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Incomplete cartels and antitrust policy : incidence and detection

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4

Cartel Detection and Antitrust Law Enforcement

“The chase is better than the catch” – Scooter¹

4.1 Introduction

In many fields of law enforcement, pro-active measures are taken to ensure compliance. For example, tax authorities frequently carry out ‘fishing expeditions’ in order to verify if certain groups of people truthfully reported their earnings, financial markets are screened for security fraud and the police regularly monitors highways to check if speed limits are respected and whether or not drivers are under the influence of alcohol or other drugs. In contrast, antitrust agencies around the world tend to rely on more passive instruments of enforcement. In particular, hard-core cartel activity is discovered almost exclusively through in-depth investigations in response to other clear signals of collusion. In other words, antitrust authorities are mainly *reacting*, not *acting*.²

An antitrust agency does, however, have the right to search for collusive behavior upon its own initiative, which we denote ‘cartel detection’. More precisely, we define it as follows,

Definition 4.1 *Cartel detection is a **pro-active, conscious search** for cartels by an antitrust agency.*

¹From the song “How much is the Fish?” by Scooter (1998).

²See, for example, Friederiszick and Maier-Rigaud (2007, 2008).

In principle, cartels can be brought to light by anybody. Yet, discoveries by, for instance, employees, direct and indirect purchasers, the board of directors, competitors of the cartel, are rather accidental and are usually communicated to the antitrust authority via a complaint procedure and/or a leniency program.³ The, admittedly somewhat narrow, definition of cartel detection therefore primarily serves the purpose of isolating those cases in which the antitrust agency is the first non-participant to find out about potential anticompetitive conduct. Additionally, the possibility that the antitrust authority discovers a cartel accidentally, for example, as a spin-off of some other investigation, is excluded from the definition.

This chapter discusses the potential role of cartel detection in antitrust enforcement and explains how economic theory can be used in the search for cartels. In antitrust practice, examples of cartel detection methods include tracking of individuals and media, infiltration and economic methods of detection.⁴ One can imagine that it might be useful to closely follow the careers of managers that have been involved in cartels before. Also, one potentially can find hints of anticompetitive behavior in relevant trade press and business related websites. In addition, the authority may attend business events with the aim to become familiar with existing social relations between firms and managers within a particular industry. Finally, use can be made of economic theory and econometric techniques to search for cartel activity.⁵ The latter is doubtless the least popular and many antitrust authorities, including the Antitrust Division of the U.S. Department of Justice, do not use economics to detect cartels.⁶

Currently, authorities that do make use of economics often use it to identify industries that are prone to collusion. This procedure typically works as follows. As a first step, investigators loosely define a particular market. For instance, the market for bicycles consists of about x players and the products involved are only slightly differentiated. A second step is then to collect more detailed information, which is partly used to determine the validity of the initial assumptions, e.g., there may be more sellers operating on the market for bicycles than was initially believed. Hence, the procedure essentially works top-down in an iterative manner. Once investigators are confident to have a sufficiently precise picture of the markets under consideration, these markets are categorized according to “likelihood of collusion”. Markets that are believed to be very conducive to anticompetitive conduct are monitored more closely and are possibly subject to further in-depth investigations. This categorization of markets is in addition based on historical findings (e.g., was there any cartel activity in this market in the past?) and cartel cases in other countries (e.g., are there any cartels discovered in similar markets in other countries?).

³See, for example, McAnney (1991).

⁴For an overview of cartel detection methods in antitrust practice the reader is referred to the Anti-Cartel Enforcement Manual, Chapter 4, 2007. This manual has been released recently by the International Competition Network and can be found at www.internationalcompetitionnetwork.org.

⁵The Anti-Cartel Enforcement Manual further mentions settlement strategies, education and cooperation between authorities as “pro-active methods of detecting cartels”.

⁶See the Anti-Cartel Enforcement Manual, Chapter 4, 2007. However, the U.S. Department of Justice does attempt to raise awareness of cartel activity as witnessed by the flyer ‘Price Fixing, Bid Rigging, and Market Allocation Schemes: What They Are and What to Look For: An Antitrust Primer’. This flyer is available at: <http://www.usdoj.gov/atr/public/guidelines/211578.htm>.

