1

As shown in Table 5.2, 99 percent of the transactions refer to acquisitions, leaving only 1 percent for pure mergers. The average and median deal values are 323 million Euro and 14 million Euro, respectively. The highest deal value is 190 billion Euro and was paid as part of the merger between Smithkline Beecham and Glaxo Wellcome in 2000. The geographical breakdown of the data reveals that about 16 percent of the observations refer

[4] "NACE" stands for "Nomenclature statistique des activités économiques dans la Communauté européenne" and is the statistical classification of economic activities in the European Community (comparable to the standard industrial classification in the United States of America). A complete list of NACE codes is available here: http://ec.europa.eu/competition/mergers/cases/index/nace_all.html , last accessed on 12 May 2014.

[5] For example, if a cartel in a particular industry ended in 2002 and another cartel in the same industry in 2006, the number of transactions in 2005 in this industry would be assigned to both categories 'three years after cartel breakdowns' and 'one year before cartel breakdowns' in the empirical analysis. As such an overlap would bias the results, only those industries are kept in which either only one cartel emerged in the observation period or in which the time distance between two cartels is sufficiently large to avoid the described overlap. Due to overlapping issues, all cartels in the following four industries were dropped from the empirical analysis: Manufacture of other wearing apparel and accessories, manufacture of other inorganic basic chemicals, manufacture of synthetic rubber in primary forms, manufacture of refined petroleum products. As a consequence, 1295 mergers had to be dropped from the data base.

[6] In principle, it would be desirable to use all mergers notified to the EC as an alternative merger data set. Although such a data set would possibly have the advantage of better possibilities to identify antitrust markets, the respective notifications are only available online for the last 6 months. Furthermore, notification thresholds are quite high in the EU, i.e., a large fraction of small- or medium-sized mergers are likely to slip under the radar when such a data set is used.

to mergers in which at least one firm originates from the EEA, while 37 percent represent transactions within the EEA and 42 percent of the mergers and acquisitions took place outside the EEA.[7] Last but not least, Table 5.2 reveals that 33 percent of the mergers and acquisitions in the data set were horizontal, leaving the remaining 67 percent for either vertical or conglomerate mergers.[8]

The two data sets were merged via industry three- or four-digit NACE codes, resulting in an overall data set that contains cartel and merger data for 24 industries on a yearly basis.[9] Table 5.3 below provides a characterization of the 22 cartels included into the analysis. In addition to the case number of the corresponding EC cartel decision, the respective industry, number of cartelists, begin and end of the cartel as well as the resulting cartel duration (in months) are reported. As implied by the table, only 22 out of 73 EC cartels (about 33 percent) which were decided between 2000 and 2011 could be included in the empirical analysis. While several cases (in four particular industries) had to be dropped due to cartel overlaps, the majority had to be excluded due to missing data. This process was nevertheless necessary in order to correctly identify the effect of one cartel breakdown on merger activity.

[7] The remaining five percent are transactions for which the originating country of either the acquirer or the target is not stated in the *Zephyr* database. Please note that these observations are dropped for the analysis of EEA mergers in the subsequent sub-sections.

[8] As *Zephyr* does not provide information on the type of transaction, a merger is defined to be horizontal if the primary 4-digit NACE codes of the acquirer and the target are identical.

[9] It is important to note that the link between these industries and relevant antitrust markets is likely to be loose, i.e., the latter typically are much narrower than the former. However, in order to minimize a possible bias in the results, the most detailed NACE level possible was used for the empirical analysis. Furthermore, one of the key arguments says that mergers take place post-cartel breakdown in an attempt to restructure the industry. Such activities are likely to refer to broader industries rather than narrow antitrust markets (typically containing one (or a small number of) product(s) or service(s)).

Table 5.3.: Characteristics of cartels included in the empirical analysis

Case No.	Industry	No. cartelists	Begin	End	Duration (m)
37512	Manufacture of pharmaceutical preparations	9	9/1989	2/1999	113
37750	M. of beer / Wholesale of beverages	2	3/1996	12/1999	45
37800	M. of beer	4	10/1985	2/2000	172
37956	M. of doors and windows of metal	7	12/1989	7/2000	127
37978	M. of other chemical products n.e.c	2	11/1990	12/1999	109
38279	Wholesale of meat and meat products	6	10/2001	1/2002	3
38344	M. of basic iron and steel and of ferro-alloys	16	1/1984	9/2002	224
38354	M. of plastic packing goods	13	1/1982	6/2002	245
38432	M. of consumer electronics	3	8/1999	5/2002	33
38543	Other transportation support activities	10	10/1984	9/2003	227
38645	M. of plastic plates, sheets, tubes and profiles	5	1/1997	9/2002	68
38823	M. of lifting and handling equipment	4	5/1996	1/2004	92
38899	M. of electricity distribution and control apparatus	5	4/1988	5/2004	193
39092	M. of ceramic sanitary fixtures	17	10/1992	11/2004	145
39125	M. of other parts and accessories for motor vehicles	4	3/1998	3/2003	60
39129	M. of electric motors, generators and transformers	6	6/1999	5/2003	47
39165	M. of flat glass	4	1/2004	2/2005	13
39309	M. of computers and peripheral equipment	6	10/2001	2/2006	52
39396	M. of other inorganic basic chemicals	7	4/2004	1/2007	33
39401	Distribution of gaseous fuels through mains	2	1/1980	8/2000	247
39579	M. of soap and detergents, cleaning and polishing preparations	3	1/2002	3/2005	38
39600	M. of other pumps and compressors	5	4/2004	10/2007	42

5.2.2. Empirical Results

In this section, the results of the descriptive analysis are presented. It is differentiated between all kinds of mergers (horizontal, vertical and conglomerate) and horizontal mergers only. In both sub-sections, the results are provided for three different geographical scopes of mergers: worldwide mergers, mergers in which one EEA firm was involved and mergers in which both parties were based in the EEA.

