Fighting Hard Core Cartels

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Non-technical summary

The paper provides a comprehensive survey of the economics behind the fight against hard core cartels. Following an introductory section, Section 2 focuses on the characterisation and rationalisation of the term 'hard core cartel'. It is found that – given the various forms of agreements between competitors – such a delineation is anything but straightforward. Subsequently, Section 3 concentrates on an assessment of the welfare effects of conduct defined as hard core cartel. A particular focus there lies on the possibilities to stabilize hard core cartels and the implied question of how severe the negative welfare effects of hard core cartels can be expected to be. Based on the key finding that hard core cartels can cause significant and long-lasting harm to customers and consumers, Section 4 focuses on the complementary question of how a cartel ban should be enforced by a competition authority, affected private parties and the respective court system. With respect to public enforcement, a focal point of interest lies in the assessment of both ex ante tools to reduce the incentives to form cartels and ex post tools to detect and intervene against existing cartels. By contrast, the economic assessment of private enforcement concentrates on the identification and quantification of the damages caused by hard core cartels. Finally, as the long term success of competition policy actions against hard core cartels depends on a continuous improvement and fine-tuning of policy tools, Section 5 discusses options to evaluate the effectiveness of enforcement actions against hard core cartels. Although it is not the focus of the paper to provide a detailed comparison of the proposed cartel enforcement framework with the current enforcement approaches followed in the European Union and the United States, the analysis reveals that some instruments discussed in the framework are currently not implemented to an economically optimal degree.

Das Wichtigste in Kürze

Der Beitrag entwickelt einen umfassenden Überblick über die grundlegenden ökonomischen Zusammenhänge in der Verfolgung von Hard Core-Kartellabsprachen. Im Anschluss an ein Einführungskapitel konzentriert sich das zweite Kapitel auf die Charakterisierung und Abgrenzung des Begriffs ‚Hard Core Kartell'. Es wird gezeigt, dass eine solche Abgrenzung aufgrund der Vielzahl an möglichen Kooperationsformen zwischen Unternehmen alles andere als einfach ist. Im nachfolgenden dritten Kapitel werden dann die Wohlfahrtswirkungen von Hard Core Kartellen genauer untersucht. Ein Schwerpunkt liegt dabei in der Betrachtung der Stabilität von Kartellen sowie der damit zusammenhängenden Frage, wie schwerwiegend die Wohlfahrtsverluste durch Hard Core Kartelle ausfallen. Basierend auf der Feststellung, dass Hard Core Kartelle signifikante und vor allem persistente Schäden für Kunden und Konsumenten verursachen, geht das vierte Kapitel der komplementären Frage nach, wie ein entsprechendes Kartellverbot von der Wettbewerbsbehörde, betroffenen privaten Parteien sowie Gerichten überwacht und vollzogen werden sollte. Im Bezug auf die öffentlich-rechtliche Durchsetzung eines Kartellverbots liegen Interessenschwerpunkte in der Analyse von sowohl ex ante Instrumenten zur Reduzierung der Anreize zur Kartellbildung als auch ex post Instrumenten zur Aufdeckung und Ahndung von Hard Core Kartellen. Im Hinblick auf die privatrechtliche Durchsetzung eines Kartellverbots konzentriert sich der Beitrag insbesondere auf die Fragen der Identifikation und Bemessung der entstandenen Schäden. Da der dauerhafte Erfolg von Wettbewerbspolitik auch von der kontinuierlichen Verbesserung der angewandten Instrumente abhängt, werden im fünften Kapitel Möglichkeiten einer Evaluation der Effektivität der jeweiligen Anti-Kartellpolitik vorgestellt und diskutiert. Obwohl konkrete Politikempfehlungen nicht im Vordergrund des Beitrags stehen, offenbart ein abschließender Vergleich des im Rahmen dieses Beitrags entwickelten Schemas mit der praktischen Wettbewerbspolitik in den Vereinigten Staaten von Amerika sowie der Europäischen Union, dass einige Instrumente derzeit entweder gar nicht oder nur zu einem suboptimalen Grad implementiert sind.

FIGHTING HARD CORE CARTELS

Kai Hüschelrath* and Jürgen Weigand#

Abstract

The paper provides a comprehensive survey of the economics behind the fight against hard core cartels. Differentiating between four subsequent stages – characterisation, welfare effects, enforcement and evaluation – the paper pays particular attention to cartel detection methods, the derivation of corporate fines, the quantification of private damages and possibilities to judge on the successfulness of cartel enforcement activities by competition authorities around the world.

Keywords
Competition Policy, Hard Core Cartels, Public Enforcement, Private Enforcement, Evaluation

JEL Classification
L41, K21

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1. Introduction

There is no question that the fight against hard core cartels is ranked high on the agenda of competition authorities these days. For example, the former European Commissioner responsible for competition policy, Neelie Kroes, frequently stated that one key aim of her work was not only to "… merely destabilise cartels. I want to tear the ground from under them".[1] The first cartel action taken by her recent successor, Joaquín Almunia, left no doubt that "[t]he Commission will continue its relentless fight against cartels".[2]

The already substantial and still increasing efforts of the European Commission ('Commission') to fight hard core cartels are reflected in the enforcement record. While the Commission only decided 10 cartel cases in the 1995-1999 period, the number increased to 30 in the period from 2000-2004 and to 33 in the 2005-2009 period. The increase in decided cases is accompanied by a strong increase in the overall fines imposed. While the 1995-1999 period saw fines (not adjusted for Court judgments) of in sum about 292 million Euros, the amount increased to about 3,462 million Euros in the period from 2000-2004 and to 9,761 million Euros in the 2005-2009 period.[3] Although the fines sizes are certainly influenced by various parameters – such as changes in the way to calculate fines or increases in cartel size – there is no significant doubt among commentators that the recent EU cartel policy has been a key explanatory variable of the identified increase in the number of detected cartels.

Given the well-documented successes in the fight against cartels, this paper aims to go back one step by providing a comprehensive survey of the economics and economic justifications behind the fight against hard core cartels. Such an endeavour promises to create value as it allows comparisons of such a framework with the actual implementation of cartel enforcement in jurisdictions such as the European Union – and therefore facilitates the identification of improvement potential of the various tools used by competition authorities in their everyday fight against hard core cartels. Additionally, such a structured thinking on the economics of cartel enforcement can help in the identification of further academic research needs in both law and economics.

The paper is structured into six sections. Following this introductory section, Section 2 focuses on the characterisation and rationalisation of the term 'hard core cartel'. Given the various forms of agreements between competitors such a delineation turns out to be anything but straightforward. Subsequently, Section 3 concentrates on an assessment of the welfare effects of conduct defined as hard core cartel. A particular focus here lies on the stability of hard core cartels and the implied question of how severe the negative welfare effects of hard core cartels can be expected to be. Based on the key finding that hard core cartels can cause significant and long-lasting harm to customers and consumers, Section 4 focuses on the complementary question of how a cartel ban should be enforced by a competition authority,

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[1] Kroes (2009), Tackling Cartels – A Never-Ending Task, European Commission SPEECH/09/454, 8 October 2009, Brussels.

[2] Almunia (2010), First Cartel Decision under Settlement Procedure – Introductory Remarks, European Commission SPEECH/10/247, 19 May 2010, Brussels.

[3] Data source: European Commission (2010), Cartel Statistics (situation as of 19 May 2010), available at http://ec.europa.eu/competition/cartels/statistics/statistics.pdf

affected private parties and the respective court system. With respect to public enforcement, a focal point of interest lies in the assessment of both ex ante tools to reduce the incentives to form cartels and ex post tools to detect and intervene against existing cartels. By contrast, the economic assessment of private enforcement will concentrate on the identification and quantification of the damages caused by hard core cartels. Finally, as the long term success of competition policy actions against hard core cartels depends on a continuous improvement and fine-tuning of policy tools, Section 5 discusses options to evaluate the effectiveness of enforcement actions against hard core cartels. Section 6 concludes the paper by summing up the key insights and providing a high-level comparison of the derived framework with actual anti-cartel policies in the European Union and the United States.

2. Characterisation

An economic investigation of the fight against hard core cartels demands a clear definition of the target as the starting point. In addition to a general characterisation of the term 'hard core cartel' a complementary understanding of the business motivations of firms behind their engagement in such conspiracies must be developed.

As part of an initial characterisation of the term 'hard core cartel', it is helpful to compare several definitions of *cartel* provided by leading industrial organisation textbooks:

Definition 1: "An association of firms that explicitly agrees to coordinate its activities is called a cartel." (Carlton and Perloff, 2000:121)

Definition 2: "Cartels are associations of independent firms in the same industry that are formed to increase their joint profits by restricting their competitive activities." (Lipczynski and Wilson, 2001: 59)

Definition 3: "A cartel is a group of firms who have agreed explicitly among themselves to coordinate their activities in order to raise market price – that is, they have entered into some form of price-fixing agreement." (Pepall et al., 1999: 345)

A comparison of the three definitions shows significant differences, but also some important similarities. The first definition surely is the broadest of the three, as it delineates *cartel* as every kind of explicit coordination of activities by an association of firms. For antitrust purposes, this definition is likely too broad and unspecific, as it would, in principle, also consider the foundation of a joint football club by several competing firms as a cartel. However, the mentioned explicitness of a cartel agreement – typically met by the existence of some form of written or verbal contract – separates cartels from various forms of so-called tacit collusion which are not analysed further (see Ivaldi et al., 2003; Kovacic, 2006: 817ff.; and Phlips, 1995: 79ff. for overviews).

The second definition is closely related to the first one, but it concretises the basic motivation of cartels (i.e., increasing joint profits) and also specifies the modus operandi (restricting *competitive* activities). Both criteria help to rule out the foundation of a joint football club as a cartel and therefore can be considered as a step forward in the search for an appropriate definition of *cartel* for antitrust purposes. However, also the second definition still falls short of a necessary substantiation of what is considered *competitive activity*. Firms can agree on many competitive activities, such as prices, quantities, customers, territories, marketing plans,

procurement of input goods, R&D investments, general business terms and conditions, rebates, standardisation plans and so on; however, it is rather unlikely that a cartelisation of either of these competitive activities should be of equal concern for competition policy (see Neven et al., 1998, for a comprehensive overview of European competition policy and agreements between firms).[4]

The third definition is relatively precise in this respect, as it characterises a cartel as an explicit agreement between firms *aiming to raise the market price*. As raising and maintaining the market price surely is of relevance for antitrust policy, the third definition can act as an appropriate working definition of *cartel*. However, what still needs to be done is identifying explicit agreements that have the potential to increase market price. The OECD refers to such cartels as *hard core cartels*, and, following Crampton (2003: 5), subsume the following agreements under this term: price fixing, bid-rigging (collusive tenders), output restrictions and quotas, allocation of customers, suppliers, territories and lines of commerce.[5] Only these hard core cartels will be assessed in the following.

From a business perspective, firms have an incentive to form hard core cartels because coordinating the respective competitive activities leads to greater profits than acting independently. The basic rationale for this allegation lies in the internalisation of a negative externality. In a competitive market, a firm is simply interested in how much a reduction in its own output benefits itself, while it ignores the (positive) effect that a reduction in output has on the profits of the other firms in the market (via the reduction in total market output and the corresponding increase in price). A cartel internalises this effect by taking into account how changes in the output level of each firm affect joint cartel profits (see Carlton and Perloff, 2000: 122ff. for a detailed treatment). As a consequence, it pays for the cartel to reduce total output below the competitive level and thereby increases joint profits.

Although economic research has identified numerous cases in which cartels have aimed at raising joint profits by exploiting customers (see, for instance, the *lysine cartel* case study by Connor, 2001), empirical studies do not generally support this presumption. In particular, a seminal empirical paper by Asch and Seneca (1976) investigates whether the profit rates of

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4 To give a practical example, the German Act against Restraints of Competition (ARC), codifies in §2 that "[a]greements between undertakings, decisions by associations of undertakings or concerted practices, which, while allowing consumers a fair share of the resulting benefit, contribute to improving the production or distribution of goods or to promoting technical or economic progress, and which do not 1) impose on the undertakings concerned restrictions which are not indispensable to the attainment of these objectives, or 2) afford such undertakings the possibility of eliminating competition with respect to a substantial part of the products in question shall be exempted from the prohibition of § 1." §1 basically prohibits "[a]greements between undertakings, decisions by associations of undertakings and concerted practices, which have as their object or effect the prevention, restriction or distortion of competition." In §3, the ARC explicitly allows cartels of small or medium-sized enterprises under certain conditions. Furthermore, in older versions of the ARC, §3 to §7 specified further types of cartels which were generally allowed or may be allowed by the competition authority. Cartel types especially mentioned were cartels which aimed at agreeing on general terms and conditions, rebates, rationalisation efforts and export or import (see Schmidt, 1996: 172ff. for an overview).

5 The choice between these different ways of forming a cartel largely depends on the circumstances in the market. While in fairly simple markets with standardised products agreements might focus on price, more complex markets make it often necessary to apply other forms of agreement, such as the delineation of exclusive territories or customer groups (see Hay, 1993: 7).

colluding firms differ from those of non-colluding firms and whether the incidence of collusion can itself be explained on the basis of the structure and performance patterns of affected firms and markets. The results of Asch and Seneca (1976) show that colluding firms are consistently less profitable than non-colluding firms and that important structural differences exist between the two groups. Somehow puzzled by especially the first result, Asch and Seneca (1976) nevertheless doubt that collusion really consistently leads to lower profitability and explain their results by the possibility that antitrust prosecution centers largely on the unsuccessful manifestations and leaves the truly successful cartels undetected (see also Shughart and Tollison, 1998: 367ff.).

Another explanation discussed by Asch and Seneca (1976) is the possibility that unsatisfactory performance may motivate firms to collude (under conditions which are not favourable to create stable cartel agreements). Historically, such an argument has been based on the hypothesis that cartels might be 'knights in shining armour', meaning that cartels are formed in difficult economic times within an industry (or a whole economy) characterised by unsatisfactory performance as well as high risk and uncertainty, which is mirrored in cut-throat competition and price warfare. Following Lipczynski and Wilson (2001: 50ff.), "[c]ollusion is seen as a way of easing the pressures of competition by unified action rather than just a strategy to maximise joint profits … evidence shows that firms enter cartel-type agreements to protect themselves rather than because of a desire to exploit the market. Agreements tend … to keep out or keep under control potential entrants and new products that could threaten the stability of existing firms."

From a historical perspective, Neumann (2000: 28 ff.) argues that fundamental changes in production technology in the second half of the nineteenth century led – partly via the corresponding changes in the cost structures of firms – to large cooperations which, because of the typically high share of fixed costs, were especially vulnerable in economic downturns. Following Bittlingmayer (1992), especially the combination of high fixed costs facing volatile demand indeed may have caused periods in which the market price dropped below average costs. From that perspective, cartels at that time could be seen as an instrument to fight these price drops and therefore might have been in the public interest (see Neumann, 2000: 28ff., and Richardson, 1965, for more detailed assessments).

Although some of these arguments have had played important roles in the toleration of cartels in several European countries in the nineteenth and the early twentieth centuries (see Resch, 2005, for an historical overview), contemporary economic research tends not to support the view that cartels nowadays are merely firm reactions to 'tough times'. Apart from general objections against such arguments – which could, for instance, remind of the fact that the pressures of competition play an indispensable role in every market economy (and are typically in the interest of society) – a theoretical assessment by Haltiwanger and Harrington (1991) and empirical studies by Dick (1996) and Bagwell and Staiger (1997) imply that cartels are in danger of breaking apart in recessions (see Neumann, 2000: 31f.). Such findings are somewhat contradictory to the knight-in-shining-armour motivation to form cartels mentioned above. Additionally, a recent empirical study by Günster, Carree and van Dijk (2010) – based on firm-specific financial data for a sample of 143 firms involved in 50 European cartel infringements between 1983 and 2004 – find support for the 'increased

profitability' hypothesis (reflected in a significant increase in return on equity in the cartel period).

In addition to the 'profit-maximisation' and 'tough times' arguments, which have been the focus of academic research on the motivation to form cartels, an alternative way to assess this question is to look at the justifications brought forward by detected cartels themselves. Although it is fairly obvious that these arguments do not necessarily have to reflect the true motivations for cartel formation – but might in fact have been developed ex post as part of a defense strategy in court - they nevertheless have to make use of logically sound lines of economic reasoning. In a detailed assessment of these justifications for cartels, the World Bank (1999: 24ff.) identifies four frequently applied arguments: the industry cannot function with competition; the industry competes on service and quality; safety and quality will decline without the cartel; and the cartel is necessary to stop unfair and unethical competition. These arguments all have in common that they are built on the belief that competition is not working in the industry (from the perspective of the cartel firms), and therefore that a concerted action by the industry – which might lead to elevated prices but which also produces benefits for the consumers (by maintaining a high level of service and quality as well as safety) – is justified. Without wanting to enter into a detailed economic assessment of these 'excuses' for cartel formation (see World Bank, 1999: 24f.), one simple but disarming counterargument would be that it is not the industry that has to decide whether competition is unworkable. Economic research and practical experiences in the majority of cases show that competition is typically socially desirable and it is up to the respective state bodies to decide whether some form of regulatory intervention is necessary, for example, to secure a high level of safety or to water down the consequences of unethical competition.