The role of economics in cartel detection is therefore profoundly limited to the identification of potential “crime scenes”, i.e., industries that are prone to collusion. It is hardly used in “crime scene investigations”, i.e., in the evaluation of certain business practices.⁷ There are several reasons for this. First, using (economic) techniques to analyze and judge firm behavior in a given industry is typically involved and because antitrust agencies face both time and budget constraints, it is often not perceived as an attractive option. Second, suitable economic methods may not always be available. Third, a more detailed economic analysis usually requires good quality micro-data, which either may not exist or which cannot be used for detection purposes due to legal constraints (e.g., because of privacy protection). Finally, both the complaint procedures as well as the leniency program are thought to be sufficiently effective and there exists no convincing evidence that available economic detection methods are indeed successful.

In this chapter, we argue that economics is likely to play an increasingly important role in cartel detection and, in turn, that cartel detection itself is likely to play a more prominent role in antitrust enforcement. To that end, this chapter provides an overview of economic methods of cartel detection and discusses the merits and demerits of these techniques. In particular, we make the case that significant improvements are within reach when detection methods are designed exclusively for a certain (type of) industry.

This chapter proceeds as follows. The goal and scope of cartel detection are discussed in Section 2. Section 3 provides an overview of economic methods of detection that are currently available. Section 4 discusses potential pitfalls of economic detection tests. In Section 5, special attention is given to detection techniques that can be used to search for incomplete cartels. In Section 6, we make the case that part of the pitfalls can be dealt with through the design of detection methods that are tailored to a certain (type of) industry. Section 7 concludes.

4.2 Goal and Scope of Cartel Detection

In order to protect competition as an institution, free market societies have adopted sets of competition rules. To enforce these rules of competition, most countries have allocated corresponding powers to an antitrust authority to pursue two main goals, deterrence and desistance. The prime goal of antitrust enforcement is to prevent firms from restricting competition in an unlawful manner, i.e., antitrust policy should be a deterrent. If nevertheless firms infringe rules of competition, the task is to stop them from doing so. However, to safeguard competition in the market place it must be known if and where rules of competition are being violated. Unlike with murder, robbery, rape, arson, *etcetera*, it is *a priori* unclear whether companies have indeed acted in breach of the law, because cartels hardly leave obvious traces that indicate

⁷Some antitrust agencies do analyze bid-patterns in auctions to search for symptoms of bid-rigging. Occasionally use is made of econometric techniques to analyze bidding behavior. See the Anti-Cartel Enforcement Manual, Chapter 4.

anticompetitive conduct.⁸ To make sure antitrust enforcement is effective it is essential to make potential anticompetitive behavior visible.

In this section, we argue that cartel detection, in all likelihood, will play an increasingly important role in antitrust policy. In addition, we make the case that economics will become a key determinant of cartel detection.

4.2.1 *Why do we need Cartel Detection?*

Some scholars and antitrust practitioners are skeptical about the potential of cartel detection. The most frequently raised objections against cartel detection are that methods currently available are complex and difficult to implement and that results, if any, are often ambiguous.⁹ Moreover, the large majority of cartels known today were disclosed by means of a complaint procedure or a leniency program.¹⁰ Be that as it may, cartel detection will arguably become increasingly important in antitrust enforcement. Perhaps the best way to explain why is by asking a classic economic question, “what is the alternative?”. In other words, what does antitrust enforcement look like without cartel detection?

Not denying the quantitative success of both the complaint procedure and the leniency program, it is questionable if these are equally successful in qualitative terms, i.e., in terms of social welfare. One may, for instance, wonder why competitors would submit a complaint given the well-established result in the economic literature that non-participants often benefit from the presence of a cartel.¹¹ Indeed, as noted by Porter (2005, p. 149),

“...one should be suspicious of complaints by a rival firm not party to the conspiracy. Rivals typically gain from higher prices and they suffer from more intense competition.”