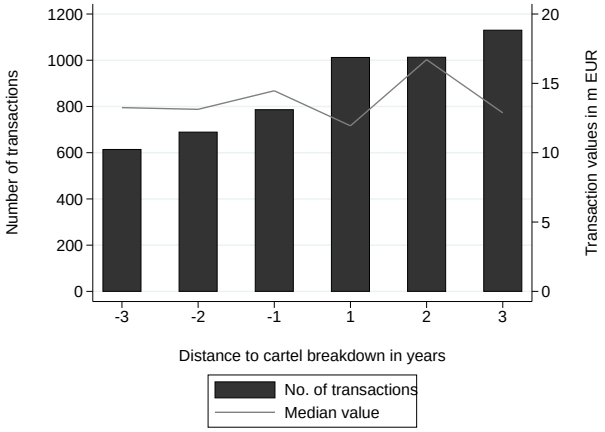
5.2.2.1. Results for all Mergers

Although market power issues are typically assumed to be strongest for horizontal mergers, the discussion in section 5.1 above revealed that especially vertical (but also conglomerate) mergers have the potential to change the structure of the post-cartel industry and may lead to increases in market power. Therefore, in a first step the number of all merger transactions in the three years before and after the cartel breakdowns in the respective industries[10] are reported for the three geographical scopes.

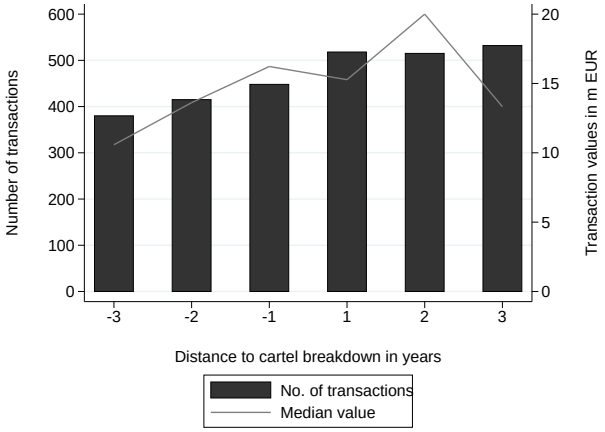
As revealed by Figure 5.1(a), a clear increase in merger activity is observable in the three years after the cartel breakdowns compared to the three years before the cartel breakdowns. Although a stepwise increase in merger activity is already identifiable in the three-year-window before the cartel breakdowns, the average number of transactions still increases from 696 in the three years before to 1052 in the three years after the cartel breakdowns; a rise of about 51 percent. Extending the analysis to the remaining two geographical scopes shown in Figures 5.1(b) and 5.1(c) reveals that – despite the expected reduction in the number of transactions – the general shapes of the pre-/post-cartel breakdown values stay quite similar; although the percentage-changes are reduced to 25 percent (EEA firm involved) and 28 percent (only EEA firms involved), respectively. However, while Figure 5.1(a) still shows an additional small increase in worldwide merger activity in the year +3, activity stays almost constant for mergers with EEA involvement (Figure 5.1(b)) and even decreases in the sub-sample of EEA mergers (Figure 5.1(c)). However, in sum, the

[10] The yearly distances 1, 2 and 3 are based on monthly time spans, i.e. [1;12], [13;24] and [25;36] months after cartel breakdowns. The same definition applies to the distances before the cartel breakdowns (-1, -2 and -3).

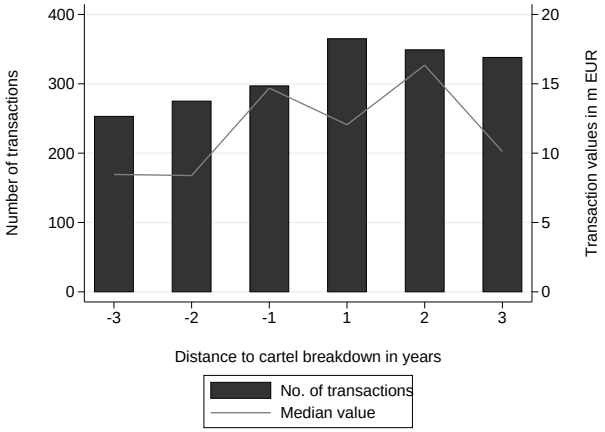
Figure 5.1.: Number of mergers and median values three years before/after cartel breakdowns (all mergers)



(a) Geographic scope: worldwide



(b) Geographic scope: at least one merging firm stems from EEA



(c) Geographic scope: both merging firms stem from EEA

descriptive results support the hypothesis that merger activity increases in the year after cartel breakdowns in the cartel-affected industries, leading to a corresponding increase in the average number of merger transactions in the three years after the cartel breakdowns. With respect to changes in the median deal values over time, a remarkable drop in transaction size is observable in the year after the cartel breakdowns in all three graphs, suggesting that a larger number of smaller mergers is realized in that period. This decrease in the median transaction value is, however, followed by an up-and-down pattern in the succeeding two years, making any consistent interpretation difficult. Furthermore, the three graphs in Figure 5.1 also reveal that absolute median values are located between 15 million and 35 million Euro, suggesting that a substantial fraction of all mergers in the data set are rather small transactions.[11] This observation can be explained by possible shake-out periods in the respective industries after the cartel breakdown.