3. Welfare effects

Given the assessment of the business motivations for hard core cartels in the preceding section, an assessment of the welfare effects appears to be s straightforward exercise: A perfectly functioning hard core cartel (involving all firms in the market and referring to substitutive products) is expected to lead to the same market outcome as a monopoly and therefore causes similar types and degrees of allocative, productive and dynamic inefficiencies. Additionally, hard core cartels usually[6] do not create any kind of benefits to society which could be traded-off against the anticompetitive effects from an antitrust perspective.[7] As a consequence, contemporary hard core cartels are a prime example for a per

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[6] One argument against the allegation could be that cartels have an incentive to shift production to the firm with the lowest production costs and probably to close inefficient plants (see Whinston, 2006: 25). Although correct from a theoretical perspective, there appears to be no significant evidence that such a practice is actually exercised within real hard core cartels. On the contrary, quota systems applied by cartels often hinder more efficient producers to expand their production, and a cartel is therefore likely to cause productive inefficiencies. As a consequence, dynamic inefficiencies would likely arise given the interfered process of replacing old technologies by new technologies. In close connection to Whinston's argument, Bos and Pot (2010) derive conditions under which hard core cartel formation can be welfare-enhancing. The conditions are loss making of part of the sales of at least one firm in competition and differences in unit costs at competitive production levels.

[7] This is an essential difference between hard core cartels and joint ventures. Although both types of agreement can be interpreted as cartels following the broad definition of Carlton and Perloff (Definition 1 above), joint ventures typically bring benefits to society, for example in the form of developing superior products (at lower

se prohibition irrespective of the particular characteristics of the industry, product or type of agreement.

Despite this clear statement with respect to the welfare effects of hard core cartels, a simple game-theoretic reasoning suggests that antitrust bans (and antitrust enforcement) against such cartels may be unnecessary, because firms will typically fail to stabilise cartel agreements and, hence, the negative welfare consequences predicted above would not materialise. The basic argumentation is exemplified in Table 1 for a simple duopoly model (see the Appendix for the derivation).

Table 1. Payoffs to cartelisation and competition in a duopoly game

		Strategy of firm 2	
		Cartelisation	**Competition**
Strategy of firm 1	**Cartelisation**	$\dfrac{(a-c)^2}{8b}, \dfrac{(a-c)^2}{8b}$	$\dfrac{3(a-c)^2}{32b}, \dfrac{9(a-c)^2}{64b}$
	Competition	$\dfrac{9(a-c)^2}{64b}, \dfrac{3(a-c)^2}{32b}$	$\dfrac{(a-c)^2}{9b}, \dfrac{(a-c)^2}{9b}$

Table 1 shows the payoffs (i.e., profits) to cartelisation and competition in a simple duopoly game. A comparison of the respective payoffs in the four possible states reveals that competition is the dominant strategy for both firms. Although both firms realise that they would achieve a higher profit in the cartelisation state, they also realise that the rival firm has a substantial profit incentive to cheat on such a collusive agreement. As both firms anticipate this possibility (as well as the negative consequences for their own profit), it is the dominant strategy for both firms not to cooperate. The subsequent policy conclusion would be that, although cartel agreements in theory harm social welfare, it is not necessary to consider antitrust bans or even antitrust actions against them, as firms typically fail to stabilise such agreements anyway.

The diagnosed chronic instability of cartels in one-shot games is basically caused by a lack of trust between the two companies. Although it is admittedly hard to establish trust in one-shot games, it is also hard to believe that one-shot games are a suitable description of real markets. Typically, firms meet regularly in markets (or even in a couple of markets) and this repeated interaction creates possibilities to stabilise cartel agreements.

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cost) by pooling research and development efforts. Furthermore, because joint ventures are often founded in the research and development phase of a product, there is not yet a product market in which the joint venture could increase market price; hence there is no immediate harm as diagnosed in case of hard core cartels. If, however, joint ventures are planned in already existing product markets, for example, by founding some kind of marketing joint venture, then hard core cartels and joint ventures become similar, and consequently also joint ventures might raise similar competitive concerns (see Schulz, 2003: 137ff.; Werden, 1998).

Although it cannot be the aim of this section to give a comprehensive overview of possible strategies to stabilise cartels (see, e.g., Schulz, 2003, and Feuerstein, 2005, for surveys), it is straightforward to characterise the consequences of repeated interaction generally (with an indefinite time horizon or unknown end of the market). Imagine that the duopoly game characterised above is played infinitely. It is then possible to show that the incentive to cheat depends on the discount factor δ (see the Appendix for the derivation):

$$\delta \geq \frac{\pi^{Defect} - \pi^{Cooperation}}{\pi^{Defect} - \pi^{Non-Cooperation}} \ . \tag{1}$$

For example, inserting the payoffs of the simple duopoly model above leads to a critical discount factor of about 0.53 which must be met to stabilise the cartel agreement.[8] In other words, as long as the discount factor is sufficiently high (i.e., the firms are sufficiently patient and value future profits to a sufficient extent), deviation does not pay for either firm and the agreement is therefore stable. Furthermore, repeated interaction gives cartel members the opportunity to implement effective punishment strategies for cheaters which also reduce the incentives to deviate and therefore stabilise the cartel.

An additional theoretical argument why cartels could be doomed to fail refers to the harmed customers of the cartel members and basically asks why this group does not react to the formation of a cartel with the formation of a coalition which aims at prompting the cartel members to end their agreement. Although the customers typically have incentives to form such a coalition, the existence of transaction costs often forecloses its actual formation. Especially the often huge number of customers of a cartel – with diverging interests and substantial free-rider problems – speaks against the practicability of such proposals as an effective deterrent against cartelisation (see von Weizsäcker, 1995: 2736f.) and for the use of the transaction-cost advantages of (antitrust) interventions by the state.

In addition to theoretical research, empirical studies have shown that firms can indeed manage to form and to stabilise cartels for relatively long periods. In this respect, Table 2 provides case study evidence of several successful cartels across different industries.

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[8] Although the supergame analysis assumes an indefinite time horizon, it is possible to show that uncertainty about the duration of the market leads to the same results. If the future of the market is uncertain, the discount factor is relatively low leading to fewer cartels. In mature markets with a clearly defined future potential, the discount factor is relatively high leading to more cartels.

Table 2. Cartel duration – Selected case studies

Industry	First year of cartel	Average length of cooperation in industry (in years)	Number of distinct episodes of cooperation	Maximum length of cooperation (in years)	Minimum length of cooperation (in years)
Beer	1933	9	1	9	9
Bromine	1885	6.5	4	10	3
Cement	1922	40	1	40	40
Diamonds	1870s	60	2	100	20
Electrical Equip.	1950	8	1	8	8
Mercury	1928	25	2	28	22
Ocean shipping	1870s	51	3	54	50
Oil	1871	2	3	3	1
Parcel Post	1851	28.5	2	40	17
Potash	1877	9.4	8	20	1
Railroad	1875	3.8	6	8	1
Railroad Oil	1871	7	5	30	0
Rayon	1932	8	1	8	8
Steel	1926	7.25	4	13	4
Sugar	1887	6.75	4	10	2
Tea	1929	3.5	2	6	1

Source: Levenstein and Suslow (2004: 61).

As shown in Table 2, cartels can not only be successful in maintaining their agreements over long time periods but often also manage to overcome cartel crises, such as market entry of new firms or the emergence of dispute among existing cartel members (see Levenstein and Suslow, 2004, for a comprehensive overview). With respect to the determinants of cartel duration, research by Levenstein and Suslow (2006) shows that organisational practices contribute significantly to cartel stability. For example, cartels that implemented some kind of market allocation mechanism were significantly less likely to break up than those that did not. However, financial distress of member firms and macroeconomic shocks had a negative impact on cartel duration.

Complementary to inter-industry studies just sketched, the new empirical industrial organization literature focuses on the detailed study of the inner workings of specific cartels and investigates how they operate, how effective they are in sustaining collusion and how large the generated welfare losses actually are. Examples of such studies – not analysed in greater detail here – are Porter (1983), Ellison (1994), Porter and Zona (1999), Genesove and Mullin (2001), Röller and Steen (2006), Asker (2009) and most recently Hyytinen, Steen and Toivanen (2010).

Although cartels typically fail to reach the outcomes of a hypothetical single monopolist – given the existence of cartel outsiders or remaining forms of non-price competition – they often manage to raise prices significantly above competitive levels. Audretsch (1989), for instance, found significantly elevated market prices for a sample of cartels in Western Germany. Connor and Lande (2006) collected average overcharges of six economic surveys consisting of more than 100 cartels (in sum) which are presented in Table 3.

Table 3. Summary of six economic surveys on cartel overcharges

Reference	Number of cartels	Average overcharge	
		Mean (%)	Median (%)
Cohen and Scheffman (1989)	5-7	7.7-10.8	7.8-14.0
Werden (2003)	13	21.0	18.0
Posner (2001)	12	49.0	38.0
Levenstein and Suslow (2004)	22	43.0	44.5
Griffin (1989)	38	46.0	44.0
OECD (2002)	12	15.8	12.75
Total (simple average)	*102-104*	*30.7*	*28.1*
Total (weighted average)	*102-104*	*36.7*	*34.6*

Source: Connor and Lande (2006: 1004).

As shown in Table 3, the average cartel overcharges differ considerably among the different empirical studies. Levenstein and Suslow (2004), for instance, calculate an average overcharge (mean) of 43%, while Werden (2003) finds 21% and the OECD (2002) 15.75% for the average overcharge (mean). The total average of all studies shows a mean of 30.7%. With respect to the factors influencing the magnitude of cartel overcharges, recent research by Bolotova, Connor and Miller (2007) finds that overcharges differ between industries and countries, longer cartel episodes generate higher overcharges and that international cartels attain higher overcharges than domestic cartels. Interestingly, the authors additionally find that the overcharges imposed recently are of the same magnitude as those imposed a few decades earlier. This finding suggests that the cartels are very efficient in enforcing cartel discipline, given the increasing efforts by competition authorities to detect and punish cartels.

In a nutshell, although customer losses (in the form of overcharges) are significant and therefore provide a sound basis for antitrust actions against cartels, it has to be kept in mind that a pure total welfare standard is not interested in the higher prices paid by customers but only in those customers who refrain from buying the good at the elevated price and would have bought it at the competitive price. In other words, the choice of the welfare standard is crucial for any assessment of the welfare effects of hard core cartels.

4. Enforcement

After delineating and characterising hard core cartels and collecting evidence on their potential to cause anticompetitive effects, economists have to identify ways of how to detect and possibly intervene against such conduct. In general, such an antitrust enforcement process aims at creating "… a more competitive environment … through the prohibition of certain practices deemed illegal …" (Harrington, 2005b: 1). Assuming that the respective laws and regulations have been installed, it is unlikely that moral commitment alone is sufficient to reach an optimal degree of compliance. As a consequence, policy makers are forced to design and implement enforcement mechanisms.[9]

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[9] It should be noted here that an important precondition for achieving an efficient antitrust enforcement is the presence of several fundamental institutional factors. Based on significant practical experience in the design of competition law institutions, Kovacic (1997: 406ff.) identified the following eight fundamental institutional factors: 1. Substantial resources; 2. Academic infrastructure; 3. Access to information networks; 4. Professional associations; 5. Sound judicial system; 6. Legal process safeguards; 7. Access to business records; and 8. Positive political environment. Although it can be assumed that most of these factors have

The concrete design of such competition law enforcement systems offers several degrees of freedom. Following Trebilcock and Iacobucci (2002), policy makers can basically choose from three genuine enforcement systems: no enforcement, public enforcement and private enforcement. Leaving aside 'no enforcement' for the time being, public enforcement basically means that antitrust rules are enforced by state authorities, typically the competition authorities. Through the imposition of a threat of civil, administrative or criminal sanctions for violations of the respective laws and regulations, policy makers aim to alter the cost-benefit assessment for forms of anticompetitive behaviour on the firm's side sufficiently to make compliance the dominant strategy.

By contrast, private enforcement is based on the actions of private parties – such as competitors, suppliers, customers or consumers – who can bring antitrust lawsuits based on the private damages caused by forms of anticompetitive behaviour. The private system has the central advantage that private enforcers often have greater incentives, information and resources to take enforcement actions than public enforcers. As McAfee et al. (2006: 2) argue, this might lead to additional benefits for society through additional deterrence. However, the downside is – in addition to the general costs incurred by an additional private system – that private enforcers also have greater incentives to (ab)use antitrust rules strategically and might therefore cause harm to society (see McAfee and Vakkur, 2004).[10] Furthermore, as argued by Rubinfeld (2006: 143) and others, it is important to harmonise the systems of public and private enforcement in order to avoid problems of under- or overdeterrence.

Although it is beyond the scope of this paper to develop a full-fledged hard core cartel enforcement system – which would especially need to take the identified interdependencies between public and private enforcement into account – the following sections will shed light on the economic design and effects of both enforcement system for the case of hard core cartels.

4.1. Public enforcement of hard core cartels

In general, the antitrust enforcement process within a system of public enforcement consists of basically three steps: The respective conduct has to be detected, prosecuted and 'penalised'. Although there may be important practical differences between 'detection' and 'prosecution' – having in mind the fundamental difference between 'having knowledge of a certain

been recognised and implemented in countries with a considerable antitrust enforcement history, the recent introduction of competition laws in many so-called transition economies reminded of the importance of these institutional foundations and the problems created by their absence. Evenett (2005), for instance, extensively studied the mixed experiences with the introduction of competition law in Thailand. He finds that "… the noble intentions of policy makers in enacting the 1999 competition law have been undermined by a combination of the following six factors: interference by government ministers, officials, and other politicians; lobbying by interest groups; legal loopholes; a lack of transparency in decision making; lack of human capacity; and, relatedly, a lack of funding" (Evenett, 2005: 11).

10 Comparing both options in a strategic model of antitrust violation and lawsuit, McAfee et al. (2006: 21f.) show that while pure private enforcement is never optimal, a public system as well as combinations of both systems can reach the social optimum. This finding is in line with practical experiences which do not show pure public or private enforcement systems but rather combinations of both systems with different focal points. For instance, while the US system is dominated by private enforcement (but also has public enforcement) the European system is based on a system of public enforcement (with current discussions on whether to increase possibilities for private enforcement).

conduct' and 'proving a certain conduct' from an antitrust law perspective – both complexes are added together for the following economic analysis, leading to a differentiation between a 'detection' stage and a complementary 'intervention' stage.

Following the theoretical and empirical evidence discussed in the previous section, hard core cartels are a prime candidate for a per se prohibition. Such a conclusion does not necessarily preclude the possibility that there might occasionally be hard core cartels which would have risen overall welfare; however, such occurrences are considered so rare that a per se ban remains the appropriate antitrust reaction[11] (see also Whinston, 2006: 15ff.).

Assuming that such a per se ban of hard core cartels is codified, the key challenges of a competition authority with respect to enforcement are two-fold. On the one hand, it needs to work on ways to reduce the incentives to form cartels and on the other hand, it must address the question how it can detect and intervene against existing cartels. As shown in Figure 1, the competition authority can – in working towards these goals – make use of both, ex ante and ex post tools.

Figure 1. Cartel enforcement options
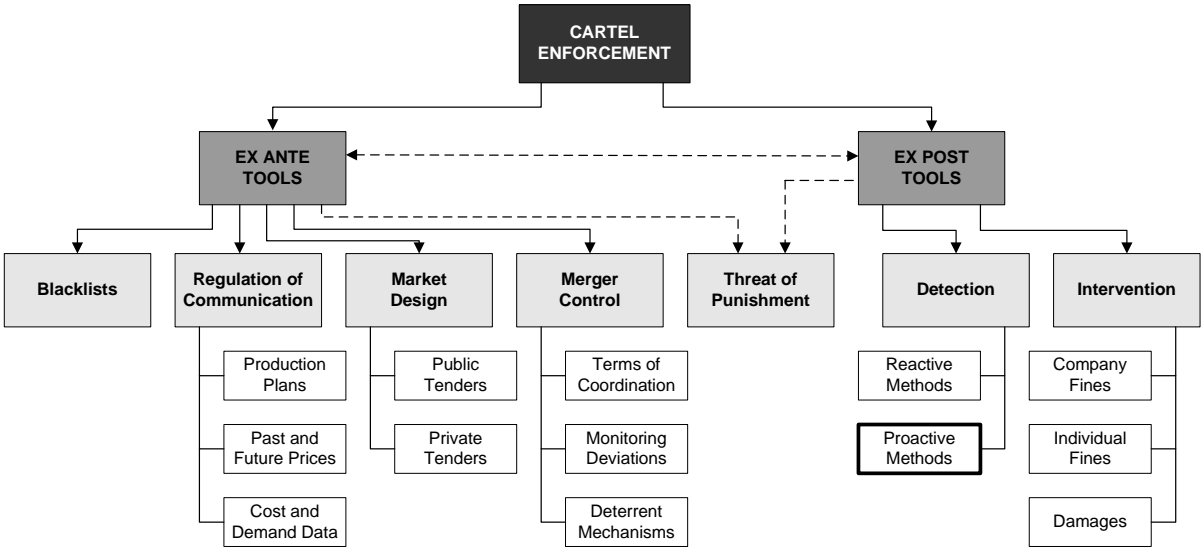
Source: Hüschelrath (2010)

As shown in Figure 1, ex ante tools to reduce the incentives to form cartels include blacklists, regulation of communication, market design and merger control. The available ex post tools can be subdivided into detection activities and intervention activities. Both categories will be characterised further in the following paragraphs.