But even if the cartel is harmful for customers and outsiders, they will only ever consider filing a complaint if they know the cartel exists. There are, however, good reasons to believe that the more sophisticated cartels, which are arguably among the most harmful ones, have effective strategies at their disposal to hide their illegal practices.¹²

Without an active search for cartels, a similar argument holds for the leniency program.¹³ The main question would be why any of the participants would ever start

⁸See also Schinkel (2008).

⁹See, for example, Rey (2007).

¹⁰Harrington (2007) reports that cartel detection was to some extent successful in finding a cartel in the Dutch shrimp industry.

¹¹See Chapter 2 and 3 of this dissertation.

¹²For example, the cartel may gradually increase its price so as not to attract too much attention by its customers. See Harrington and Chen (2006).

¹³The effectiveness of leniency programs is theoretically discussed in, for example, Aubert *et al.* (2006) and Motta and Polo (2003). There further exists experimental evidence that a leniency policy may enhance the deterrent effect of antitrust policy and may lead to lower cartel prices. See Hinloopen and Soetevent (2008). However, both theoretical and experimental contributions on leniency programs typically assume positive detection probabilities.

such a “race to the courthouse”. That is, why would a criminal turn himself in and confess his guilt if the police is not even looking for him? Either, the authority is about to discover the cartel for other unclear reasons, or cartel members are trying to use the program to their own advantage, i.e., once the cartel breaks down the first firm to self-report avoids a fine, but at the same time allows the authority to impose a, possibly substantial, fine on fellow members.¹⁴ Cartel detection therefore has an important indirect effect as well. When effective, cartel detection increases the probability of discovery, which in turn encourages members to apply for leniency.¹⁵

Arguably, well-organized sophisticated cartels will take measures to avoid discovery via complaint procedures or leniency programs.¹⁶ In particular, one is likely to find out mostly those cartels that are already falling apart or the least professional ones.¹⁷ Hence, a more active search and destroy policy is warranted in order to guarantee effective antitrust enforcement.

4.2.2 *Why do we need Economics to Detect Cartels?*

It is often not immediately clear whether or not markets are “infected” by collusive behavior. This implies that before hunting the bad guys, we need to know if and where they are likely to operate. Economists are traditionally well-trained in identifying such potential “crime scenes”. For example, it has long been recognized that cartels are, *ceteris paribus*, more likely to be present in industries with a limited number of firms and with significant barriers to entry.¹⁸ However, once suspect industries have been identified, it is not yet clear if any cartel activity indeed takes place. The main, but at the same time most challenging, exercise is to determine to what extent observed behavior is led by ‘visible hands’.

A straightforward way to discover cartel activity is through interception of relevant communication between cartel members, e.g., finding minutes of a cartel meeting. Frankly however, to attempt to detect cartels by sifting through E-mail, phone calls, *etcetera*, between firms is not only legally objectionable, but is also likely to be a dead end road. The reason is that with modern technology it is becoming easier to encode pieces of information.¹⁹ Also, there is no need anymore for managers to be physically present in the same room or to use the phone. An increasing number of criminal organizations make use of environments on the internet that cannot be located by, for example, search engines. This so-called “freenet” (or related technologies) allows participants to exchange information almost anonymously.²⁰ Use is made of programs similar to MSN messenger, while it remains very difficult and sometimes even impossible to trace the source of the information exchanged.

¹⁴See Goppelsroeder *et al.* (2008) which argues that leniency programs potentially can be abused by sophisticated cartel organizations.

¹⁵See Friederiszick and Maier-Rigaud (2008) for an argument along similar lines.

¹⁶See Schinkel (2008).

¹⁷See Posner (1970) and Goppelsroeder *et al.* (2008)..

¹⁸See Section 3 of this chapter.

¹⁹See Halliday and Seabright (2001).

²⁰See Clarke *et al.* (2001).