5.2.2.2. Results for Horizontal Mergers

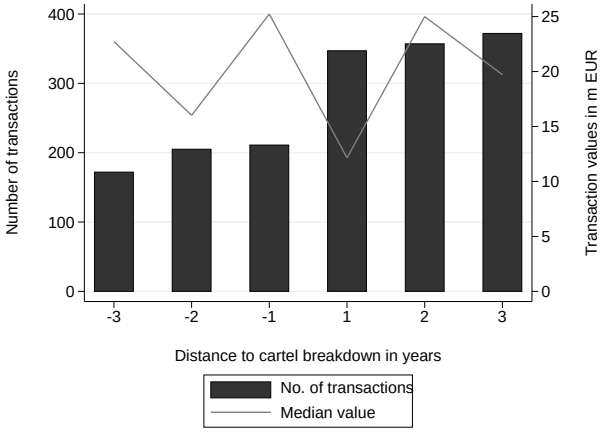
Although a cartel breakdown might also motivate vertical and conglomerate mergers, it is reasonable to expect that horizontal mergers are the primary candidate; basically because, by definition, the respective cartels referred to the horizontal level and it is therefore reasonable to assume that the desire to merge is strongest on this horizontal level in the post-cartel world. In order to investigate this hypothesis, Figure 5.2 below provides the above results for the subset of horizontal mergers (for the three geographical scopes).[12]

As revealed by Figure 5.2(a), an even more pronounced increase in merger activity is observed in the three years after the cartel breakdowns compared to the three years before the cartel breakdowns. While the stepwise increase in merger activity in the years before the cartel breakdowns – identified in Figure 5.1(a) – is reduced or even disappears, the average number of transactions increases substantially from 196 in the three years before

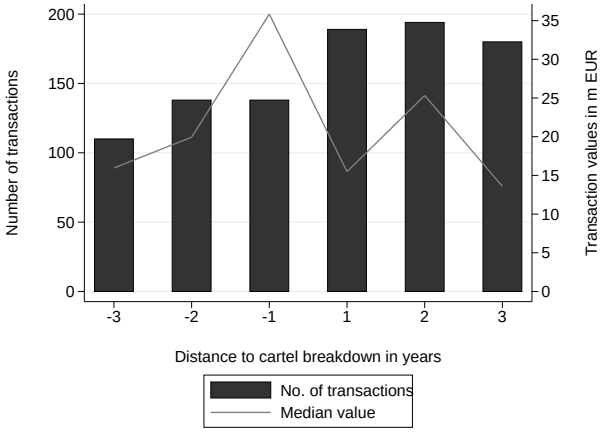
[11] In this respect, it is important to mention that restricting the data set to only those transactions in which at least 50 percent of the target firm was acquired (thereby dropping smaller transactions) reveals an almost identical pattern, i.e., the general results are not driven by the fact that a substantial amount of small transactions is included. The number of transactions, however, does differ quite substantially.

[12] Furthermore, the results for the sub-group of non-horizontal mergers are provided in Appendix B. It is revealed that the shape of the three graphs is comparable – but less pronounced – compared to the group of all mergers, supporting the hypothesis that horizontal mergers are the main (but not the only) driver of general merger activity after cartel breakdowns.

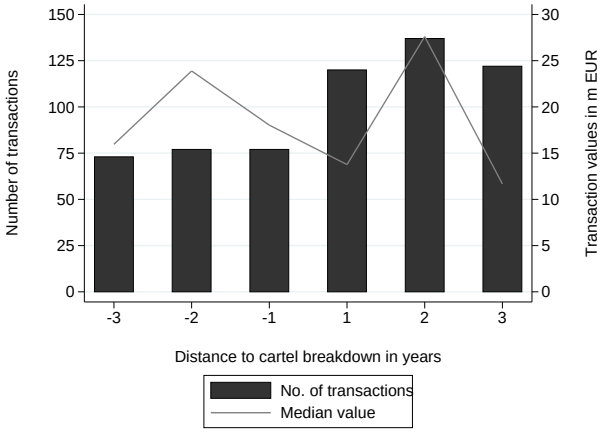
Figure 5.2.: Number of mergers and median values three years before/after cartel breakdowns (horizontal mergers)



(a) Geographic scope: worldwide



(b) Geographic scope: at least one merging firm stems from EEA



(c) Geographic scope: both merging firms stem from EEA

to 359 in the three years after the cartel breakdowns; a rise of about 83 percent.

Extending the analysis to the remaining two geographical scopes shown in Figures 5.2(b) and 5.2(c) reveals that – despite the expected reduction in the number of transactions – the general shapes of pre-/post-cartel breakdown values stay quite similar, although the percentage changes are reduced to 48 percent (EEA firm involved) and 66 percent (only EEA firms involved), respectively. Again, while Figure 5.2(a) shows an additional small increase in merger activity in year +3, activity is visibly reduced in Figure 5.2(b) and Figure 5.2(c). However, in sum, the descriptive results support the hypothesis that horizontal merger activity increases substantially in the years after cartel breakdowns in the cartel-affected industries, leading to a corresponding increase in the average number of merger transactions in the three years after the cartel breakdowns.

With respect to changes in the median deal values over time, a remarkable increase in transaction size is cognizable in the year before the cartel breakdowns in Figure 5.2(a) and Figure 5.2(b), and already in year -2 in Figure 5.2(c). Although increases in the median value suggest that a number of larger mergers were realized in the respected period, the developments reported in the figures are again difficult to interpret without a detailed case-based assessment of the respective mergers.

In a nutshell, comparing the average number of merger transactions and percentage changes between Figure 5.1 (all mergers) and Figure 5.2 (horizontal mergers only) reveals a substantial increase in post-cartel merger activity for both breakdowns of the data set. However, as expected up-front, results for the subset of horizontal mergers are much clearer compared to the entire data set including all merger transactions.

Table 5.4 summarizes the key results by providing the average number of merger transactions and percentage changes three years before and after the cartel breakdowns. As shown in Table 5.4, the percentage change in the average number of transactions lies between 25 percent for all mergers in which at least one merging firm stems from the EEA and 83 percent for worldwide horizontal mergers. Although admittedly part of these differences might be driven by other factors, the dimension of the observed changes together with the different points in time at which the cartels ended provide a strong case for a direct relationship between cartel breakdowns and merger activity.