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11 In fact, Whinston (2006: 16f.) constructs a simple model and argues that the prospect of building a cartel may – under certain special conditions, such as the impossibility of perfect collusion – act as an inducement to entry and might therefore help to reach a socially optimal number of firms in the market (and might therefore raise overall welfare). Whinston refers to a case from the US railroad industry for which such an argument – based on a theory of ruinous competition – was in fact (unsuccessfully) made in front of a court. "[T]he railroads had argued that their agreement [to set reasonable railroad rates] was not illegal because their rates were reasonable and, absent the agreement, ruinous competition would ultimately lead to monopoly and consequently higher prices" (Whinston, 2006: 16).

Ex ante enforcement tools

There are several possibilities for a competition authority to ex ante reduce the formation of cartels. One prominent example is the development and publication of blacklists which specify the types of conduct that belong to the category called 'hard core cartels'. The potential of blacklists to reduce cartelisation is, however, limited to cases in which firms are uncertain (or ignorant) about the illegality of their planned conduct and only decide to refrain from applying it after studying the respective blacklist. Given this inherently informative character of blacklists, they are of exceptional importance in countries where competition policy has been introduced recently[12] (and hence where firms might simply be unaware of the exact content and meaning of antitrust rules) and for companies which operate in foreign countries and have to comply with the interpretation of antitrust law in these countries.

A second possibility to prevent the formation of cartels and collusion is the identification of types of communication between competitors which should be interpreted as attempts to form a cartel (or tacitly collude) and should therefore enter some kind of blacklist. In this respect, Kühn (2001) proposes to fight collusion by banning certain types of communication between firms that are, on the one hand, particularly likely to facilitate collusion but, on the other hand, are unlikely to improve social welfare by enabling some kind of procompetitive information communication or exchange. In particular, the following forms of communication should be banned: any private discussion of future output prices or production plans, individualised information exchanges about past prices and quantities and (probably) the exchange of individualised cost and demand data (p. 195ff.). According to Kühn (2001: 196), banning these forms of communication could "significantly improve competition policy towards collusive practices".

A third type of ex ante instrument for preventing the formation of cartels is adjustments in market designs (see Motta, 2004: 191f.). The application of contemporary auction theory, for example, can help in designing auction mechanisms which offer fewer possibilities for bid-rigging than standard auction types (see Klemperer, 2004, for an overview of auction theory).[13]

A somewhat related fourth ex ante tool to reduce cartel formation is the coordinated effects analysis, which is a compulsory part of the horizontal merger control procedure (see Motta, 2004: 192). Such an analysis investigates whether a proposed merger would create a post-merger environment in which collusion is more likely than in the pre-merger environment. Hypothetically, suppose an aggressive firm (a so-called maverick firm[14]) manages to enter a mature industry with high entry barriers and several episodes of cartelisation in the past. If now one of the three incumbent firms tries to get rid of the 'troublemaker' by simply acquiring it, merger control would probably impede such an attempt by arguing that the post-

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[12] In Estonia during the late 1990s, for instance, several cartel cases were reported in which the involved companies simply did not realise that their agreements were breaking new Estonian competition law. See Konkurentsiamet (1999: 8ff.) for an example from the taxi services market in Pärnu.

[13] However, from a practical perspective, it seems rather unlikely that a competition authority has a big influence on the design of such auctions.

[14] See Baker (2002) for a detailed characterisation of the role of maverick firms in an assessment of coordinated competitive effects.

merger environment (again consisting of the three incumbents) would ease coordination among the incumbents.[15] Generally, the history of European competition policy has shown that coordinated effects analysis typically is a difficult undertaking that carefully needs to consider factors such as terms of coordination, monitoring deviations or deterrent mechanisms in order to have a chance to be accepted by the respective court.

Ex post enforcement tools

Although ex ante instruments are certainly useful in reducing the number of cartels in an economy, it is unlikely that these instruments alone will deter cartelisation to an economically optimal degree.[16] Consequently, from an ex post perspective, the competition authority's fundamental challenge is to detect hard core cartels. As cartel members are typically aware of the illegality of their agreements, they have a strong motive to keep them secret. As a consequence, a key action for a competition authority lies in the identification of such illegal agreements (detection in a narrower sense) and the collection of sufficient evidence to prevail in possible court examinations (detection in a broader sense). In general, the competition authority can use a selection of reactive and proactive detection tools to increase the probability of cartel detection. Both options will be characterised in greater detail in the forthcoming Section 4.1.1.

Interventions against hard core cartels are motivated by the belief that the imposition of fines discourages attempts by firms to form hard core cartels. Consequently, the fundamental purpose of company fines is to create and keep up a deterrence effect by signalling to the companies that substantial fines will have to be paid if their conspiracy is detected ('threat of punishment'). However, as shown in Figure 1 above, intervention does not necessarily have to stop at the imposition of corporate fines but can be complemented by individual fines (monetary fines or even prison sentences). Although such types of fines can certainly be effective additional intervention tools, the more detailed discussion in Section 4.1.2 below concentrates on the derivation of optimal fines and the role of leniency programs.

4.1.1. Detection

It has long been recognized that competition authorities can make use of various methods to detect cartels. Generally, these methods can be separated into reactive methods and proactive methods. According to the International Competition Network (ICN, 2010), reactive methods rely on some external event to take place before the competition authority becomes aware of an issue while proactive methods are initiated from within the authority and do not rely on an external event. An overview of the different methods is provided in Figure 2.

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[15] Although it cannot be assessed here in detail, it is also thinkable that the acquisition does not raise concerns from a coordinated effects point of view, as the acquisition of the maverick firm creates an unequal market share distribution among the remaining three incumbents. Such inequalities typically make it harder to stabilise a cartel agreement. However, apart from coordinated effects, a 4-to-3 merger, including a maverick firm, would surely also raise concerns with respect to the unilateral effects of such a proposed transaction.

[16] In general, the theory of law and economics shows that it is typically not optimal to deter behaviour completely, but to find the optimal degree of enforcement based on assessments of costs and benefits (see Cooter and Ulen, 2000: 427ff.).

Figure 2. Methods of detecting cartels
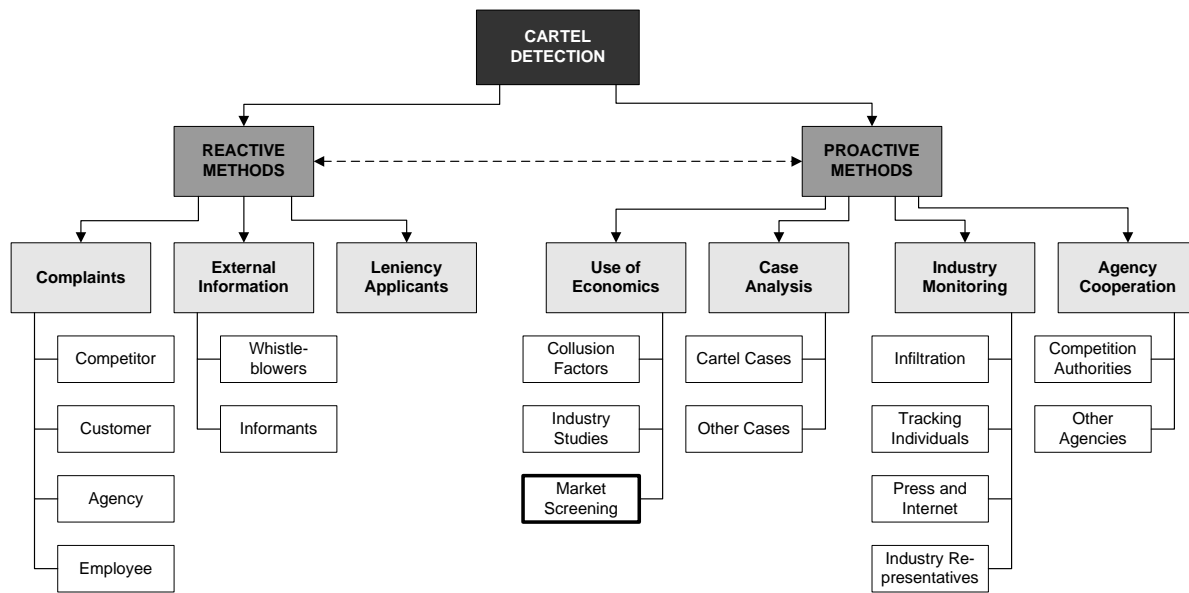
Source: Hüschelrath (2010), largely following the content of ICN (2010)

As shown in Figure 2, reactive methods to detect cartels include complaints, other external information and leniency applicants. Following the detailed characterization in ICN (2010: 7ff.), complaints about an alleged cartel agreement can be filed by competitors, customers, other agencies or current or former employees of the respective companies. A whistleblower typically is a current or former employee who is aware that his employer is involved in a cartel but was not personally involved. An informant, on the other hand, typically is an outsider who received access to information from within the cartel. Finally, a leniency applicant is a cartel member who reports the respective cartel to the authority to aim at reducing or even eliminating the fine that would otherwise be applicable.

Proactive methods offer a variety of tools to actively detect cartels. The explicit use of economics, for instance, can play a role in the form of the study of collusion factors across industries, the conduct of market or industry studies or inquiries and in the implementation of a market screening approach discussed below. Complementary to these approaches, a competition authority can derive useful information on existing cartels by analyzing past cartel cases or other competition cases. Furthermore, the constant monitoring of industries through infiltration of informants, career tracking of industry managers, press and internet monitoring as well as regular contact with industry representatives promises to increase the probability to detect cartels. Last but not least, cooperation between agencies – either competition authorities or other national or international agencies – can promote the detection of cartels.

In terms of the relative importance of reactive and proactive methods to detect cartels, evidence is rare. In their seminal paper, Hay and Kelley (1974) identified not less than twelve different methods of both categories which were actually applied by the two US competition authorities between 1963 and 1972 to detect in sum 49 cartels. However, in 70 percent of the cases, one of the following four methods was actually applied: Grand Jury investigation in

another case (24%), complaint by competitor (20%), complaint by customer (14%) and complaint by Local, State or Federal Agency (12%).

Following ICN (2010: 10), the dominant role of complaints in the detection of cartels can still be observed today, however, leniency applications are catching up in their relative importance. Although detailed statistics are unavailable, proactive methods generally seem to play a relatively small role compared to the reactive methods. However, there are signs that a collection of complementary proactive methods is increasingly being applied to further increase the probability of cartel detection. For example, at the Annual Conference of the International Competition Network in Istanbul in April 2010, representatives from the competition authorities in Hungary, Ireland, Japan and Turkey presented their approaches to proactively detect hard core cartels.[17] Furthermore, the Competition Commission of India (2009) recently published a case study on the identification of a cartel in the Indian cement industry by using a market screening approach.

Given these recent developments, the remainder of this section will concentrate on one particular proactive detection tool out of the sub-category 'Use of Economics', namely so-called 'market screening'. In general, the market screening method can be subdivided into three steps. In the first step, a structural assessment of all industries in an economy is undertaken, followed by an in-depth behavioural study of those industries which were identified as suspicious by the initial structural assessment. If sufficient behavioural evidence is found, the competition authority may – in a third step – successfully apply a leniency program and/or may be allowed to execute dawn raids with the aim of collecting written proof for the existence of conspiracies. Such hard evidence is typically needed to prove the existence of a cartel agreement in court. The three steps of the market screening methods are characterized in greater detail in the following sub-sections.

1. Structural assessment of all industries in an economy

Within an antitrust framework to actively detect cartels, the first step is a structural assessment of industries. Such a structural assessment reverts to the stability problems cartel agreements typically face. As mentioned above, although firms have developed various incentive schemes to stabilise cartel agreements, these schemes typically cannot be applied profitably in every market environment. The underlying economic reasons are twofold. On the one hand, the profit differential between the cartel profit and the competitive profit – i.e., "the difference between the most profitable outcome possible for the firms (the best possible Nash equilibrium) and the worst" (Whinston, 2006: 40) – depends on the specifics of the market and market interaction. On the other hand, the costs of operating a cartel – i.e., reaching and monitoring[18] cartel agreements, and possible antitrust fines and damages – also

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[17] Sarai (2010), Pro-Active Cartel Detection: A Hungarian Example, Presentation, 9th Annual Conference of the International Competition Network, Istanbul; Galbreath (2010), Cartel Detection in Ireland, Presentation, 9th Annual Conference of the International Competition Network, Istanbul; Yabuki (2010), Proactive Cartel Detection from NGAs Viewpoint, Presentation, 9th Annual Conference of the International Competition Network, Istanbul; Ünlüsoy (2010), Proactive Cartel Detection in Turkey', Presentation, 9th Annual Conference of the International Competition Network, Istanbul.

[18] In general, the stronger, the swifter, or the more certain punishment, the more likely a collusive agreement is sustainable, or alternatively, the closer to joint profit maximising is the industry equilibrium.

depend on the specifics of the market and market interaction and might become prohibitive in certain constellations. To give a simple example, consider a market with 10 firms and a market with 3 firms. Ceteris paribus, it can be expected that it is more costly to reach and maintain a cartel agreement in a market with 10 firms than in a market with only 3 firms, simply because negotiations (and the subsequent monitoring) among 10 parties is typically more complex and expensive than negotiations among only 3 parties. As a consequence of this reasoning, it would make more sense for a competition authority to investigate more closely the 3-firm market rather than the 10-firm market, simply because, ceteris paribus, a cartel in the 3-firm market is more likely than in a 10-firm market.[19]

In addition to this simple structural example focusing on the number of firms in a market, theoretical research has identified an ample number of additional factors which have the potential to influence the potential benefits and costs – and therefore the rationality and stability – of cartels and collusion. Rey (2006) – in accordance with many other commentators on the topic – subdivides these factors into structural, supply-related and demand-related factors. Structural factors that ease collusion include a low number of competitors (as discussed above), high entry barriers, frequent interaction between firms and market transparency. Demand-related factors include market growth, absence of significant fluctuations or business cycles, low demand elasticity, buying power and the absence of club and network effects. Finally, supply-related factors which ease collusive agreements include mature industries (with stable technologies), symmetric costs, symmetric capacities, product homogeneity, multi-market contact, structural links and cooperations and other contractual agreements. The theoretical reasoning upon which these different collusion factors are based can be found, for instance, in Rey (2006), Motta (2004), Ivaldi et al. (2003) and Grout and Sonderegger (2005).[20]

Given this collection of collusion factors, it is important to remark that such an analysis of collusion factors is by no means deterministic with respect to the detection of cartels. The presence of one or more structural factors in a market simply makes it more likely to find a cartel in such an industry than in an industry with, for example, 'inverted' characteristics. However, there is neither a guarantee of finding a cartel nor a guarantee that cartels do not exist in industries with different structural characteristics. In the words of Fraas and Greer (1977: 21): "To a large degree, none of these factors taken singly appears to be a sufficient condition nor, with the possible exception of the number of participants, even a necessary

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[19] Following a seminal paper by Selten (1973), cartelisation pays for all firms in the market as long as this number is sufficiently small. However, if the number of firms exceeds a threshold level – 5 firms in Selten's model – then it becomes more profitable to become a cartel outsider (which reduces profits for the cartel). See Schulz (2003: 64ff.) for a model studying the effects of fringe firms on the stability of the cartel agreement. He shows that fringe firms by no means have to cause the breakdown of the cartel but can even have a stabilising influence. A cartel is found to be stable as long as $f+3 \geq k \geq f+2$, with f being the number of fringe firms and k the number of firms in the cartel. As $f+k=n$, the above expression can be rearranged and expressed as follows: $(n+1)/2+1 \geq k \geq (n/2)+1$.