Yet, in contrast to the internal organization of cartels, the *result* of the agreement is far less easy to cover.²¹ Implementing the cartel contract implies that members have to restrict production levels and increase their selling prices, which is often observable. The key question is therefore if we recognize cartel behavior on the basis of what we actually observe and what we typically observe are *economic* data. Consequently, the challenge is to use available economic information to determine if overt collusion provides the best explanation for observed firm conduct. In other words, the objective of economic detection methods is to identify market conduct that is the result of an explicit cartel agreement between firms.

A first major challenge is then to delineate tacit collusion and explicit collusion, because only the latter is considered illegal.²² Firms that collude tacitly coordinate actions without direct communication between them. Collusion is explicit when firms directly communicate to establish a cartel agreement. Given some collusive market result, tacit collusion is arguably the preferred strategy. On the one hand, such tacit coordination of strategies is, *ceteris paribus*, more efficient (e.g., you save cost associated with the formation and management of the cartel). On the other hand, firms substantially reduce the risk of being caught for acting in breach of antitrust laws, because they leave no traces of physical evidence. However, colluding tacitly can be quite complex, in particular when there exists no natural focal price. A firm that feels the current price is too low may aim to hike the price, but this may be costly when the price increase is not followed by other firms, e.g., it may lose market share. Similarly, reducing the price to signal that collusive prices should be lower is potentially costly, because it may trigger a price war if misunderstood by competitors. When received as the start of a price war it typically cannot be stopped by individual firms without communication.²³

Instead, communicating directly on the preferred price-quantity combinations avoids a lot of these risks. Also, shocks that change market conditions are less likely to undermine the stability of the cartel. Direct communication between firms allows them to coordinate on a new equilibrium. Such explicit collusion, however, contains drawbacks. It not only implies costly negotiations, but it is also more risky in the sense that a firm probably has to communicate more private information than in situations of conscious parallelism. In addition, gathering together in “smoke-filled rooms” potentially leaves extra evidence that can be used in trial. For example, there may exist minutes of the meeting or evidence that the suspect managers were together in the same hotel on the same day.

Despite its importance, economists do not have a clear understanding yet of how to delineate tacit from overt collusion. In particular, it is often not immediately clear if observed market conduct is the result of tacit or overt collusion. For example, in some markets firms may find out about prices of rivals faster than consumers. High priced firms may then decide to buy out the low priced firm(s), i.e., buy all the products of

²¹See also Bos (2007).

²²Tacit collusion is not prohibited by law. In Europe, for example, tacit collusion without further evidence is not sufficient to establish an infringement of article 81. See, for instance, Ahlström *v.* Commission, 1988, ECR 5193 (*Wood Pulp*).

²³See Motta (2004).

the low priced firms. The obtained products may then be sold to customers at higher prices. Van Cayseele and Furth (1996b) show that in a Stackelberg setting firms often can obtain the monopoly outcome by buying up rival output. Note that, in principle, firms can express buy-out behavior non-cooperatively.²⁴ That is, if one observes buy-out behavior, this may simply be the result of a tacit coordination of actions. First refusal contracts, i.e., agreements between firms to offer the output to each other first, may have a similar effect.²⁵ However, with first refusal contracts firms typically have to communicate “more directly”, which is why this practice should be considered more suspect.

To further illustrate the problem, consider the study by Christie and Schultz (1994) who aim to find an answer to the question why the vast majority of NASDAQ market makers seem to avoid so-called odd-eight quotes in 1991. They consider various potential explanations for this surprising phenomenon and provide indirect evidence indicating that this market outcome is the result of tacit collusion among market players. This conclusion finds additional support in a subsequent study by Christie *et al.* (1994), which shows a rapid and significant increase in the use of odd-eight quotes after the results of the previous study were published in leading newspapers. Yet, even though both studies provide convincing evidence of the existence of a collusive agreement the possibility that this agreement may have been explicit is not considered. In particular, the very fact that the NASDAQ has many market makers that know each other reasonably well in combination with the sudden breakdown after May 26, 1994 (i.e., the day that the results of Christie and Schultz (1994) became publicly known), suggests that overt collusion may well form a better explanation for observed practices.²⁶

The second major challenge is to delineate (imperfect) competition and collusion. Currently, economic methods of cartel detection almost exclusively focus on this distinction. These methods are discussed in the next section.