Table 5.4.: Average number of merger transactions and percentage changes three years before and after the cartel breakdowns

	All mergers			**Horizontal mergers**		
Geographic scope	Before	After	%-change	Before	After	%-change
Worldwide	696	1052	+51.2	196	359	+83.2
One firm from EEA	414	522	+25.1	129	188	+45.7
Both firms from EEA	275	351	+27.6	76	126	+65.8

5.3. Challenges of an Econometric Implementation

Given the substantial investment in the construction of the data set applied in this study, it is worthwhile to complement the descriptive evidence presented in the previous sections with econometric evidence on the question whether cartel breakdowns lead to a significant increase in merger activity. In particular, applying a difference-in-differences approach or a before-during-after approach would further substantiate the analysis. Despite the undisputed general value of such econometric investigations, it is abstained from them in this study for the following reasons.

In principle, a difference-in-differences approach would be a suitable empirical method to investigate the research question. In addition to substantial data needs, a key challenge in an application of such a method lies in the choice of a suitable control group. For several reasons, such a suitable control group, however, can not be identified. First, cartels are not equally likely in all markets and industries and as a consequence, it would be necessary to include industries in which cartels are in principle possible. Second, even if such industries can be identified, they would face the challenge of containing undetected cartels, thereby questioning these industries as suitable control group. Third, the data set only includes cartels detected on the level of the European Union and therefore ignores the (potentially significant) impact of either national cartels in the EU or international cartels outside the EU, which might still have an impact on European markets.[13]

Complementary to a difference-in-differences approach, a before-during-after approach

[13] In principle, it would be desirable to add all national cartels to the data set (especially because the merger data is broader in the sense that it contains both national and international mergers). However, although several national competition authorities provide the necessary information (at least for recent years), others do not and therefore foreclose any attempt to undertake a cartel analysis on a national and EU level. Furthermore, the potential bias of the results is expected to be rather small. While EC cartel cases clearly can have an influence on national states (and the incentives to merge for the respective national firms), national cartel cases by definition have a rather local influence and, hence, are likely to have a reduced impact on merger activities in other EU member states.

could be applied. In principle, such an approach could explain merger activity before, during and after cartelization while controlling for other drivers such as the general economic development, interest rate levels or more specific trends in particular industries, which might determine general merger activity. In addition to possible methodological problems of such an approach (e.g., due to overlaps between different cartels at a particular point in time causing severe identification problems), an application as part of this study is foreclosed due to a lack of sufficiently detailed data.

Despite the described challenges of an econometric implementation – which led to the decision not to undertake them as part of this study – the findings derived as part of the descriptive empirical analysis provide a strong case for an existing impact of cartel breakdowns on merger activity. Although admittedly part of the observed differences might be affected by other drivers such as, e.g., general waves in the economic development, the fact that the cartel breakdowns included in the analysis took place at different points in time is likely to reduce the impact of such effects on the key results.

5.4. Summary of Findings

In the aftermath of the breakdown of a German cement cartel in early 2002, one of the large former cartel members tried to acquire the cartel breaker – Readymix AG – probably in an attempt to both 'pacify' the industry and punish the deviator. The German Federal Cartel Office, however, prohibited the transaction, thereby avoiding the (partial) substitution of cartel-related market power by merger-related market power. In the end, Readymix was nevertheless acquired by Cemex, a larger Mexican cement company which was not active in the German market before the transaction.

Although admittedly anecdotal evidence, the aftermath of the breakdown of the German cement cartel provides a nice example of the interaction between cartel breakdowns and merger activity in a world with workable antitrust enforcement. The breakdown of the cartel led to an increased desire to merge and antitrust policy was – albeit able to foreclose the (likely) most anticompetitive merger – not in the position to entirely prohibit subsequent mergers in the post-cartel world. More generally, the case suggests that modern antitrust policy certainly can have an influence on the choice of the merging parties, however, is

typically unable to disrupt the general incentives to merge after a cartel breakdown.

Against this background, this chapter analyzes the impact of cartel breakdowns on merger activity. Merging information on cartel cases decided by the EC between 2000 and 2011 with a detailed data set of worldwide merger activity, the descriptive analysis reveals that, first, the average number of all merger transactions increase by up to 51 percent when comparing the three years before the cartel breakdowns with the three years afterwards. Second, for the subset of horizontal mergers, merger activity is found to increase even more – by up to 83 percent – after the cartel breakdowns. The results stay largely robust for variations in the geographical scope (worldwide, EEA firm involved, only EEA firms involved). Although several methodological (and data) problems did not allow to test the descriptive results with econometric methods, it can be expected that they provide a strong case for an existing impact of cartel breakdowns on merger activity.

The policy implications and specific contributions of this chapter to the literature on public and private antitrust enforcement can be read in the subsequent chapter.

6. Conclusion

During recent years public and private enforcement of antitrust law has been put on top of the agenda of European competition policy. On the public enforcement side, the European Commission has introduced and adjusted various enforcement tools, such as the European corporate leniency program or the European Guidelines on the method of setting antitrust fines, with the objective to increase the efficiency and effectiveness of cartel prosecution. In the same vein, the process of private enforcement has been substantially strengthened by two judgments of the European Court of Justice as well as an initiative started by the Commission, thereby facilitating private parties to claim compensation for the harm suffered due to cartels. Due to the fact that these alterations were foremost implemented in the recent past, some important questions on the enforcement of antitrust law are still unanswered by economic literature.

Against this background, this dissertation tries to bridge some of the unsolved gaps by providing four chapters with new insights on the topic of public and private antitrust enforcement. Each chapter either refers to the private or public antitrust enforcement literature and the discussion of the specific contributions, policy implications as well as new opportunities for future research is dedicated to this final chapter.