[20] The economic literature also identifies collusion factors with ex-ante unclear direction. The classical example is production capacity. On the one hand, binding capacity constraints reduce the possibilities to deviate from a collusive agreement. On the other hand, spare capacity might be necessary to punish deviations from the cartel agreement by other cartel members. If such production increases are not possible in the short run, this tends to make deviations from the cartel more likely. As a consequence, the production capacity situation has an ambiguous impact on the stability of collusion.

condition for effective collusion; instead, the emergence of an effective coalition seems to depend on some broad combination of these conditions."[21] Harrington (2005a: 3) therefore concludes that structural assessments may not be too helpful a screening device, as the output of such a screening procedure is simply a large amount of markets which all have a cartel potential, although it is quite likely that the majority of them is in fact not cartelised. In other words, structural assessments are likely too inexact to really deliver a selection of markets in which in-depth investigations are worthwhile. Additionally, extensive case study evidence collected by Levenstein and Suslow (2004) also suggest that although many structural factors are approved by the case studies, there are always exceptions possible.

One fundamental problem with the application of general collusion factors for the detection of cartels is that such an approach treats both collusion strategies, explicit collusion (cartelisation) and tacit collusion, as equal. However, if tacit collusion and cartelisation would be equally applicable, would be driven by the exact same factors and would lead to identical profits, it would be irrational to form cartels and take the risk of being caught if tacit collusion is available as an identical strategy but with almost no chance for the competition authority to prove it. In other words, the conscious choice of forming a cartel must have certain advantages over tacit collusion that are not picked up by the general application of collusion factors. Consequently, in order to develop powerful strategies to detect cartels, it would be of great importance to extract such cartel-specific factors out of the pool of factors that affect the likelihood of collusion. Whinston (2006: 41) describes this problem as follows: "What determines how a given factor affects the incentive to engage in price fixing is the extent to which it makes coordination relatively easier when firms talk than when they do not". As a consequence, following Grout and Sonderegger (2005: 36), firms might only be willing to engage in explicit cartel agreements in circumstances that are predicted by the theory as being adverse to collusion.

Despite these restrictive remarks on the accuracy of structural assessments, Grout and Sonderegger (2005) developed an operational framework to predict cartels in the United Kingdom. Based on the 3-digit standard industrial classification – which they considered as the right level of disaggregation between industries and markets to conduct such a study – they first collect and apply existing evidence on detected cartels to identify structural characteristics that seem to be important for the formation of (formerly workable) cartels. Second, they use an economic model to compare the structural characteristics of detected cartels with the structural characteristics of each of the industries which belong to the 3-digit SIC in the United Kingdom aiming at providing predictions of the probability of cartels within these industries. Their results show that in 8 industries, the probability of the existence of at least 1 cartel lies above 50%. These industries are: telecommunications; manufacture of aircraft and spacecraft; manufacture of grain mill products, starches and starch products; legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and

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[21] In an empirical study, Dick (2005) aims at identifying whether the structural characteristics of cartels provide a reliable basis to screen industries for potential cartels. He concludes in this respect that "[w]hile readily observable industry characteristics are statistically correlated with cartel activity, the economic magnitudes of these correlations are sufficiently small as to be likely undetectable in practice when industry conditions are measured with noise" (p. 169).

public opinion polling; business and management consultancy; and cargo handling and storage.

The potential value of a structural assessment of markets can be exemplified by the US lysine industry. Lysine (an essential amino acid) is a homogenous product with inelastic demand, produced in an industry with only a few firms operating and with relatively symmetric costs. Additionally, the whole industry has seen long periods of cartelisation before, basically because two major producers are based in Japan, which traditionally followed a more lenient approach to cartel enforcement. These structural factors make the lysine industry a possible candidate for the creation or existence of cartel agreements.

2. Behavioural assessment of 'suspicious' industries

Subsequent to a study of the structural characteristics of industries, suspicious industries should be investigated further by a behavioural assessment, which focuses on signs in actual market behaviour that may signal the existence of cartel agreements. Such a behavioural assessment, according to Harrington (2006b: 3), "focuses on the market impact of that coordination; suspicions may emanate from the pattern of firms' prices or quantities or some other aspect of market behaviour". Typically, a behavioural analysis focuses on structural breaks (e.g., caused by cartel price wars) and exogenous shocks (e.g., caused by changes in input costs). It aims at investigating whether the firm's (re)actions to the observable breaks or shocks are consistent with competitive behaviour or whether it might better be explained by some kind of collusive model (see, for instance, de Roos, 2006).

In order to illustrate the basic idea behind behavioural assessments, consider again the US lysine industry (from which it is known that a cartel agreement was in place during the 1990s). Figure 3 shows the average monthly lysine prices for the United States and the European Union between July 1991 and June 1995.

Figure 3. Average monthly lysine prices in the United States and the European Union between July 1991 and June 1995
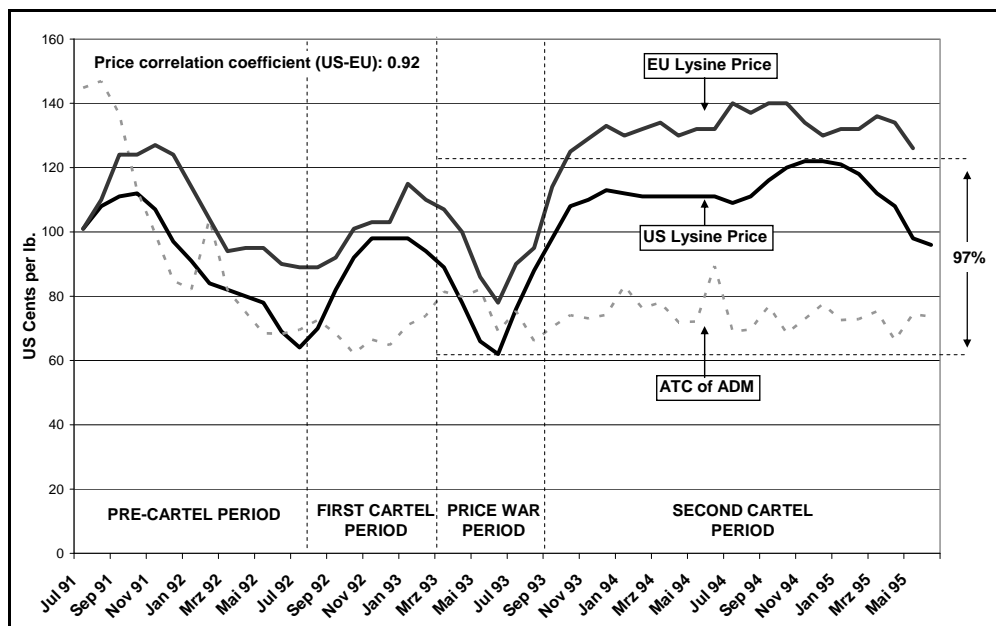
As shown in Figure 3, the lysine market history between July 1991 and June 1995 can be separated into four periods (which were disputed but nevertheless identified during the criminal lysine price-fixing trials): A pre-cartel period, a first cartel period from August 1992 to February 1993, a price war period from March 1993 to August 1993 and a second cartel period from September 1993 to June 1995.[22] The pre-cartel period was characterised by the large-scale market entry of ADM and a smaller-scale market entry by a Korean firm and shows the expected downward reaction in price that would be expected in a competitive market. As a consequence of the implementation of the cartel agreement in August 1992, a structural break can be identified, characterised by a steady increase in the market prices for lysine over a couple of months. The price increase was interrupted and was reversed by a price war from March 1993 to August 1993, which is reflected by two additional structural breaks in the market price for lysine. The first break is caused by the beginning of the price war and the corresponding substantial price decreases, while the second break is characterised by the reinstatement of the cartel agreement after resolving the price war. The post price war period can be characterised by steady increases in market price and especially the maintenance of the elevated price level – with only minor variations in price – until the FBI cracked the cartel in June 1995. In a nutshell, studying the market prices for the US lysine industry prior to and during the cartel suggests that especially during the transition from the

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22 In addition to the US and EU market prices of lysine, Figure 3 also shows the time series of the average total costs of Archer Daniels Midland, the US firm which participated in the cartel. Although a comparison of average total costs with the market price might also allow some conclusions on the existence of a cartel, such information typically cannot be used in a behavioural approach, as it is typically confidential ex ante and cannot be monitored by the competition authority. However, it may be possible to use cost data – collected for other antitrust purposes such as a predatory pricing allegation – to see whether cartelisation could also have been an issue in the markets at hand.

pre-cartel state to the cartel state, possible price wars and longer periods of stationary prices with low variance might be considered as typical patterns of price-fixing conspiracies.

Based on factual evidence of 20 EU cartel cases between 2000 and 2004, Harrington (2006a, 2006b) affirms the identified specifics as part of a broader behavioural screening, but he adds several additional *collusion markers*, which can be used to distinguish between collusive market behaviour and competitive market behaviour. Table 4 provides an overview of the markers.

Table 4. Collusive markers for behavioural screening

Type of collusive marker		Description
Price	1	A higher list (or regular) price and reduced variation in prices across customers
	2	A series of steady price increases is preceded by steep price declines
	3	Price rises and imports decline
	4	Firms' prices are strongly positively related
	5	A high degree of uniformity across firms in product price and other dimensions including the prices for ancillary services
	6	Low price variance
	7	Price is subject to regime switches
Quantity	8	Market shares are highly stable over time
	9	There is a subset of firms for which each firm's share of total supply for that subset of firms is highly stable over time
	10	A firm's market share is negatively correlated over time

Source: Content follows Harrington (2006a: 4ff.)

As shown in Table 4, next to an analysis of market prices over time, a complementary analysis of quantity data might add value to a behavioural assessment. It is, however, beyond the scope of this section to discuss all the collusion markers sketched in Table 4 (see Harrington, 2006a, for a complete assessment). A good example for a recently applied – and apparently working – collusion marker is low price variance. From a theoretical perspective, such a marker is justified by the expectation that price variance is reduced during a conspiracy because, for example, frequent adjustments of cartel agreements are costly. Or alternatively, if individual adjustments by cartel members were allowed, that would make it harder to detect deviations from the cartel agreement. Hence, it can be expected that the transition from a cartel state to a non-cartel state is characterised by an increase in price variance. Furthermore, it can be expected that prices become more responsive to cost after a cartel breakdown.

Recent empirical research supports this theoretical reasoning. Abrantes-Metz et al. (2006) (re)investigate price movements over time around the collapse of a bid-rigging conspiracy among seafood processors in the United States (with respect to supplying seafood to military installations). The authors find that in the case of frozen perch fillets, the average weekly price decreased by about 16% after the collapse of the cartel, while the standard deviation of price increased by 263%. Furthermore, Esposito and Ferrero (2006) investigate data of two Italian cartel cases with respect to the question whether a variance screen would have successfully detected the conspiracies. The authors conclude that in both cases – motor fuel and baby food products – such a screen would have detected the conspiracies. Finally, Bolotova (2005: 10) found for the lysine price-fixing conspiracy that the price variance decreases significantly during the cartel period.

3. Collection of hard evidence

After applying structural and behavioural screens, the third step in the ex post detection of cartels is the collection of hard evidence. 'Dawn raids' basically are unannounced visits by state officials (equipped with a respective search warranty) at the cartel firm(s) headquarters which basically aim at finding written proof of the alleged cartel agreement. Alternatively, the competition authority can motivate the cartel members to come forward with proofs of their cartel agreement in exchange for a reduction or an exemption of fines through a leniency program. However, because leniency programs factually lead to a reduction in fines, they will be assessed in the intervention section below.[23]

In any case, hard evidence is essential in order to prove the cartel allegation in the courtroom. In the case of the lysine cartel, a senior manager of ADM, Mark Whitacre, became an undercover informant of the FBI in November 1992 and supplied several audio tapes of conversations among lysine managers and of several meetings of the lysine producers. Due to the help of Whitacre, the FBI was even able to make videotapes of some of the meetings.[24] Finally, by the end of June 1995, the FBI raided offices in the ADM headquarters to gather additional documents, which proved the conspiracy (see White, 1999, for a detailed description).

4.1.2. Intervention

Interventions against hard core cartels are motivated by the belief that the imposition of fines discourages attempts by firms to form hard core cartels. Consequently, the fundamental purpose of corporate fines is to create and keep up a deterrence effect by signalling to the companies that substantial fines will have to be paid if their conspiracy is detected. This basic allegation immediately demands economic answers to the question of how a deterrence-optimal fine should be derived.

Derivation of deterrence-optimal corporate fines
In general, an ex ante deterrence effect is determined by especially two parameters: the severity of the sanction and the probability of detection (see Gal, 2000: 104ff., for a detailed assessment). In general, a certain behaviour is deterred if the fine is equal to the gain of the conduct (for the offender) divided by the probability of detection. For example, if the excess profit of a cartel agreement g is given by $g=200$ and the probability of detection p is given by

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[23] Friederiszick and Maier-Rigaud (2006) develop a two-step framework for initiating ex-officio cartel investigations. In the first step, an industry analysis – equivalent to the structural step in the framework above – focuses on price-related indicators, transparency-related indicators, content-related indicators and entry-related indicators. In order to decide which industries should be investigated further, Friederiszick and Maier-Rigaud propose a simple scoring method. The structural indicators are given a scoring value dependent on the assumed importance. The values for every industry are added up and every industry above a certain threshold will be subject to a closer investigation. In the second step of the framework, market behaviour in the selected suspicious industries is more closely investigated by screening for critical events (exogenous shocks and structural breaks).

[24] For example, Whitacre convinced the Japanese cartel members to meet in Hawaii, where the FBI was allowed to follow him, rather than in cartel-friendly Japan, where these meetings usually took place.

p=0,2, the corresponding fine *F* to deter such behaviour can be calculated to *F=(200/0,2)=1000.*[25]

Although the focus on the gain for the offender as the numerator in the deterrence-optimal fine calculation seems to be straightforward, research in law and economics identified an alternative numerator which refers to the 'net harm to others' caused by the offender. As shown by Polinsky and Shavell (2000: 50), if the net harm to others is given by *h* and the probability of detection is still *p*, then the optimal harm-based fine *F* is given by *F=h/p* (as long as individuals are risk-neutral[26]), which is equal to the policy conclusion that the expected fine has to equal the net harm to others caused by the offender in order to optimally deter the harmful conduct.

Although it is still disputed in antitrust law and economics whether 'gain' or 'harm' provides the appropriate basis for antitrust fines, recent commentators tend to favour the harm-based approach (see Wils, 2006: 12ff., for a discussion). This trend is based on a seminal paper by William Landes (1983), in which he showed under fairly general conditions that "[t]he optimal penalty should equal the net harm to persons other than the offender, adjusted upward if the probability of apprehension and conviction is less than one. This sanction encourages efficient behavior" (p. 678). One fundamental advantage of the harm-based fine over the gain-based fine is that the former would not deter those types of efficient conduct which cause more gain to the offender than harm to society and should therefore not be deterred (but punished) from a welfare perspective.[27] As stated by Wils (2006: 13): "The optimal fine thus set makes the offender internalise all the costs and benefits of the violation, thus leading the offender to commit the 'efficient violations' whose total benefits exceed the total costs while deterring 'inefficient violations' whose total costs exceed the total benefits."

With respect to cartel enforcement, Souam (2001) investigates two different regimes of pecuniary punishment in a theoretical model: a fine based on revenues of the respective industry and a fine which relates to the damage caused to customers. Given the fact that investigations are costly and have a declining social benefit, he generally found – in line with many other authors – that it is welfare-optimal in both systems to tolerate some degree of collusion. As long as the damage is less than the ex ante costs of deterrence, it is welfare-optimal not to intervene. With respect to the comparison of the two alternative fine bases, Souam's results show that both approaches are theoretically similar as they both reach similar deterrence levels. However, in industries in which the likelihood of collusion is small, a

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[25] The basic model was developed in a seminal paper by Gary S. Becker (1968), in which he focused on a utility maximisation problem for an individual who faces the introduction of a law enforcement regime. Translated into the cartel world, the expected profits of the cartel agreement are given by $E(G^c)=p(G^c-c-F)+(1-p)G^c=0$. It immediately follows that the deterrence-optimal fine is given by $F=(G^c/p)-c$, where *c* is used as a measure of costs incurred by the detection process (which is set to 0 for the time being).

[26] An individual is risk-neutral if he or she is indifferent about an expected cost or value and its certain equivalent.

[27] However, in case of hard core cartels, it is quite unlikely – as discussed as part of the welfare assessment above – that the gain will be bigger than the harm; i.e., gain-based fines would almost certainly deter cartelisation. However, this might not be true for other areas of antitrust policy (see Camilli, 2005: 6ff., for a discussion).

revenue-based fine has certain advantages over a damages-based fine, while in industries with high possibilities of collusion, a damage-based fine reaches slightly better performances.