4.3 Economic Methods of Cartel Detection

The economic literature on cartel detection distinguishes between so-called *structural* and *behavioral* methods of detection.²⁷ The structural approach aims to identify what type of industries are conducive to anticompetitive conduct. The behavioral approach focuses instead on suspect firm behavior. The two approaches are not mutually exclusive and, in order to enhance the effectiveness of cartel detection, may very well be used in combination. The structural approach can be viewed a first phase in which a (type of) market with a high probability of being a “potential crime scene” is deter-

²⁴See, for instance, Van Cayseele and Furth (2001) which shows that with a buy-out option firms can reach the monopoly outcome without an explicit cartel agreement

²⁵See Van Cayseele and Furth (1996a).

²⁶Christie and Schultz (1994) states that “market makers interact frequently and over longer periods of time with the same population of other market makers.”

²⁷See Grout and Sonderegger (2005) for a discussion of structural factors that make markets prone to collusion. The behavioral approach is discussed in detail in Harrington (2007).

mined. A second step is then to analyze firm behavior in this particular industry, i.e., the behavioral approach can be used for “potential crime scene” investigations.

This section provides an overview of economic methods of cartel detection. It is convenient to organize the detection literature in such a way that it closely follows the traditional structure-conduct-performance paradigm.²⁸ In its simplest form, this paradigm expresses the view that market structure affects firm conduct, which in turn determines market performance. Arguably, some industries are more prone to conspiracy than others and the structural approach helps to identify these industries. Detection methods that focus on firm behavior might then be used to delineate competition and collusion. Finally, economic performance can be determined by testing if observed behavior is more consistent with collusion or instead with (imperfect) competition. In addition, one could test for robustness of results by analyzing alternative specifications.

4.3.1 Market Structure

In the absence of warnings that an industry may be “infected” by cartel activity, it is *a priori* unclear *where* the antitrust agency should start its search for cartels. Screening all sectors in the economy is, given budget as well as time constraints, simply impossible.²⁹ Also, based on the premise that the majority of markets is reasonably competitive, selecting industries randomly as subjects of closer scrutiny is unlikely to be fruitful. Consequently, some preliminary information is required.

Since the start of Industrial Organization as a distinct field of economic research, many contributions have enhanced our understanding of what type of markets are conducive to collusive conduct.³⁰ Market characteristics, especially those that are relatively easy to observe, can be used as a first screen to determine the likelihood of collusion in a particular industry. One must keep in mind, however, that such a market structure analysis can never be a conclusive exercise. That is to say, some markets that seem highly vulnerable to anticompetitive behavior may very well not be cartelized. Likewise, cartels can be present in markets that, at first sight, appear quite competitive. Yet, identifying market structures that are sensitive to anticompetitive conduct, *ceteris paribus*, increases the probability that behavioral analyses, which are typically more involved, will be successful.

One particular advantage of detection methods that focus on the structure of the market is that market characteristics are to a large extent beyond the control of firms. Arguably, sophisticated cartels will consciously try to ‘fly under the radar’, but manipulating the market environment in which the cartel operates is often difficult or even impossible. As we discuss below in more detail, cartels are, *ceteris paribus*,

²⁸This paradigm dominated Industrial Organization until the 1970s. Joe Bain is by many viewed to be the founding father. He took this approach in several, mainly descriptive, papers, around 1950. Most of the results have been summarized in his famous work: *Barriers to New Competition* (1956).

²⁹Notice that, from a social welfare perspective, screening all markets is, even without budget and time constraints, unlikely to be an optimal policy given that competition is sufficiently strong in most industries.

³⁰For an overview see, for example, Motta (2004), Chapter 4.

more likely to emerge in industries characterized by a limited number of firms, stable demand patterns and many small buyers. It is difficult to see how a cartel could significantly manipulate these factors so as to give a more competitive appearance.