Chapter 2 contributes to the public enforcement literature and analyzes the price-setting behavior of cartels in Europe as well as the status quo of cartel deterrence, given the current level of fines according to EU competition law. Precisely, in the first part of the chapter the impact of different cartel characteristics and the market environment on the level of overcharges is analyzed using a sample of 191 overcharge estimates and different parametric and semiparametric estimation methods. The study reveals an average cartel overcharge in Europe of 20.70 percent of the selling price and identifies several determinants

that significantly influence the magnitude of overcharges. It therefore contributes to the understanding of how cartel and market characteristics influence the price setting scheme of cartelists and allows the deduction of at least two important policy implications for the enforcement of antitrust law.

First, since the results suggest that the overcharges and cartel durations significantly differ between regions within Europe, it is reasonable to assume that these deviations are caused by differences in the severity of national antitrust enforcement. It is therefore worth thinking about more standardized national antitrust laws within single European countries in order to prevent geographical markets in which cartels might find safe harbors in terms of comparatively lucrative framework conditions for cartelization. The design and extent of such a standardized national antitrust law should be closely related to European antitrust law enforced by the European Commission in order to facilitate cooperation between national antitrust authorities and the Commission.

Second, estimation results indicate that bid-rigging cartels attain significantly higher overcharges than non bid-rigging cartels. This finding is important in that the European Guidelines on the method of setting fines do not explicitly differentiate between bid-rigging and non bid-rigging cartels. By contrast, the US Guidelines contain such a distinction by providing higher fines for bid-rigging cartels. Importantly, estimation results of Bolotova et al. (2008) for the US market show no significant difference between bid-rigging and non bid-rigging cartels regarding the magnitude of overcharge level, suggesting a positive effect of such a regulation. Thus, an adjustment of the European Guidelines to its US model concerning this point should be taken into consideration and investigated in more detail.

The second part of chapter 2 analyzes whether the current fining policy of the EC with its 2006 Guidelines on antitrust fines is sufficiently deterrent for cartels. In a first step, the specific factors taken into account during the calculation of fines are discussed, followed by a second step in which the actual fining policy of the Commission with these Guidelines in practice is analyzed. The results show that in the vast majority of cases the Commission does not even impose the maximum possible level of base fine but rather grants substantial discounts to it. On the contrary, in those few cases in which the imposed final fines exceed the maximum possible base fines, the increases are extremely low compared to the extensive base fine discounts that were granted. Based on these findings the deterrent

effect of the fining policy of the Commission with the Guidelines is formally analyzed in a third step by comparing the gain from price-fixing attained by cartels in Europe with the maximum expected base fine level according to the Guidelines. The approach reveals that for two out of three cartels from the sample the gains from price-fixing exceed expected punishments. For almost half of the cases the cartel profit is even two times higher than the expected punishment, indicating that those firms are not deterred even if they would assume a duplication of the maximum possible base fine, which has never been imposed by the Commission so far. Hence, effective cartel deterrence seems to be unachievable with the current fining policy of the Commission, asking for additional deterrence tools in order to strengthen the antitrust enforcement process in Europe.

In this context, it is worth mentioning that further upward adjustments of monetary fine levels are probably not the final solution since cartels may react to such changes via overcharge increases in order to make expected profits lucrative again. This would merely shift the problem of cartel deterrence on a higher level. Thus, it is important to think about other solutions as well such as imprisonment, personal liability of managers, bonus payments for whistleblowers or increased private enforcement. The latter aspect might be particularly promising because by facilitating private parties to claim damages, the expected punishment increases, thereby reducing the incentives for firms to join anticompetitive agreements. In addition, increased private enforcement creates an uncertainty concerning the cost-benefit analysis of cartels. Without private enforcement, potential offenders can use the information provided by the EU Guidelines in order to approximate the maximum expected fine level and, thus, to evaluate the success of a potential cartel agreement from an ex-ante perspective. With private enforcement in general and increased private enforcement in particular, however, firms neither know who is going to claim damages in case of cartel detection nor how high the overall fine will be at the end. This uncertainty evoked by private enforcement hampers the possibility for firms to predict the financial outcome of a potential cartel agreement and therefore perfectly complements the public enforcement process via increased cartel deterrence.

Given this policy implication that increased private enforcement may significantly contribute to improved cartel deterrence, chapters 3 and 4 focus on the compensation of

private parties in price-fixing cases by providing and applying econometric estimation methods for the quantification of cartel damages. Each chapter concentrates on one particular private party that might be harmed but has been ignored in the private enforcement discussion so far.

Chapter 3 deals with direct and indirect cartel suppliers. In a first step, the lost profits suffered by suppliers are graphically and formally assessed. The analysis reveals three effects determining the level of damages. A direct quantity effect due to decreased input demand of the cartel firms and two follow-on effects influencing the cost structures and prices charged by the suppliers. Using these information on the determinants of harm, an econometric approach based on residual demand estimation is derived in a second step, which allows the quantification of all three effects. The chapter therefore contributes to the private enforcement literature by equipping cartel suppliers with a toolkit for the quantification of compensation payments, thereby increasing the circle of potentially damaged parties that are in the position to claim damages. Thus, the results contribute to improved private antitrust enforcement in general and lay the cornerstone for private damage claims of cartel suppliers in particular.

Chapter 4 addresses final consumers who are in a special position within the value chain because they cannot pass on the price increase they suffer. Final consumers are therefore particularly in need of protection towards antitrust infringements, however, private antitrust enforcement on pan-European level has kept them out of private damage claims so far. The chapter argues in favor of damage claims of consumer associations and exemplifies how consumer panel data can be used in this context in order to quantify the monetary harm suffered by private households. In particular, established estimation methods commonly used for the quantification of direct purchaser damages are applied to a consumer data set on detergent purchases with the objective to quantify the monetary harm suffered by consumers due to the European detergent cartel. The estimations reveal average cartel overcharges between 6.7 and 6.9 percent and an overall consumer damage of about 13.2 million Euro in Germany over the period from July 2004 until March 2005. Under the assumptions that the pricing behavior of cartelists and buying behavior of consumers during the last nine months of cartelization are representative for the entire cartel period, the overall consumer damage sums up to about 55.7 million Euro. If it is further assumed that

the estimate is relevant for all affected markets, an overall damage of about 315 million Euro is observed. The analysis additionally identifies significant overcharges for non-cartel firm products during the collusive period, suggesting the existence of umbrella effects. The monetary consumer damage due to this umbrella pricing is quantified to 1.7 million Euro during the last nine months of the cartel period and, under specific assumptions, to 7.3 million Euro over the entire cartel period.