Assuming that harm is chosen as the generally appropriate basis for antitrust fines, the harm caused by a cartel is determined by market size, duration of the infringement and size of the price rise compared to the competitive level[28] (i.e., the overcharge). If such a fine is a credible threat to market participants – together with a probability of detection of one – cartel agreements would be completely deterred. However, as already indicated by Souam above, keeping up a probability of detection of one would be an extremely expensive task far away from practical implementation. For example, for the United States, a study by Bryant and Eckard (1991) estimated that the probability of detection for cartel agreements in a twelve-month period is about 15% on average.[29] More recently, Combe, Monnier and Legal (2008) develop a general stochastic detection model and use it to estimate the annual probability of detection for a sample consisting of all cartels convicted by the European Commission from 1969 to 2007. The authors find an annual probability of detection that falls between 12.9% and 13.3%.

Despite the relatively low probability of detection, it would still be theoretically possible to reach a full deterrence effect, as the size of the fine could be adjusted upward to compensate for the reduction in the probability of detection. However, studies also have revealed that such a proposal is far off any practical applicability for general economic reasons, such as the social and economic costs of such high fines, as well as for practical reasons, such as the inability of firms to pay such fines[30] (see Wils, 2006: 18ff.). In other words, it is neither possible not economically desirable to completely deter cartelisation.

However, even if antitrust fines and the probability of detection are not high enough to deter cartelisation completely, they still benefit consumers. The basic economic rationale behind such an assertion is formalised by Block et al. (1981), who study the relationships between antitrust enforcement and optimal collusion in a simple theoretical framework. The authors assume that the cartel objective is to maximise profits; hence, in a world without a competition authority all firms in the industry collude and charge the monopoly price. If now a competition authority is introduced which monitors the price-cost markup and decides to investigate (and imposes fines) if the markup exceeds a threshold level, the price-cost markup now significantly affects the probability of detection – that is, the higher the price-cost markup, the more likely is an investigation by the competition authority. In such a model

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[28] These three parameters also determine the damage caused by the cartel, which needs to be calculated in private damage claims.

[29] In a recent study, Connor (2006: 9ff.) collects views on the probability of cartel detection and found that most evidence seems to suggest a 10-20% chance of detection. Combe, Monnier and Legal (2008) develop a general stochastic detection model and use it to estimate the annual probability of detection for a sample consisting of all cartels convicted by the European Commission from 1969 to 2007. The authors find an annual probability of detection that falls between 12.9% and 13.3%.

[30] This reminds of the general question why it is not optimal to introduce capital punishment for price fixers. Although such a step might come near to full deterrence, it would very likely cause the avoidance of any kind of procompetitive cooperation that could be interpreted as a cartel. As shown above, the term *cartel* represents a relatively diverse set of business conducts. Additionally, managers threatened by capital punishment would have a huge incentive to invest in compliance systems or alternatively in ways to hide their criminal acts. Both types of investment are costly to society.

setup, it is straightforward to show that a profit-maximising cartel will not set the monopoly price anymore; but it will, however, nevertheless charge a price above the competitive level. In fact, the price level is determined by both the size of the expected fine and the probability of detection (i.e., the enforcement efforts of the competition authority). In other words, the Block et al.'s model shows that an increase in either the size of the fine[31] or the probability of detection leads to a reduction in the price-cost markup by the cartel firms. This reduction in price is solely caused by the deterrent effect of antitrust enforcement.[32]

The role of leniency programs
A relatively recently (re-)discovered possibility to increase the probability of detection – and therefore to strengthen the deterrence effect – are leniency programs. Generally speaking, a leniency program adopted in cartel cases promises the first cartel member which reports its involvement in the cartel to the competition authority either partial or total leniency from any subsequent fines. However, in practice, leniency programs are much more complex, basically to assure that the program provides an appropriate incentive structure for corporations and individuals[33] to come forward with hard facts, while at the same time without giving them the possibility to abuse the program.

From a theoretical perspective, the general idea behind leniency programs is that they "may destabilise organised crime by undermining internal trust with the increased risk that one of the involved parties unilaterally reports to enjoy the benefits of the leniency program" (Spagnolo, 2000: 3). In other words, leniency programs intend to reinforce the prisoner's dilemma situation, which exists in every cartel agreement.

The plausibility of this fundamental argument in favour of leniency programs as a way to destabilise collusion is disputed among economists. Ellis and Wilson (2001: 3), for instance, ask why cartel members should abandon their profitable cartel agreement in exchange for a reduction in fines. Intuitively, applying for leniency would only make a difference to them if the cartel is at the border of breaking apart anyway. In other words, firms will only apply for leniency when the cartel is already detected and the probability of punishment is sufficiently high. The influence of a leniency program on the probability of detection can therefore be expected to be minimal.

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[31] With respect to the effects of an increase in fines, Whinston (2006: 45) generally remarks that such a step should, ceteris paribus, lead to an increase in the level of effectiveness at which firms find it worthwhile to cartelise. As a consequence, the price effects of detected cartels should be more fundamental.

[32] Cyrenne (1999) examines an antitrust enforcement policy which focuses on significant price changes in an industry as a sorting mechanism for the allocation of enforcement resources. He shows that such an enforcement strategy typically reduces the expected profits from the collusive agreement; however, it will be ineffective in reducing the frequency of collusion as long as the punishment is not large enough. Furthermore, Cyrenne suspects that firms can easily adjust their behaviour to such an enforcement policy so that the method would not be able to detect their conspiracy any more.

[33] As price-fixing is a criminal offence in the United States, it is possible and common practice to convict leading cartel managers to jail terms of up to three years. Following Gallo et al. (2000), 53% of the convicted managers were sent to prison since 1970. This threat of incarceration might be an important incentive for managers to come forward without necessarily wanting to convince the whole company to apply for leniency as a corporate act. Hence, the consequential reaction to the situation in the United States was the implementation of a separate leniency program for individuals (see Werden and Simon, 1987, for a general assessment of why price-fixers should go to prison).

Aubert et al. (2005) developed a simple model to study the effects of leniency programs on collusive agreements. They suppose that two firms play an infinitely repeated game in which they have to choose at the beginning of each period whether they go for the collusive strategy or the competitive (i.e., deviation) strategy. It is further supposed that π^M is the profit per period and per firm if both firms decide to collude, π^D is the profit for a firm that deviates, π^S is the profit of the firm that decides to collude while the other firm deviates, and π^C is the profit if both firms compete in the market. It is reasonable to assume that firms gain from collusion and that the deviating firm benefits at the expense of the other firm, so $\pi^S < \pi^C < \pi^M < \pi^D$ as well as $\pi^S + \pi^D < 2\pi^M$. It is further assumed that if one firm deviates, both firms play the competitive strategy in each of the coming (infinite) number of periods.

It is further assumed that a competition authority is overseeing the industry and can impose a maximal fine F which is not large enough to deter collusion, so $\pi^M - \pi^C > \omega F$. In order to detect collusion, the authority can either collect evidence by auditing the industry (this is assumed to take place with probability ω), or, if a leniency program is implemented, each firm can decide to inform the authority of the existence of the collusive agreement. Given this setup, Aubert et al. (2005) characterise the effects of both mechanisms on the sustainability of collusion as follows.

In the absence of a leniency program, the profits for the firms in every period are $\pi^M - \omega F$ in case both firms collude, $\pi^D - \omega F$ for a firm which competes while the other colludes (and therefore only realises a profit of $\pi^S - \omega F$) and simply π^C if both firms compete. As shown by Aubert et al. (2005), the most profitable collusive strategy is to collude in every period and punish deviations with returning to the competitive equilibrium. Collusion is sustainable if the gains realised when deviating are lower than the discounted gains from colluding:

$$\pi^D - \omega F + \frac{\delta}{1-\delta}\pi^C \le \frac{1}{1-\delta}\left[\pi^M - \omega F\right], \tag{2}$$

or equivalently

$$\pi^D - \pi^M \le \frac{\delta}{1-\delta}\left[\left(\pi^M - \omega F\right) - \pi^C\right]. \tag{3}$$

If, however, the competition authority has implemented a leniency program with which it can reward reporting by firms with a reduction of the fine from F to f, a deviating firm will denounce its competitor if the reduced fine is lower than the expected fine it would have to pay if an audit takes place. In this case, collusion is sustainable if

$$\left(\pi^D - f\right) - \left(\pi^M - \omega F\right) \le \frac{\delta}{1-\delta}\left[\left(\pi^M - \omega F\right) - \pi^C\right]. \tag{4}$$

It follows that a leniency program has a deterrence effect on collusion only if

$$\pi^D - \pi^M \le \frac{\delta}{1-\delta}\left[\left(\pi^M - \omega F\right) - \pi^C\right] \le \pi^D - \pi^M + \omega F - f . \tag{5}$$

In this model, leniency programs do not influence the profitability of collusion and affect its sustainability only by giving deviating firms the opportunity to avoid a fine in the case of investigations by the competition authority. "Leniency programs can therefore be effective

only when the expected fine ... is large, that is, when collusion would already be fragile without any leniency program" (Aubert et al., 2005: 12). In other words, leniency programs likely raise the probability of punishment (as defecting firms have an incentive to apply for leniency and to provide hard evidence about the conspiracy), but likely have a very limited influence on the probability of detection.[34] However, a refinement of the basic model shows that leniency programs become a more powerful detection and deterrence tool as soon as the competition authority is allowed to pay rewards to reporting cartel members (or especially individuals) instead of just offering an exemption from fines.[35] Such an approach, however, might conflict with moral considerations, seeing a lawbreaker receiving rewards for cheating on an illegal agreement he himself profited from.

Motta and Polo (2003) present another modelling approach of leniency programs in which they analyse the effects of leniency programs on the incentives of firms to collude and to reveal information that helps the competition authority to prove illegal behaviour. One important result of their model is that leniency programs might induce firms to collude more often, as leniency programs reduce the expected fines in the event of detection. Consequently, preventing collusion by setting optimal fines is the first best option for a competition authority. However, if an optimal fines approach cannot be followed, the introduction of leniency programs may be optimal in a second-best perspective. "Fine reductions, inducing firms to reveal information once an investigation is opened, increase the probability of ex-post desistence and save resources of the antitrust authority, thereby raising welfare" (Motta and Polo, 2003: 26).

From an empirical perspective, there have recently been first attempts to clear up the ambiguous results of the game-theoretical literature with respect to the impact of leniency programs. In the most promising attempt, Miller (2009) develops a theoretical model of cartel behaviour that provides empirical predictions and subsequently applies the model to a data set of indictments information reports issued by the DOJ. Reduced form statistical tests are found to be consistent with the notion that leniency programs positively affect deterrence and detection capabilities. The direct estimation of the model yielded a 59 percent lower cartel formation rate and a 62 percent higher cartel detection rate due to leniency programs. Brenner (2009) conducts an empirical study of the European corporate leniency program and finds strong evidence that the program provides incentives to reveal information on the conspiracies, i.e. competition authorities are better informed about the cartel conduct than they would be absent the program. With respect to the role of deterrence, Brenner neither finds that the leniency program stabilizes cartels (through facilitating punishment strategies) nor he finds that cartels are destabilized (as defecting from the cartel agreement becomes less costly).

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[34] The scepticism towards the role of leniency programs with respect to influencing the probability of detection is also shared by Harrington (2006b: 13): "[I]t is an open question … as to how effective leniency programs have been in discovering cartels. I am convinced by their role in prosecution as the evidence is much stronger when it is provided by one of the cartel members."

[35] Spagnolo (2000) models another, more courageous form of leniency program which allows reporting firms to be rewarded. In this context, optimally designed leniency programs for undetected cartels can be a very powerful detection instrument. While the reporting firm receives rewards, the costs of the competitors are raised by the fines imposed.

In a nutshell, although a huge influence of leniency programs on the probability of detection in the current design – at least in the European Union – is unlikely, such programs can have important value for an overall strategy of the competition authority to detect and to prove hard core cartels. As described on the detection stage, the authority has structural and behavioural tools to screen industries. If something suspicious is found – i.e., the probability of detection increases significantly – cartel members might decide to come forward and apply for leniency. This step, in turn, typically provides the competition authority with the hard evidence it must have in order to prevail with the case in court. In the words of Harrington (2006b: 13): "the presence of an active leniency program makes the case for screening more, not less compelling because they are complements".

4.2. Private enforcement of hard core cartels

Complementary to the public enforcement of competition law by state authorities, private parties such as competitors, suppliers, customers or consumers are typically entitled to bring antitrust lawsuits as soon as they believe that they were harmed by a competition law infringement. Unlike the fines in public enforcement – which are imposed for reasons of deterrence and punishment – monetary payments in private enforcement are generally motivated by the pursuit of corrective justice though compensation (see generally Wils, 2009, for a detailed assessment). However, although these private damages actions aim at compensation, they typically also have a reinforcing effect on the deterrence of hard core cartels and are therefore also of relevance for the fight against hard core cartels.[36]

As already mentioned in the introduction to Section 4 above, private enforcement has the central advantages that private enforcers often have greater incentives, information and resources to take enforcement actions than public enforcers. However, possible downsides are – in addition to the general costs incurred by an additional private system – on the one hand, that private enforcers might have incentives to (ab)use antitrust rules strategically (e.g. through unmeritorious suits or undesirable settlements) and, on the other hand, that the combination of systems of public and private enforcement might cause a situation of (socially inefficient) under- or over-deterrence. Problems of under-deterrence may be caused, e.g., by a reduction of the effectiveness of public enforcement through private enforcement actions. Such a problem might occur if the effectiveness of the leniency programme is reduced due to the expected damages claims in the aftermath of the disclosure of a hard core cartel (see generally Beschorner and Hüschelrath, 2010).

Contrary to such a risk of under-deterrence, some commentators argue that the opposite problem of over-deterrence might play a role as private damage claims can be interpreted as additional monetary fine for a participation in a hard core cartel. As discussed in detail by Wils (2009) and others, the risk of over-deterrence is especially present as soon as a punitive component is included in the damages estimation following a competition law infringement. For example, in the United States, violators of antitrust law face up to treble damages in

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[36] As raised by Wils (2009) and others, achieving additional deterrence through private damage claims is suboptimal from a welfare perspective as the same effect could be reached by an administratively much cheaper increase in public fines. Furthermore, given the purely monetary incentives of individuals to bring private antitrust suits, a socially optimal deterrence level would only be reached by accident.

addition to the civil, administrative or criminal sanctions imposed as part of public antitrust enforcement.

Abstracting from the need to harmonise public and private enforcement for the time being (see, e.g., Segal and Whinston, 2006, for a detailed treatment), this section will shed some light on the key challenges in the private enforcement of competition law. In addition to an assessment of the identification and quantification of damages in Section 4.2.1., real data from the global lysine cartel is used for a practical application of selected concepts in Section 4.2.2.

4.2.1. Identification and quantification of damages

From an economic perspective, a system of private antitrust enforcement must have convincing answers to particularly three questions. First, which parties are damaged?; second, how are they damaged?; and third, by how much are they damaged? In other words, any elaborate thinking on private antitrust enforcement needs to focus on the identification and quantification of damages. Both complexes will be sketched in the following.

Identification
The quantification of damages caused by a hard core cartel must be based on an identification and detailed assessment of the potentially damaged parties. The following Figure 4 provides a systematic overview of such parties.

Figure 4. Potentially damaged parties due to cartel members increasing prices
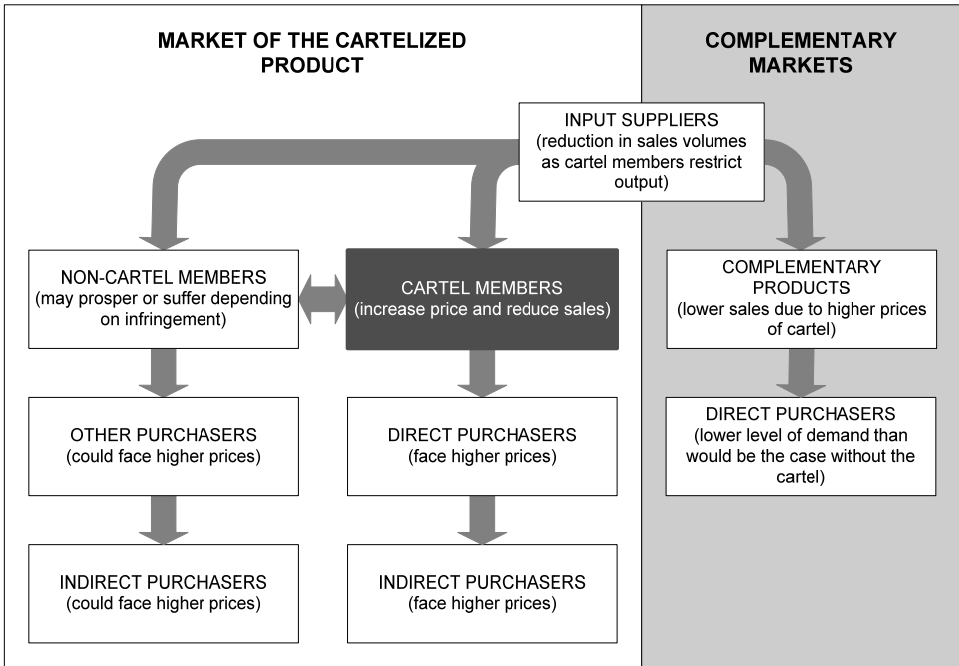
Source: Inspired by a comparable Figure in Clark et al., 2004: 13

As Figure 4 shows, on the upstream level, input suppliers of the cartel members might be damaged due to the reduction in sales volume caused by the cartel. Furthermore, the reduction in sales might lead to diseconomies of scale in the production process of the input suppliers and correspondingly might lead to an increase in its average total cost. As a consequence,

every firm using the input product is eventually harmed by the cartel agreement due to elevated input prices.