The results imply that it is straightforward to quantify final consumer damages and allow the deduction of several important policy implications regarding private antitrust enforcement by consumer associations.

First, on EU level there is no clear authorization for consumer organizations to claim consumer damages so far. The implementation of such a regulation, however, would not only enable consumer associations to actively fulfill their mandate of consumer protection, but would even contribute to increased cartel deterrence. As previously outlined, the fact that any individual or entity can claim damages hampers the possibility for cartels to predict the financial success of a potential cartel agreement ex-ante, thereby increasing uncertainty regarding the cost-benefit analysis and reducing firms' enthusiasm regarding cartel participation.

Second, it is essential for claimants to get access to evidence. Apart from general case information - which in the detergent case is rather scarce - it is particularly important to have the opportunity to gather relevant data that can be used for damage estimations. Whereas consumer panel data are straightforward to obtain from firms who are specialized in collecting scanner data, wholesale prices are usually impossible to get without the help of public authorities. The availability of consumer panel data along with wholesale data, however, would allow for a more in-depth analysis of consumer damages. In particular, one could compare the overcharges on retailer and final consumer layer and thus analyze passing-on effects and the distribution of harm between the different layers more accurately.

Last but not least, since the incentive for single consumers to claim damages is comparatively low due to the small individual loss, it is necessary to provide a practical system that effectively allows to bundle individual claims. It is doubtful whether an opt-in procedure as proposed by the EC is sufficient or whether on an opt-out redress system is the

preferred option.[1] As noted by the European consumer consultative group, recent experience in Europe shows that the rate of consumer participation of the opt-in procedure is extremely low (less than 1 percent) in comparison to an opt-out regime (between 97 and 100 percent).[2] The latter would certainly increase incentives to sue, facilitate consumer organizations to represent consumers interests and significantly contribute to increased private enforcement.

Chapter 5 contributes to the public enforcement literature again and evaluates the relationship of cartel breakdowns and merger activity. Using a combined data set of cartel cases and merger transactions realized in the respective cartel industries, the descriptive analysis detects an increase in merger activity by up to 51 percent when comparing the three years before the cartel breakdowns with the three years afterwards. For the subset of horizontal mergers, merger activity is found to increase even more – by up to 83 percent – after the cartel breakdowns. The results stay largely robust for variations in the geographical scope (worldwide, EEA firm involved, only EEA firms involved). Although several methodological (and data) problems did not allow to test the descriptive results with econometric methods, it can be expected that they provide a strong case for an existing impact of cartel breakdowns on merger activity and allow the deduction of at least two important policy implications regarding the enforcement of antitrust law.

First, the results suggest that competition authorities should consider mergers as a potential 'second-best' alternative to cartels, i.e., they should take the prior collusion history of the industry into account during the merger control procedure in order to avoid a simple replacement of the type of market power. It is therefore necessary to extend the antitrust enforcement process by keeping former cartel members and cartel industries on the radar screen even after the end of litigation. Otherwise, increased merger activity might result in the same or, at least in a similar, anticompetitive market outcome as during the collusive period.

Second, the finding that cartel breakdowns are followed by an increased merger activity

[1] In simple terms, whereas in an opt-in redress system each consumer explicitly has to agree to the damage claim, in an opt-out system all individuals harmed by the infringement are automatically involved in the damage claim, except they explicitly declare their refusal.

[2] See European consumer consultative group (2010), section 2.3.

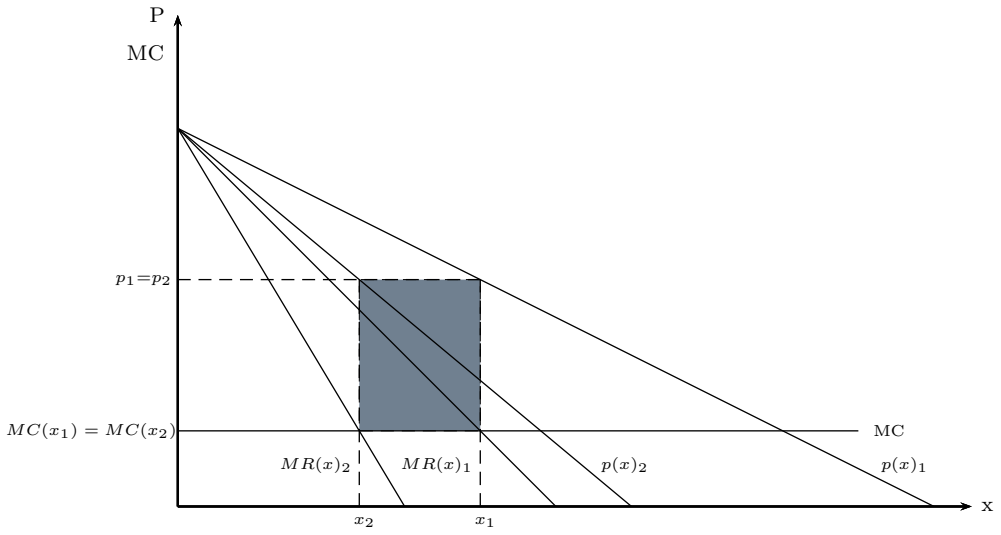
also implies that resource (re)allocations in competition authorities, law practices and economic consultancies may become necessary to handle the respective increase in the workload. In addition, the before mentioned interplay between cartel prosecution and merger control makes it necessary to create new resources for the screening of future changes in the market structure of former cartel industries.

Last but not least, the study points towards two interesting future research areas. On the one hand, the observed merger activities suggest additional research on ex-post merger assessments that explicitly take a prior collusion history into account. Such studies would allow detailed answers to the question whether approved mergers in the respective industries should in fact had been prohibited or – more generally – whether merger control in such cartel-affected industries should become tougher in order to increase the probability that competition has a fair chance to grow.

On the other hand, although merger activity after cartel breakdowns can be motivated by anticompetitive purposes, it is reasonable to assume that a substantial fraction of these transactions rather follow efficiency motivations; e.g., post-cartel mergers might play an important role in facilitating the transition from old and inefficient cartel industry structures to more efficient competitive market structures. As a consequence, a fruitful area of future research is detailed case studies on such transition processes in general and the role of mergers in particular. Such investigations are especially likely to provide answers to one key question the study had to leave open: the true motivations underlying the identified substantial increase in merger activity after cartel breakdowns.

A. Attachments for Chapter 3

Figure A.1.: Damage suffered by a direct cartel supplier (monopolist) producing with constant marginal costs



In this appendix the situation illustrated in Figures 3.3 and 3.4 is applied to a numerical example. The indirect cartel supplier (monopolist) on the top layer produces with cost function $C(x) = F + x^2 + \lambda x$, where F denotes fixed costs and $\lambda > 0$. He sells one unit of output at price q to the direct cartel supplier, who acts as monopolist on the second layer. This second layer monopolist needs one input unit in order to produce one unit of his own output. It is abstracted from additional costs, indicating that the marginal costs for him coincide with the output price q of his supplier. The second layer monopolist sells his product at price p to several firms on the third stage, who are in competition with each other in the initial situation and going to collude later on. The linear inverse demand function representing the demand situation on the third layer is given by

$$p(x) = \alpha - \gamma x,\ \alpha > q\,. \tag{A.1}$$

The objective is to receive the lost profits suffered by the direct and indirect cartel suppliers after cartel formation between the firms on the third layer. Thus, the profits of both suppliers before and after collusion must be compared. Using backwards induction the profit maximization problem of the second layer (downstream) monopolist in the competitive situation is given as follows:

$$max\, \pi^D = (\alpha - \gamma x - q)x$$

Solving the first order condition for x yields

$$x = \frac{\alpha - q}{2\gamma}\,. \tag{A.2}$$

This is the optimum quantity offered by the direct cartel supplier under the competitive regime in the downstream market. Substituting (A.2) into (A.1) yields the optimal output price for the direct supplier:

$$p = \frac{\alpha + q}{2}\,. \tag{A.3}$$

Note that both downstream price p and quantity x depend on the input price q charged by the upstream monopolist. Thus, the upstream price q influences the quantity sold by the downstream monopolist and this quantity coevally coincides with the amount sold by the upstream monopolist to the downstream monopolist. Due to this interdependency, solving (A.2) for q results in the inverse demand function the upstream monopolist is confronted with:

$$q(x) = \alpha - 2\gamma x\,. \tag{A.4}$$

As illustrated in Figures 3.3 and 3.4, this function is identical to the marginal rent function and has twice the slope of the inverse demand function the downstream monopolist faces. Turning to the first stage, the indirect cartel suppliers maximizes

$$\pi^U = (\alpha - 2\gamma x - 2x - \lambda)x\,.$$

Solving the first order condition for x yields the optimal quantity offered by the upstream monopolist:

$$x = \frac{\alpha - \lambda}{4(\gamma + 1)}\,. \tag{A.5}$$

Setting (A.5) into equation (A.2) gives the output price charged by the upstream firm:

$$q = \frac{\alpha(\gamma + 2) + \gamma\lambda}{2(\gamma + 1)}\,. \tag{A.6}$$

Before looking at the changes of these values due to collusion, the prices, quantity and profits of both firms for specific values of F , λ, α and γ can be calculated. Therefore, assume $F = 5$, $\lambda = 2$, $\alpha = 10$ and $\gamma = 3$. Given these values, equilibrium quantity and price for the upstream monopolist at the top layer amount to

$$x = 0.5 \text{ and } q = 7\,.$$

The upstream monopolist sells 0.5 units of output at unit price 7 to the downstream monopolist. The latter takes the input price of 7 as given, so that his equilibrium values result in

$$x = 0.5 \text{ and } p = 8.5\,.$$

The downstream monopolist uses his 0.5 input units in order to produce 0.5 units of output and sells them at unit price 8.5 to the firms at the third layer. The profit of the downstream monopolist amounts to

$$\pi^D = (p - q)x = (8.5 - 7)0.5 = 0.75,$$

and the profit of the upstream monopolist to

$$\pi^U = (q - 2x - \lambda)x = [7 - (2 \times 0.5) - 2]0.5 = 2.$$

Given these equilibrium values, the impact of collusion at the third layer on the profits of direct and indirect cartel suppliers can be analyzed. As illustrated in Figures 3.3 and 3.4, the cartel agreement leads to an inward turn of the inverse linear demand function. It is therefore adjusted from

$$p(x) = \alpha - \gamma x$$

to

$$p(x) = \alpha - \mu x,\ \mu > \gamma, \tag{A.7}$$

where assumption $\mu > \gamma$ ensures the decrease in demand.