On the level of the cartel agreement, it is possible that non-cartel members have suffered due to the cartel agreement. However, as theoretical research has shown, it can very well be the case that non-cartel members manage to take advantage of the cartel (i.e. raised their prices and profits compared to the competitive counterfactual) without actually joining the cartel (see generally Phlips, 1995: 23ff.). Additionally, producers of complementary products to the cartelised product might have been damaged due to lower sales caused by the cartel agreement. To give a practical example, if a shoe cartel is formed and the production and sales of shoes is reduced, it is imaginable that the producers of shoe polish (the complementary product) experience a decline in demand and consequently might also be damaged by the cartel agreement.

On the downstream level, the so-called 'direct' effect of the cartel is the damage caused by charging elevated prices to the direct purchasers of the cartel product. Although this type of damages is subject of most private antitrust suits, it is anything but straightforward to quantify the actual harm. In addition to the general challenges of such a quantification (discussed in the following section), the possibility of a so-called pass-on of the higher input costs on to the subsequent downstream level makes such assessments particularly difficult.[37]

Quantification

Given the identification of the potentially damaged parties, the next step is the quantification of the respective damages. Focusing on downstream direct purchasers for the time being, the damages are generally calculated by multiplying the difference between the price charged by the cartel and the price that would have existed in the absence of the cartel (the so-called 'but for' price) with the respective sales volumes.

Although the basic calculation concept is straightforward, its practical implementation is often challenging. While it is straightforward to see that the fixing of the counterfactual 'but-for' price is a difficult exercise, the following ten compulsory steps in a professional damages estimation show that the real complexity of such an exercise is much larger (see Veljanovski (2007b: 11f.):

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[37] The question if and to what extent such cost increases are passed on downstream basically depends on the so-called 'pass-on rate' which is (in a competitive industry) given by $\psi = \left(1 / \left(1 + \varepsilon_D^m \cdot \varepsilon_S^m\right)\right)$. ε_D^m represents the market demand elasticity and ε_S^m stands for the market supply elasticity, i.e. the percentage increase in marginal costs when the output rises by one percent. Supposing a demand elasticity of 0.5 and a market supply elasticity of 1.0, the pass-on rate can be calculated to $(1/(1+(0.5*1)))= 0.67$. See van Dijk and Verboven (2005) as well as Kosicki and Cahill (2006) for longer treatments of pass-on rates – and indirect purchaser analysis in general – in cartel damage cases. The authors also provide an assessment of the chances of the potentially damaged parties (on different downstream levels) to prevail in court with their damage claims. In general, no restitution is granted to parties who were not customers of the cartel but argue that they would have bought the cartel product at competitive prices. In other words, the deadweight loss caused by the cartel is not part of the damages estimate derived in court (see generally Leslie (2006) for an in-depth assessment of the relationship between antitrust damages and deadweight losses).

1. Determine or estimate the actual cartel prices for each period;
2. Determine or estimate the quantity purchased by each claimant,
3. Estimate the price for each period in the absence of the illegal cartel (known as the 'but-for' price);
4. Calculate the overcharge in each year by subtracting the estimated 'but-for' price from the actual price for each year period;
5. Estimate the proportion of the overcharge absorbed by upstream supplier;
6. Estimate any downstream pass-on of the overcharge;
7. Multiply the net annual overcharge absorbed by the claimant by quantity purchased in each year to arrive at the annual net overcharge absorbed by the claimant;
8. Apply the statutory simple pre-judgment interest rate;
9. Take account of other factors required by law, such as taxation; and
10. Aggregate annual net losses to arrive at a compensable amount.

Although it cannot be the aim here to provide a detailed discussion of all ten compulsory steps in a damages estimation, it is important to remark that in addition to the fixation of the 'but-for' price, the determination or estimation of the actual price paid by each claimant in the respective cartel periods can also be a challenging exercise given the presence of, e.g., different forms of rebates. Furthermore, as already mentioned above, an estimation of the degree of pass-on of the overcharge to downstream levels (thereby reducing the actual harm on the present level) can increase the complexity of the analysis significantly.

Turning back to the counterfactual 'but-for' scenario, an extensive literature on methods to derive an estimate of the 'but-for' price has developed. An overview of the most prominent methods is provided in Table 5.

Table 5: Methods of estimating the counterfactual scenario

Method	Description
Before and after approach	The counterfactual is approximated by the situation before and/or after the infringement
Yardstick approach	The counterfactual is approximated by the performance of a similar but unaffected group (a control group) – e.g., a parallel but non-cartelised market
Difference-in-differences approach	A combination of the two methods above. The performance of the control group before and during infringement is compared with the performance of the affected group before and during the infringement. This ensures that factors specific to the control group do not affect the damages estimate for the affected group
Cost-based approach	The counterfactual price is calculated by using the data on the defendant's production cost and adding a margin to obtain a price which can be considered reasonable under competitive conditions. Unlike other methods, this model can usually provide information only on prices, not counterfactual volumes
Time series techniques	The counterfactual is estimated using the variable's past performance. This is a more sophisticated 'before-and-after' technique than a simple average or trend estimation as it takes into account patterns in the data
Deterministic eco-nometric model	This explains market outcomes using the drivers hypothesised by economic theory, such as GDP, inflation, and changes in input costs
Oligopoly modelling	Such a model uses data on the structure of the market (e.g., number of firms, market shares), combined with an assumption of how the market operates (e.g., Cournot oligopoly) and the structure of firms' costs and market demand to estimate the counterfactual

Source: Oxera (2008: 3)

The methods to derive the 'but-for' price shown in Table 5 differ significantly with respect to their input requirements, conceptual complexity, technical complexity and underlying assumptions. Given these differences together with the varying characteristics of the investigated cases, Oxera (2008) among others argue that there cannot be one method that generally dominates the others. Quite the contrary, it is not only necessary to identify the most suitable methods on a case-by-case basis, but it is also advisable to apply several methods in parallel in order to cross-check (or even pool) the results thereby identifying a robust and reliable estimate of the 'but-for'-price.

Although the description of the procedure to calculate damages is very close to its actual implementation in reality, Hellwig (2006) and others remind that the overcharge estimated so far is only part of the entire harm that also needs to include foregone profits when the cartel members' overcharging induces the direct buyer to reduce his purchases. As a consequence, the actual losses of downstream firms consist of the overcharge and the foregone profits. Interestingly, Hellwig (2006) shows that that the business-loss effect may actually outweigh the per-unit revenue enhancing effect. This questions the common practice of courts to exclude foregone profits from the damages calculation.[38]

4.2.2. Quantification of damages in practice – The case of the global lysine cartel

In this section, the calculation of damages is exemplified with real data from the global lysine cartel which effectively existed from August 1992 until June 1995. Although the cartel operated on a world wide basis, data limitations force the following analysis to concentrate on the losses to customers in the United States.

Based on the characterisation of the lysine industry in general and the existing hard core cartel in particular in Section 4.1.1 above, the availability of data on production, prices and average total cost of ADM between July 1991 and June 1995 (i.e. the pre-cartel period as well as the whole cartel period) allows, on the one hand, an application of the cost-based approach (described in Table 5 above) to estimate the 'but-for' price and, on the other hand, a simple 'back of the envelope' quantification of the excess profits ADM was able to collect due to the cartel agreement. The calculations are (schematically) conducted in Table 6 below (see Hüschelrath, 2009, for the entire analysis).

Table 6. Estimating excess profits of ADM collected during the lysine cartel (1992-1995)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Month/ Year	US Price	ATC	ATC + ROI	Production	Total costs	Total revenue	Total profit	But-for revenue	But-for profit	Excess Profit
	Cents /lb.	Cents /lb.	6% of sales	lb.	US Dollar	US Dollar	US Dollar	US Dollar	US Dollar	US Dollar
Jul 91	101	144.8	150.9	4,345,749	6,292,645	4,389,206	-1,903,438	6,555,997	263,352	-2,166,790
…	…	…	…	…	…	…	…	…	…	…
Jun 95	96	73.70	79.46	14,754,945	10,874,394	14,164,747	3,290,353	11,724,279	849,885	2,440,468
Total	*101*	*73.31*	*79.37*	*48,.435,264*	*352,530,077*	*495,264,847*	*142,734,771*	*382,245,967*	*29,715,891*	*113,018,880*

Source: Own calculations based on data from Connor (2002); Connor's ATC estimates and US market prices used for calculations; Monthly production = Monthly sales assumed.

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[38] One argument to justify the non-inclusion of foregone profits is the high costs to identify and prove the respective damage in court.

Column (1) shows the actual US market price for lysine. Column (2) shows the average total cost of lysine production of ADM as estimated by Connor (2002: 34). Column (3) in the calculation spreadsheet above adds an average return on investment of 6% of sales to the ATC to get a cost-based 'but-for' price which would have existed in the absence of the cartel. Column (4) shows the monthly lysine production of ADM. As detailed sales data is unavailable, the calculations have to assume that the whole monthly production is sold to the US market price in the United States in the same month. Columns (5), (6) and (7) calculate total costs, revenues and profit of ADM during the cartel as well as in the pre-cartel period. Columns (8) and (9) provide the numbers on revenues and profits ADM would have made if they faced the competitive 'but-for' price. Column (10) finally calculates the excess profit collected by ADM during the cartel. To get this value, the 'but-for' profit in column (9) simply has to be subtracted from the total profit estimate in column (7).

The results of the calculations in Table 6 show that the overall excess profit for ADM alone was about $113 million (or $3.229 million per month on average) during the cartel period from August 1992 to June 1995. The table further shows that the derived average 'but-for' price of $0.7937 is relatively close to the 'but-for' price of $0.8000 which was derived (by a different technique) during the trial (see Connor, 2006a: 18). The spreadsheet calculations further allow deriving the 'incremental' reduction in 'damages'[39] if the 'but-for' price is raised by one cent. The result of $4.82 million damage reduction per cent generally shows the sensitivity of the damage calculations to the 'but-for' price mentioned above. From a practical perspective, it shows why it usually pays for the defendant to hire economic experts: They might be able to raise the 'but-for' price by a few cents and so might save the defendant millions and millions of dollars in damages.[40]

From a conceptual perspective, it is important to remind of the alternative methods that can be used to derive the 'but-for' price. For example, one additional possibility is the application of economic models aiming at simulating competition and deriving an estimate for the 'but-for' price. For example, in a simple Cournot model with homogenous goods, the market price P can be estimated by using the following expression (ε_D^m is the market demand elasticity, c are marginal cost and HHI is the Herfindahl-Hirschman Index; see the Appendix for the derivation):

$$P = \frac{\varepsilon_D^m \cdot c}{\left(\varepsilon_D^m - HHI\right)}. \tag{6}$$

Equation (6) basically shows that the predicted 'but-for' price decreases with the number of firms in the market. In a competitive industry, the 'but-for' price would be equal to marginal costs. As reported by Connor (2000: 66f.), economists defending ADM actually used price estimates derived by a similar Cournot model to calculate (lower) damages. One basic problem which such estimates turned out to be its sensitivity to small changes in the

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[39] Technically, the excess profit calculated here is the amount that needs to be distributed to the downstream lysine buyers subject to their actual demand in the respective cartel periods.

[40] The exact values for different 'but-for' prices are as follows: $157,560,162 for a 'but-for' price of $0.70, $133,438,399 for a 'but-for' price of $0.75, $109,316,636 for a 'but-for' price of $0.80, $85,194,873 for a 'but-for' price of $0.85, $61,073,110 for a 'but-for' price $0.90, $36,951,346 for a 'but-for' price of $0.95 and still $12,829,583 for a 'but-for' price of $1.00.

underlying assumptions on market demand elasticity and marginal cost. This can be exemplified by plotting the above equation for different marginal costs of lysine (range from $0.40-$0.90 per lb.) as well as different absolute demand elasticities (range from 0.0-2.0; see Figure 5 below).

Figure 5. Predicted lysine 'but-for' prices applying a basic Cournot model with homogenous goods (HHI=3,500)
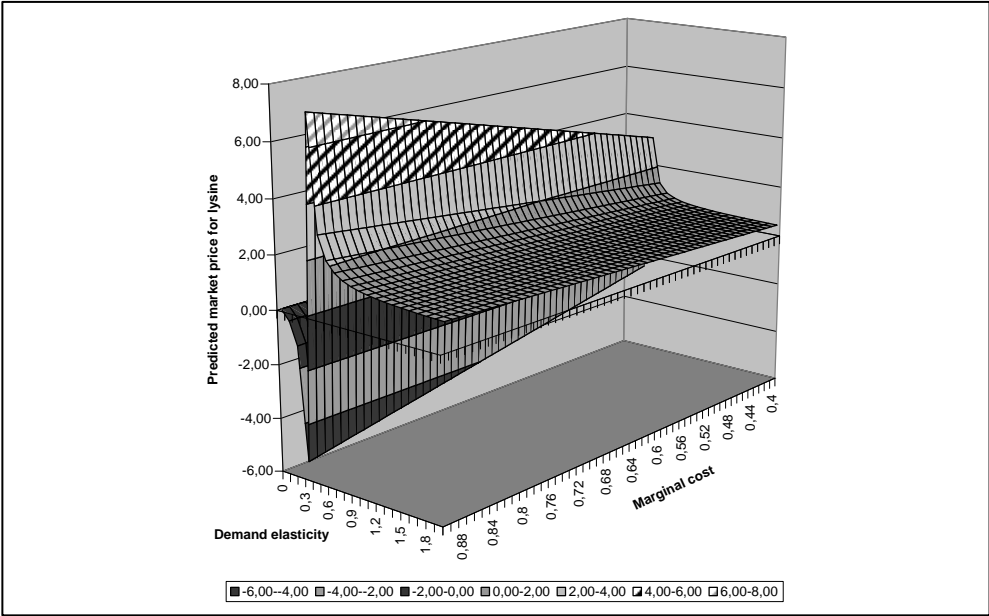
Source: Hüschelrath (2009: 366)

As shown in Figure 5, the price predictions of the Cournot model can indeed be sensitive to slight changes of the marginal costs as well as the underlying demand elasticity. Especially in case of relatively inelastic demand (which was assumed to be the case for lysine), the predicted Cournot prices can even be negative or up to 800% higher than marginal cost. It is obvious that such model specifics make it difficult to use the respective results (successfully) in the courtroom – first of all because such results are easy to attack by the plaintiff.

However, as already sketched above, economic research has provided much more sophisticated methods to simulate 'but-for' prices. Given a sufficient data basis, it would, e.g., be possible to conduct a simulation analysis which combines a demand model, a firm model as well as a model of competitive interaction to receive 'simulated' market outcomes for different scenarios. De Roos (2006), for instance, construct and applies such a more sophisticated collusion model in order to understand the lysine market and to derive 'meaningful' 'but-for' prices.

Finally, it is worth mentioning that the criminal lysine price fixing conspiracy trials led to five corporate fines and seven personal fines. The US corporate fines add up to $92.5 million, compared to $97.9 million in the EU and $11.5 million in Canada. In 1999, three persons where sentenced to a total of 99 months in prison (with a maximum per individual of 36 months). The private antitrust suits ended with agreements that the cartel members pay damages of (in sum) about $85 million (only in the United States) which was roughly the loss

of the lysine buyers in the United States. US antitrust law would have allowed up to treble damages.

5. Evaluation

In general, an evaluation of the successfulness of cartel enforcement faces an identification problem. If only a few cartels are detected, this could on the one hand be an indicator of a successful deterrence policy of the competition authority. On the other hand, however, an alternative interpretation of such an observation could be that the competition authority follows an ill-equipped approach to detect cartels or suffers from insufficient resources to exercise its duties conscientiously. Vice versa, an increase in the detection of cartels could on the one hand be an indicator that certain policy changes have been steps in the right direction. However, on the other hand, it could also indicate that only the number of cartels has risen and the competition authority was able to detect some of them more or less accidentally.