To receive equilibrium values for x, q and p under collusion, γ must be replaced by μ in the formulas derived above. If $\mu = 5 > 3 = \gamma$ is assumed in the numerical example, the equilibrium values for the indirect cartel supplier amount to

$$\widetilde{x} = 0.33 \text{ and } \widetilde{q} = 6.67\,,$$

and the corresponding values for the direct cartel supplier result in

$$\widetilde{x} = 0.33 \text{ and } \widetilde{p} = 8.34\,.$$

In comparison to the competitive situation between the firms on the third stage, output prices and quantity decrease for both suppliers. The new profits under the cartel regime are

$$\widetilde{\pi}^D = (\widetilde{p} - \widetilde{q})\widetilde{x} = (8.34 - 6.67)0.33 = 0.5511$$

for the direct supplier and

$$\widetilde{\pi}^U = (\widetilde{q} - 2\widetilde{x} - \lambda)\widetilde{x} = [6.67 - (2 \times 0.33) - 2]0.33 = 1.3233$$

for the indirect cartel supplier. The lost profits due to collusion therefore amount to

$$\Delta\pi^U = \pi^U - \widetilde{\pi}^U = 2 - 1.3233 = 0.6767$$

and

$$\Delta\pi^D = \pi^D - \widetilde{\pi}^D = 0.75 - 0.5511 = 0.1989\,.$$

Table A.1 decomposes the lost profits of both firms in the three effects (quantity effect, price effect and cost effect) described in chapter 3.2.2.

Table A.1.: Decomposition of damages

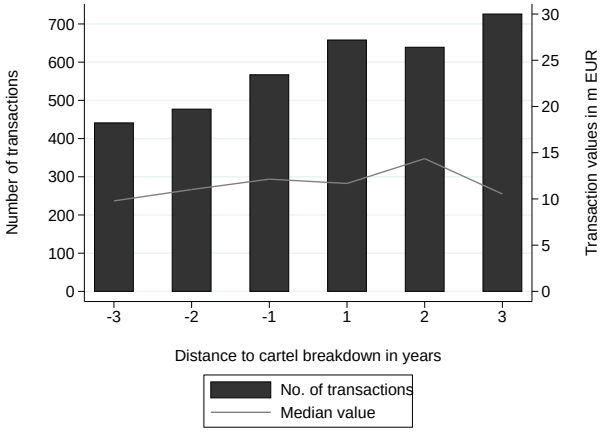
	Direct supplier	Indirect supplier
Profit under competition	$\pi^D = 0.75$	$\pi^U = 2$
Profit under cartelization	$\widetilde{\pi}^D = 0.5511$	$\widetilde{\pi}^{DU} = 1.3233$
Lost profits	$\Delta\pi^D = 0.1989$	$\Delta\pi^U = 0.6767$
Quantity effect	$(x - \widetilde{x})(p - q) = 0.255$	$(x - \widetilde{x})(q - 2x - \lambda) = 0.68$
+ Price effect	$(p - \widetilde{p})\widetilde{x} = 0.0528$	$(q - \widetilde{q})\widetilde{x} = 0.1089$
- Cost effect	$(q - \widetilde{q})\widetilde{x} = 0.1089$	$[(q - 2x - \lambda) - (\widetilde{q} - 2\widetilde{x} - \lambda)]\widetilde{x} = 0.1122$

B. Attachments for Chapter 5

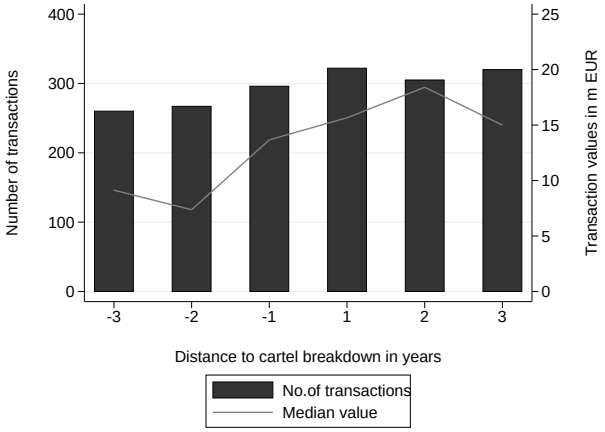
Table B.1.: Industries included in the empirical analysis

Industry	NACE Code
Manufacture of beer	1105
Manufacture of soap and detergents, cleaning and polishing preparations	2041
Manufacture of other chemical products nec	2059
Manufacture of plastic plates, sheets, tubes and profiles	2221
Manufacture of plastic packing goods	2222
Manufacture of other plastic products	2229
Manufacture of flat glass	2311
Other non-ferrous metal production	2445
Manufacture of doors and windows of metal	2512
Manufacture of electric motors, generators and transformers	2711
Manufacture of electricity distribution and control apparatus	2712
Manufacture of other pumps and compressors	2813
Manufacture of other taps and valves	2814
Manufacture of lifting and handling equipment	2822
Manufacture of other parts and accessories for motor vehicles	2932
Distribution of gaseous fuels through mains	3522
Other construction installation	4329
Wholesale of meat and meat products	4632
Wholesale of beverages	4634
Other transportation support activities	5229
Manufacture of pharmaceutical preparations	212/2120
Manufacture of basic iron and steel and of ferro-alloys	241/2410
Manufacture of computers and peripheral equipment	262/2620
Manufacture of consumer electronics	264/2640

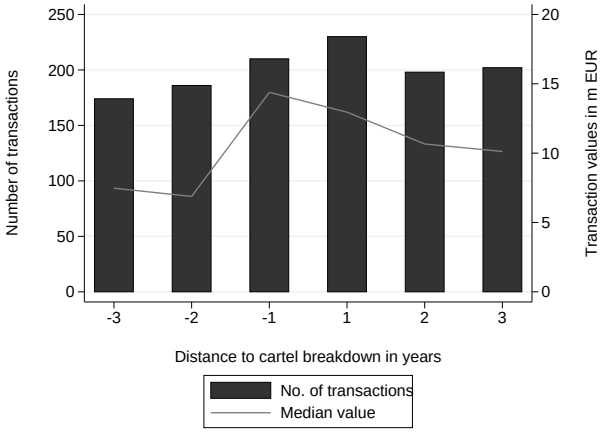
Figure B.1.: Number of mergers and median values three years before/after cartel breakdowns (non-horizontal mergers only)



(a) Geographic scope: worldwide



(b) Geographic scope: at least one merging firm stems from EEA



(c) Geographic scope: both merging firms stem from EEA

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