Despite the apparent identification problems, economists have developed and applied several methods which allow an evaluation of cartel enforcement activities. In the following sub-sections, the implementation of optimal corporate fines, the impact of cartel enforcement on post-cartel prices and the attempts to measure the deterrent effect of cartel enforcement are investigated in greater detail.[41]

Implementation of optimal corporate fines
A first indicator of the success of cartel enforcement focuses on the question whether the fines actually collected by the competition authorities come anywhere near to the theoretically derived optimal fines (and therefore signal firms that cartelisation does not pay). To answer this question, Veljanovski (2007a) collected data on duration, fines imposed, sales, overcharges, and consumer losses for several detected and prosecuted hard core cartels in the European Union. He further calculated the theoretically optimal fines – largely based on the respective cartel overcharge estimate (the measure for 'harm caused') as well as an (optimistic) probability of detection for cartels of 33%. An extract of his results is presented in Table 7.

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[41] Although the academic methods sketched in the following provide useful insights into the effectiveness of cartel enforcement, these studies are unlikely to guide the competition authority into an improved allocation of its resources. This has partly to do with the fact that a large fraction of the real success of anti-cartel policies depends on the actual implementation of the respective tools in practice (see generally ICN (2010) for an overview). As a consequence, the presentation of academic evaluation methods should be complemented by a more practical perspective which allows an actual assessment of the costs and benefits of competition policy in general and anti-cartel policy in particular. The building blocks of a respective methodology are developed in Hüschelrath and Leheyda (2010).

Table 7. Estimates of consumer losses and optimal fines

Cartel	Dura-tion	Fine	Sales	Over-charge	Consu-mer loss	Fine	Optimal fine	
	Years	*€m*	*€m*	*€m*	*€m*		*Fine €m*	*Multipl.*
Lysine	4	110	164	121	181	61%	549	5.0
Vitamin A	9	132	150	275	413	32%	1,251	9.5
Vitamin E	9	203	250	459	688	30%	2,085	10.3
Vitamin C	5	114	120	112	168	68%	510	4.5
Vitamin D3	4	41	20	15	22	184%	67	1.6
Graphite Electr.	6	219	420	481	722	30%	2,188	10.0
Citric Acid	4	135	320	236	353	38%	1,071	7.9
Food Flavor Enh.	9	21	12	22	33	62%	100	4.9
Organic Peroxides	25	70	250	1,694	2,649	3%	8,029	115.5
Copper Plumbing	13	222	1,151	3,311	4,967	4%	15,052	67.7
Rubber Chemicals	5	76	200	188	282	27%	854	11.3

Remarks: Optimal fines calculations are based on a probability of detection of 0.33; 'Sales' refers to annual sales in preceding year.
Source: Table largely follows Veljanovski (2007a: 22); own calculations.

As shown in Table 7, the fines collected by the European Commission largely under-deter price-fixing.[42] As shown by the multiplier in the last column, the optimal fine would have been between 1.6 and 115.5 times higher than the fines actually imposed. The general result of significant under-deterrence of price fixing is confirmed by a recent study by Combe and Monnier (2009) who concluded from an analysis of a sample of 64 cartels convicted by the European Commission from 1975 to 2009 that the fines imposed by the European Commission were overall suboptimally low (whatever the assumed level of the probability of detection). Furthermore, a detailed empirical study of cartel sanctions by Bolotova and Connor (2008) – using a sample of international cartels – suggests that modern antitrust policy is unlikely to be effective in their deterrent function. One key reason is the weak link between the concept of optimal fines (based on the net harm to others) and the fine calculation methods actually applied by competition authorities (typically based on a percentage of affected sales during the last full calendar year of cartel operation). Interestingly, Bolotova and Connor (2008) find that the relationship between cartel fine and cartel overcharge is negative, implying that cartels imposing higher overcharges (i.e. harm customers to a larger extend) tend to pay smaller fines.

However, although these results on the surface speak for significant under-deterrence, it is important to remark that the company fines presented in the table might be complemented by other payments, which can be interpreted as additional fines from the viewpoint of the cartel members. For example, in some jurisdictions, courts are not only entitled to impose

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[42] In a recent paper, Connor (2006) reaches the same conclusion albeit applying an alternative approach. He concludes that in order to "ensure optimal deterrence of global cartels, total financial sanctions should be four times the expected global cartel profits (the overcharge). In the case of followers, deterrence would require penalties in all geographic regions to be equal to eight times global cartel overcharges. Even in cases widely regarded as exemplary prosecutions, antitrust sanctions historically have failed to approach optimal levels" (p. 30). Furthermore, a recent empirical investigation by Combe and Monnier (2009) concluded from an analysis of a sample of 64 cartels convicted by the European Commission from 1975 to 2009 that the fines imposed by the European Commission were overall suboptimally low (whatever the assumed level of the probability of detection).

(pecuniary) fines on undertakings for proven infringements of competition law but can also punish the responsible individuals for (specific) infringements of competition law with either pecuniary fines and/or prison sentences. *Individual punishment* is normally not limited to the prison term as such but is often extended through a reduced employability of the manager afterwards. Furthermore, the loss of the respective manager can have an additional punitive effect on the firm, especially if the manager was important for the business success and cannot be replaced easily. Although the legal system of the European Union currently does not foresee individual sanctions, the legal situation in several member states such as the UK or Germany allows individual sanctions for specific serious infringements such as cartelisation in general (UK) or specifically bid-rigging (Germany).

An additional component in a calculation of the overall negative consequences of detected hard core cartels is *private damage claims*. As assessed in Section 4 above, although damages generally aim to compensate affected private parties for the harm caused by price-fixing conspiracies, they can also be interpreted as an additional punitive weapon. For example, in the United States, damages are an important cornerstone of the entire enforcement strategy and damaged parties are entitled to sue for up to treble damages. Furthermore, class actions are allowed to bundle the interests against the cartelists. In the European Union, private damage claims have not played a huge role so far; however, recent initiatives by the European Commission can expect this situation to change in the coming years. Referring to the calculation of the consumer losses and optimal fines for selected European hard core cartel cases in Table 7 above, a comparison of the values for the corporate fines imposed and the overcharges reveals that the addition of both categories lead to a significant increase in the overall fine and therefore reduces the respective multiplier (based on the optimal fine in the respective cases).

A further component of the entire fine package must be seen in the *trials* in court following the detection of a hard core cartel. These procedures not only incur direct costs such as litigation costs and counsel fees but also cause substantial in-house costs, e.g., as employees need to invest part of their working time in the provision of information for the investigation or trials. These costs might be complemented by contract renegotiation costs if it turns out that contracts including anticompetitive practices are void and therefore need to be renegotiated. The actual size of litigation costs and counsel fees depends to a large degree on the type and size of the respective case. For the European Union, Neven (2005) reports that the costs and fees spent by Airtours in the EC merger investigation of *Airtours/First Choice*[43] add up to more than €2.2 million overall with about 80% of these costs referring to the work of lawyers and the remaining 20% to the work of economists. Although it can be expected that merger cases are more complex and therefore need more resource input than cartel cases – as in the latter case the conduct as such is relatively easy to prove – litigation costs and counsel fees can still become quite significant if, first, the costs of trials in multiple jurisdictions are taken into account[44] and, second, private damages actions follow the

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43 Case No IV/M.1524 – Airtours/First Choice.

44 A survey by PriceWaterhouseCoopers (2003: 4) found that a typical multi-jurisdictional merger deal generates on average €3.3 million in external merger review costs. However, the survey shows further that a

imposition of public fines thereby demanding the investment of substantial additional resources in, e.g., the calculation of the 'true' damages caused by the cartel agreement.

An additional component in a calculation of the overall negative consequences of detected hard core cartels is the *effects on stock prices*. Generally, the stock prices of a firm change as a result of market forces and are an indicator for the perceived value of the firm. An important factor that affects the value of a company is its profits and profit expectations. A detected cartel involvement reduces the profits and profit expectations and therefore expects a drop in the stock price. Ceteris paribus, such a development must be considered as an additional negative consequence of detected hard core cartels. With respect to quantification, Langus and Motta (2006) use an event-study approach to investigate the impact of various events of EU cartel enforcement on the respective firm's stock market value. Their results show that dawn raids reduced the firm's stock market value by 2.2% on average on the day of the raid. Furthermore, the formal decision of the European Commission (that a cartel was detected) led to another loss of 3.0% on average of the firm's stock market value.

A final component of the entire fine package must be seen in *negative effects on firm reputation*. As hard core cartels detected by the competition authority usually cannot be kept in secret, a further negative consequence of such infringements must be seen in adverse publicity causing negative effects on firm reputation. The knock-on effects of such a decrease in reputation can be multifaceted. For example, in addition to a general reduction in future business opportunities, especially public sector customers might have to debar the firm from doing business with them. Furthermore, a damaged firm reputation might complicate the process of hiring high potential employees and therefore causes negative effects on future firm performance. Additionally, the payment of substantial fines and damages can cause a competitive disadvantage due to reduced possibilities to undertake investments in the firm's operations or research and development. Depending on the general financial situation of the firm and the competitive situation in the respective markets, the competitive disadvantages might become so severe that the firm's existence is at stake and therefore fortifies the negative effects on firm reputation.

In sum, given the absence of a complete empirical assessment of the various cost components of detected hard core cartels, the question whether price-fixing in the European Union is really under-deterred has to remain unanswered.

Impact of cartel enforcement on post-cartel prices
Still aiming at assessing the successfulness of hard core cartel enforcement, another quantitative possibility is to analyse its effect on post-cartel prices. From a theoretical perspective, the breakdown of a cartel should be followed by price declines down to the non-collusive level. Empirical evidence, however, partly suggests that this price decline is often less significant. Feinberg (1984), for example, found a decline in average prices in four out of five investigated cartels between 6.6% and 11.4% which, however, partly diminished in the

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few major deals with at least one in-depth review by a competition authority incurred costs of more than €10 million.

five years following the cartel detection (3.4%-8.9% lower prices due to deterrence). Sproul (1993) surveys 25 price-fixing cases between 1973 and 1984 with respect to the price levels four years after the breakdown. He finds an increase in prices of 7% on average for his sample. Thompson and Kaserman (2001) analyse the stock price movements 'after the fall' of 57 price-fixing cases with 127 firms involved. They find that within roughly one year of indictment, the stock prices of 85% of the firms in the sample had returned to their pre-indictment (collusive) values. Confronted with these results, they conclude that cartel enforcement has a very little lasting effect on market outcomes. "While it punishes individual offenders, it does not effectively deter collusion on any sort of sustained basis" (p. 334), basically because the cartel-adequate market structures remain unchanged after the conviction (and so the general incentives to re-build the cartel at a later point). In line with this finding, Harrington (2005a: 5) concludes from his review of the empirical research that cartel enforcement typically leads to price declines in the short run, however, that price increases are often experienced in the medium and long run. Taking a look at the price data over time for the US lysine cartel somehow corroborates this view (as shown in Figure 6).

Figure 6. Average monthly lysine prices in the United States between July 1991 and December 1995
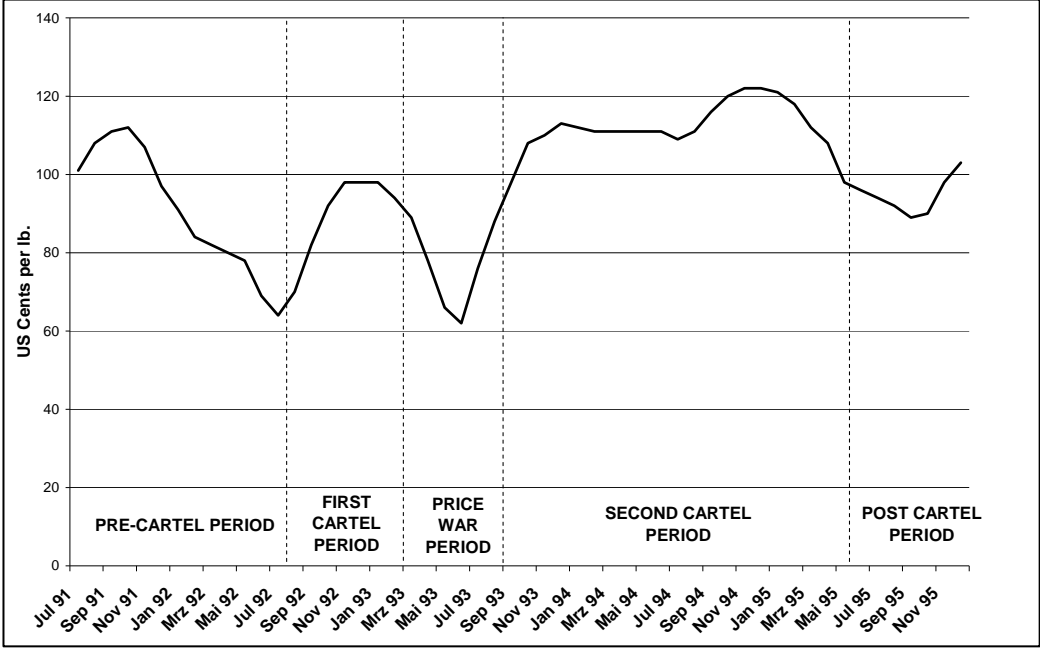
Data source: Connor (2002)

As shown in Figure 6, the price decline after the breakdown of the cartel was relatively small and – less than half a year later – the actual average lysine price already overtook the price that existed at the end of the cartel.[45] One explanation for this observation could be that firms learned to collude tacitly and therefore managed to realise prices above the competitive level. In addition to the fact that the detection of a cartel does not change the collusion-friendly

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45 A noticeable and a bit puzzling characteristic of the average monthly lysine prices shown in Figure 6 is the experienced substantial decline in the lysine price in the months prior to the dawn raids that cracked the cartel. One explanation could be the beginning of a second price war (which was ended by the dawn raids in June 1995).

market structure of the industry (and therefore keep up the basic collusion incentives), the cartel members might have an additional incentive to avoid fierce price competition in the post-cartel period, as this would signal the court a higher harm caused by the cartel (probably causing the fixation of a lower 'but-for' price in the trials).[46]

Assessing the deterrent effect of cartel enforcement
Measuring the deterrent effect is particularly difficult because it is typically not known how a group of firms would have behaved in the absence of cartel enforcement. As shown in the following paragraphs, economists and lawyers have nevertheless collected pieces of evidence for the general existence and powerfulness of a deterrent effect of cartel enforcement.

Block et al. (1981), for example, test their theoretical model described in Section 4.1.2 above and indeed find for the US bread industry that an increase in the DOJ's enforcement capacity or filing of a DOJ price-fixing complaint had a negative effect on the price markups. Furthermore, Block and Feinstein (1986) find evidence on the existence of a deterrence effect in highway construction procurement auctions. Clarke and Evenett (2003: 725f.) show for the case of the international vitamins cartel that the cartel reduced its overcharges in jurisdictions with tough cartel enforcement. For most European jurisdictions, this reduction in overcharges reached by the presence of tough cartel enforcement regimes was already large enough to cover a substantial proportion of the overall budgets of the respective competition authorities (including the budget of DG Competition at the European Commission). Additionally, Symeonidis (2000) analyses the effect of the introduction of anti-cartel laws in the United Kingdom in 1956 and finds that price competition increased and led to lower margins in industries which had been previously cartelised.

In addition to these largely quantitative research efforts, there have been several attempts by researchers to track down the deterrent effect by conducting surveys. Following the review of the literature by Gordon and Squires (2008: 414f.), Beckenstein and Gabel (1982) must be considered pioneers of this type of study. They conducted a survey of 859 members of the Antitrust Law Section of the American Bar Association and asked questions related to compliance programs, reasons for violations, factors which generate deterrence or generally how deterrence can be improved. One key result of the survey was that private enforcement seems to play a larger role in creating a deterrent effect than public enforcement. In a comparable study for the European Union, Feinberg (1985) interviewed 24 Brussels-based lawyers and came to the conclusion, that the two most important factors to increase the deterrent effect were an increase in the use of private damages actions and the introduction of individual sanctions for competition law violations. Finally, Rodger (2005) investigated whether the reform of UK competition policy in the late 1990s – which introduced significant improvements in investigatory and fining powers of the competition authorities – led to increased compliance efforts in the UK industry. He assessed the competition law compliance

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46 From a policy perspective, these results suggest that competition authorities should continue to monitor the respective industries in order to make attempts to re-build the cartel more difficult. An alternative way of tackling the post-cartel phase problems would be the imposition of behavioural or even structural remedies. One possibility of a potentially suitable behavioural remedy would be to force each of the former cartel members to furnish a compliance report, in which the firms have to submit price data and report on the state of competition in the industry to the competition authority.

programs of three major UK companies and found limited evidence to support the theoretical argument that an increase in the expected sanctions for cartel breaches leads to an increase in compliance efforts.

Based on these early efforts to study the importance of the deterrent effect, significant advances were realized by a recent study by Deloitte (2007) on behalf of the Office of Fair Trading in the UK. Interestingly, the key aim of the study was to measure the size of the indirect deterrent effects of competition policy in relation to its direct effects realized in the areas of cartels, mergers and abuses of dominant positions. In order to reach this aim, 30 expert interviews were conducted between May and November 2006 among antitrust lawyers, economists and firms. These efforts were complemented by two telephone-based surveys: the first survey addressing 234 antitrust lawyers and the second survey addressing 202 firms (with more than 200 employers) in the UK. As part of this extensive survey, the deterrent effect of merger control was measured as number of merger plans that were abandoned or modified after consulting external lawyers but before the OFT was informed about the plans relative to the number of mergers in which a substantial lessening of competition was found during an OFT investigation. With respect to the measurement of the deterrent effect of cartel enforcement, respondents to the legal survey were asked in how many instances one of their clients abandoned or modified an existing or proposed agreement that may have been considered a cartel because of the risk of an investigation by the OFT. Subsequently, these results were compared with the number of cartels detected by the OFT.[47] The results of the survey show for the period from 2000 to 2006 a ratio of 5 to 1 for merger control and for cartel enforcement – in both cases reflecting the relationship of the deterrent effect and the direct effect.

In addition to an assessment of the deterrent effect of public enforcement, it should be reminded that private enforcement activities can reinforce this effect. Although empirical research in this area is sparse, a recent empirical study based on forty hard core cartel cases in the United States by Lande and Davis (2008: 907) finds that "… private litigation actually does a better job than the government in advancing the primary goal of the government's enforcement program: deterring illegal corporate behaviour. The forty cases analyzed … by themselves provide greater deterrence against anticompetitive behaviour than all the DOJ imposed criminal fines and prison sentences since 1990". These empirical results, on the one hand, suggest that future attempts to measure the deterrent effect of cartel enforcement need to be extended to the benefits of private enforcement. On the other hand, the results are a general reminder of the above finding that an efficient and effective overall policy against hard core cartels needs to harmonise the systems of public and private enforcement in order to avoid problems of (socially inefficient) under- or over-deterrence.

6. Conclusion

"Our customers are our enemies"[48] is probably the most famous cartel-related quote once stated by a member of the international lysine cartel that operated between 1992 and 1995. It

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[47] See Gordon and Squires (2008) for a detailed description of the approach.
[48] The quote is taken from Connor (2001:5).

nicely reflects the significant harm for customers and consumers caused by hard core cartels and therefore provide an anecdotal justification for the significant efforts by competition authorities around the world to fight such conspiracies among competitors. The recent enforcement record of, for example, the European Commission, proves that these efforts already paid off in the form of an increasing number of detected and subsequently punished hard core cartels.

Against this background, this paper aimed to go back one step by providing a comprehensive survey of the economics and economic justifications behind the fight against hard core cartels. Following an introductory section, Section 2 focused on the characterisation and rationalisation of the term 'hard core cartel'. It was found that – given the various forms of agreements between competitors – such a delineation is anything but straightforward. Subsequently, Section 3 concentrated on an assessment of the welfare effects of conduct defined as hard core cartel. A particular focus there lied on the possibilities to stabilize hard core cartels and the implied question of how severe the negative welfare effects of hard core cartels can be expected to be. Based on the key finding that hard core cartels can cause significant and long-lasting harm to customers and consumers, Section 4 focused on the complementary question of how a cartel ban should be enforced by a competition authority, affected private parties and the respective court system. With respect to public enforcement, a focal point of interest lied in the assessment of both ex ante tools to reduce the incentives to form cartels and ex post tools to detect and intervene against existing cartels. By contrast, the economic assessment of private enforcement concentrated on the identification and quantification of the damages caused by hard core cartels. Finally, as the long term success of competition policy actions against hard core cartels depends on a continuous improvement and fine-tuning of policy tools, Section 5 discussed options to evaluate the effectiveness of enforcement actions against hard core cartels.

Although it was not the focus of this paper to provide a detailed comparison of the proposed cartel enforcement framework with the current enforcement approaches followed in the European Union and the United States, the empirical sections of the paper revealed that some instruments discussed in the framework are currently not implemented to an economically optimal degree. For example, with respect to ex ante enforcement, especially the regulation of communication between firms has not played a great role in both jurisdictions. Although several forms of communication via information exchanges are banned under both competition legislations, there does not seem to be a coherent approach to use the respective insights of relatively recent research efforts to an optimal degree (see also Kovacic, 2006: 815f.). With respect to market design, the altering of especially public procurement procedures in order to restrict collusion opportunities still contains improvement potential on both sides of the Atlantic. As discussed by Kovacic (pp. 830ff.), promoting entry and applying collusion-proof auction mechanisms can substantially mitigate the problem of cartelisation in public procurement. Finally, a coordinated effects analysis in merger control is well established in the United States as another ex ante instrument to prevent cartelisation, whereas the European Commission experienced several difficulties because decisions were later overturned by European courts (see Kühn, 2002). However, the development and

implementation of a new EC Merger Regulation (and the accompanying EC Horizontal Merger Guidelines) in 2004 should mitigate such problems in the future.

With respect to the detection stage, there does not seem to be a coherent attempt in either the United States or the European Union to implement a screening approach to detect cartels actively. Nevertheless, the sector inquiries conducted in the European Union can provide useful insights into the specifics of certain industries and might therefore also help toward this effort (see Kroes, 2007a). Generally, current cartel enforcement in the United States and the European Union seems to build more on complementary detection mechanisms such as motivating employees or customers to come forward with information on possible cartels. Furthermore, it is believed that the recently reformed and implemented leniency programs have significantly raised the probability of detection (see Kovavic, 2006; Kroes, 2007a). The same conclusion is true for the intensification of international cooperations between competition authorities in their fight against international hard core cartels, which still contain plenty of improvement potential.

With respect to the sanctioning of hard core cartels, both jurisdictions aim at deterring cartel formation with stiff fines and significant probabilities of detection. Nevertheless, the empirical evidence discussed in Sections 4 and 5 suggest that despite the recent significant increases in fines, the fine levels might still be too low to deter cartelisation to an optimal degree. In direct connection to this argument, the deterrence effect of cartel enforcement can be expected to be even lower in the European Union given the impossibility of sanctioning individuals responsible for cartel formation. While the responsible managers in the United States face prison terms of up to three years, comparable actions in Europe are only possible in selected member states such as the UK (for price-fixing generally) or Germany (in cases of bid-rigging only). Consequently, policy actions – especially in the European Union – to further increase the expected fine package might be socially desirable. Such policy actions may also include a reform of the fine calculation methods which appear to have only weak link to the theoretical concept of optimal corporate fines (based on the net harm to others).

Complementary to the identified reform potential with respect to public enforcement, the analysis of private enforcement showed that these actions – although generally guided by the pursuit of corrective justice through compensation – can also have a reinforcing effect on the deterrence of hard core cartels. From this perspective, the recent initiative by the European Commission to strengthen the role of private enforcement in the European Union is a step into the right direction. However, in addition to the general challenges of the identification and quantification of damages in real cartel cases, policy makers need to harmonise the systems of public and private enforcement in order to avoid problems of (socially) inefficient under- or over-deterrence.

Finally, one improvement potential that can be derived out of the discussion of the evaluation of anti-cartel policies is an ex post monitoring of cartel-prone industries. As detection and punishment leave the industry structure unchanged, the (re-)formation of further cartels is not unlikely. Although there are indications that suspicious industries are monitored on a random basis in both jurisdictions, it is worth considering extending these efforts in a more systematic way.

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Appendix

Instability of cartels in one-shot games

As shown in Table 1 in Section 3 above, cartels are chronically instable as every cartel member has an incentive to deviate and the Nash equilibrium therefore is simply to compete against each other. The theoretical reasoning behind this finding is developed below based on a simple Cournot model.

Joint profits of cartelisation

The joint profits of the duopolists are given by

$$\max_{q_1+q_2} \pi(q_1+q_2) = [a - b(q_1+q_2) - c](q_1+q_2), \tag{7}$$

which have to be maximised by selecting outputs optimally. The first-order conditions are

$$\frac{\partial \pi_1}{\partial q_1} = \frac{\partial \pi_2}{\partial q_2} = a - c - 2b(q_1+q_2) = 0 \tag{8}$$

so that the total output is

$$Q^{Cooperation} = \frac{a-c}{2b} = Q^{Monopoly} \tag{9}$$

and the resulting market price is

$$P^{Cooperation} = \frac{a+c}{2} = P^{Monopoly} \tag{10}$$

This is exactly the monopoly outcome. If the colluding firms share profits equally, we get

$$\pi_1^{Cooperation} = \pi_2^{Cooperation} = (p-c)\frac{Q^M}{2} = \left[\frac{a+c}{2} - c\right]\left[\frac{a-c}{4b}\right] = \frac{1}{8}\frac{(a-c)^2}{b}. \tag{11}$$

Profits in Cournot competition

If the duopolists engage in Cournot competition instead, profits are given by

$$\pi_1^{Cournot} = \pi_2^{Cournot} = (p-c)q^c = \left[\frac{a+2c}{3} - c\right]\left[\frac{a-c}{3b}\right] = \frac{1}{9}\frac{(a-c)^2}{b}. \tag{12}$$

Comparing expressions (11) and (12) shows that cartel profits are higher than the profits under competition. Consequently, firms will have an incentive to engage in collusive agreements.

Profits if one firm deviates

Now assume that firm 1 believes that firm 2 sticks to the collusive agreement. In such a case, it is profit-maximising for firm 1 not to stick to the collusive agreement. Instead, firm 1 should produce the quantity that is the best response to the quantity

$$q_2^{Cooperation} = \frac{a-c}{4b} \tag{13}$$

provided by firm 2. If this quantity is considered in firm 1's best response function we get

$$q_1^{Defection} = \left(\frac{a-c}{2b}\right) - \left(\frac{q_2^{Cooperation}}{2}\right) = \left(\frac{a-c}{2b}\right) - \left(\frac{a-c}{8b}\right) = \frac{3(a-c)}{8b}. \tag{14}$$

Total output is then given by

$$Q = q_2^{Cooperation} + q_1^{Defection} = \frac{a-c}{4b} + \frac{3(a-c)}{8b} = \frac{5(a-c)}{8b} \tag{15}$$

which leads to a price of

$$\frac{3a + 5c}{8b} \tag{16}$$

and profits of

$$\pi_1 = \frac{9(a-c)^2}{64b}, \tag{17}$$

$$\pi_2 = \frac{3(a-c)^2}{32b}. \tag{18}$$

Comparing these profits with the profits realised in a cartel shows that it pays for both firms to deviate from a cartel agreement (assuming that the other firm keeps the agreement). As both firms anticipate this, 'non-cooperation' is the Nash equilibrium of the simple game. Any form of cooperation is unstable due to a lack of trust. From a social welfare perspective, a comparison of the respective outputs shows that welfare is maximised under Cournot competition followed by the state of one deviating firm. In the cartel state, the industry provides the lowest output to the highest price and therefore realises the lowest surplus of all three states.

Additionally, it is insightful to analyse the same game as above for n firms in the market. In that case, the profit for the cartel member i in the collusion state is given by

$$\pi_i^{Cooperation} = \frac{1}{4n} \frac{(a-c)^2}{b} \tag{19}$$

while the profit of the same firm i in Cournot competition can be calculated to

$$\pi_i^{Cournot} = \frac{1}{(n+1)^2} \frac{(a-c)^2}{b}. \tag{20}$$

Finally, in case that n-1 firms are sticking to the cooperation quantity, and firm i deviates by maximising its profits by increasing quantity, the profit of firm i is given by

$$\pi_i^{Defection} = \frac{(n+1)^2}{(4n)^2} \frac{(a-c)^2}{b}. \tag{21}$$

Stability of cartels in supergames
Based on the general model framework developed in the preceding section, it has to be assessed here under what conditions cartel agreements can be stable in a dynamic context. To be exact, the so-called supergames basically assume the repetition of a certain one-shot game for an infinite time horizon. The infinity (or at least the 'unknown ending') of the game is a crucial assumption – following Selten's concept of backward induction – as a definite ending of the game would again lead to the conclusion that cartel agreements are instable.

Assuming an infinite time horizon, the payoff for cooperation can be written as follows:

$$\Pi^{Cooperation} = \pi^{Cooperation} [1 + \delta + ...]. \tag{22}$$

If one firm is deviating from the cooperative output in the first period, it receives the higher deviation profit for one period but the lower non-cooperation profit in the subsequent periods. In an intertemporal context this leads to

$$\Pi^{Defection} = \pi^{Defection} + \pi^{Non-Cooperation}\left[\delta + \delta^2 + ...\right]. \tag{23}$$

Hence, a cartel agreement is stable if the following condition holds

$$\pi^{Cooperation}\left[1 + \delta + ...\right] \geq \pi^{Defection} + \pi^{Non-Cooperation}\left[\delta + \delta^2 + ...\right] \tag{24}$$

or

$$\pi^{Cooperation}\sum_{t=0}^{T}\delta^t \geq \pi^{Defection} + \pi^{Non-Cooperation}\sum_{t=1}^{T}\delta^t. \tag{25}$$

Further rearrangements allow writing (25) as follows

$$\pi^{Cooperation}\frac{1}{1-\delta} \geq \pi^{Defection} + \pi^{Non-Cooperation}\frac{\delta}{1-\delta} \tag{26}$$

and finally

$$\delta \geq \frac{\pi^{Defection} - \pi^{Cooperation}}{\pi^{Defection} - \pi^{Non-Cooperation}}. \tag{27}$$

Inserting the payoffs derived from the one-shot game above lead to

$$\delta \geq \frac{\dfrac{(n+1)^2}{(4n)^2}\dfrac{(a-c)^2}{b} - \dfrac{1}{4n}\dfrac{(a-c)^2}{b}}{\dfrac{(n+1)^2}{(4n)^2}\dfrac{(a-c)^2}{b} - \dfrac{1}{(n+1)^2}\dfrac{(a-c)^2}{b}} = \frac{\dfrac{(n+1)^2}{(4n)^2} - \dfrac{1}{4n}}{\dfrac{(n+1)^2}{(4n)^2} - \dfrac{1}{(n+1)^2}}. \tag{28}$$

For n=2, the critical discount factor can be calculated to

$$\delta \geq \frac{\dfrac{9}{64}\dfrac{(a-c)^2}{b} - \dfrac{1}{8}\dfrac{(a-c)^2}{b}}{\dfrac{9}{64}\dfrac{(a-c)^2}{b} - \dfrac{1}{9}\dfrac{(a-c)^2}{b}} \approx 0.53. \tag{29}$$

Equation (29) shows the minimum discount factor necessary to stabilise the cartel agreement. In terms of the interest rate r – which is given by $\delta = (1/(1+r))$ – Equation (27) can be expressed as follows

$$r \leq \frac{\pi^{Cooperation} - \pi^{Non-Cooperation}}{\pi^{Defection} - \pi^{Cooperation}}. \tag{30}$$

Simulation of the 'but-for' price with a simple Cournot model
In a first step, it has to be shown that the following relation between the Lerner index (L) and the Herfindahl-Hirschman Index (HHI) is true:

$$L = \frac{HHI}{\varepsilon_D^m}. \tag{31}$$

Following, for instance, Motta (2004: 123f.), it is assumed that firms compete in quantities, produce a homogenous good and have constant marginal cost c_i. The profits of firm i are then given by

$$\pi_i = p(Q)q_i - c_iq_i, \text{ with } Q = q_i + \sum_{j \neq i}q_j. \tag{32}$$

52

Profit maximisation leads to the following first-order condition:

$$\frac{\partial \pi_i}{\partial q_i} = p(Q) + \frac{\partial p}{\partial q_i} q_i - c_i = 0.$$

(33)

The equilibrium price p* is defined by the solution of all first-order conditions. At such a price, the first-order condition for firm I can be expressed as follows:

$$p^*(Q) - c_i = -\frac{\partial p}{\partial Q} \frac{\partial Q}{\partial q_i} q_i.$$

(34)

Dividing both sides by p* and multiplying the right-hand side by (Q/Q) we get

$$\frac{p^* - c_i}{p^*} = -\frac{\partial p}{\partial Q} \frac{Q}{p^*} \frac{q_i}{Q}.$$

(35)

This can be rewritten as

$$L_i = \frac{s_i}{\varepsilon_D^m}.$$

(36)

Given this 'Lerner index of market power for the firm i', it is possible to derive an aggregate index of market power for an industry as a whole. If $L = \sum_i s_i L_i$ we get

$$L = \sum_i \frac{s_i^2}{\varepsilon_D^m} = \frac{HHI}{\varepsilon_D^m}.$$

(37)

Equation (37) basically shows that there is a direct relationship between industry concentration (HHI) and market power (L).

In a second step, rearranging Equation (37) yields

$$P = \frac{\varepsilon_D^m \cdot c}{\left(\varepsilon_D^m - HHI\right)}$$

(38)

which can be used to simulate the 'but for' price as part of damages estimations.