One important limitation of this type of analysis, however, is that it typically does not allow the investigator to discriminate between tacit and overt collusive arrangements. This is partly due to the fact that the structural approach relies quite heavily on theoretical analyses carried out in an infinitely repeated game setting. The infinitely repeated game framework stems from the *noncooperative* game theory literature in which explicit communication between players is commonly assumed to be absent. In other words, the stylized market characteristics listed below might equally well be used to select industries in which ‘conscious parallelism’ is a possibility.

Infinitely repeated games have already been discussed in the previous two chapters. Recall that in this setting collusive agreements are typically sustained by means of threats. Assuming grim-trigger strategies, a cartel member will find it profitable to abide by the cartel contract when the following incentive compatibility constraint is satisfied,

$$\sum_{t=t_0}^{\infty} \delta^{t-1} \pi^c \geq \delta^{t_0-1} \pi^d + \sum_{t=t_0+1}^{\infty} \delta^{t-1} \pi^N. \quad (4.1)$$

Like before, individual cartel profits, profits of defection and competitive profits are respectively denoted, π^c , π^d and π^N , with $\pi^d > \pi^c > \pi^N$. The common discount factor is given by δ and t_0 indicates the date of defection. The factors listed below affect (4.1) in a variety of ways.

Number of Firms

Ever since Chamberlin (1933), economists are well aware of the negative correlation between the number of firms in a market and the likelihood of collusion in that market. There are at least two reasons why the number of firms matters. On the one hand, it is easier to reach an agreement when there are only a few parties involved, all else equal. For example, negotiations are typically more difficult and therefore increasingly costly with a larger number of parties gathered around the table. On the other hand, a cartel agreement between only a few firms might be easier to sustain. To illustrate, consider the situation of an all-inclusive cartel agreement between firms that compete in price and produce a homogeneous product. The number of participants affects (4.1) in the following sense. First, π^c will be higher the smaller is the number of participants. Second, the short-run gain from defection increases with the number of participants. Both effects make that (4.1) is more likely to hold when the market consists of only a few undertakings, all else equal.³¹ It must be noted, however, that in other settings a larger number of cartel participants may result in a more severe punishment, which helps to stabilize the cartel agreement.

³¹A notable exception to this theory are markets in which there exist strong ties between firms, for example, through membership of a trade association. Here the trade association may function as a coordinating device. Historically, a significant number of cartels were organized by means of such a ‘head-quarter’ that sometimes even determined the prices and quantities to be set by all members.

Contestability of the Market

Entry barriers are probably among the most widely accepted structural factors to make markets conducive to anticompetitive behavior. Supra-normal profits generated by a cartel potentially attracts new producers and these newcomers may well undermine the stability of the cartel. The cartel is protected against new competition when entry barriers are significant. To put it differently, potential newcomers might find it too costly to start a new profitable business when the “entry-fee” is sufficiently high.

To see how entry barriers affect the likelihood of collusion, we may distinguish between two scenarios. Either the cartel anticipates entry or it does not. If it does not expect new producers to enter the market, but entry nevertheless occurs, the result will be a loss in market share, a price war or the newcomer (tacitly) joins the cartel agreement. Clearly, entry is never beneficial for cartel members, because in all three cases the per-firm cartel profit decreases. This, in turn, makes (4.1) less likely to hold. Hence, compared to a situation in which entry is not profitable, a cartel agreement is, *ceteris paribus*, less likely to be sustainable.

Alternatively, the cartel rightly anticipates the possibility of entry and *ex ante* decides either to accommodate or to deter entry. If the optimal cartel strategy is to accommodate entry, entry will occur and per-firm cartel profits will decrease. If the cartel, in contrast, finds it optimal to deter entry it has to put a limit on the per period profit levels earned, i.e., it has to implement some form of limit pricing. Either way, it will be, *ceteris paribus*, less attractive to take part in a cartel agreement the easier it is for new firms to enter the market.³²

Nature of Demand

The possibility for firms to collude depends on the stability, the frequency and the elasticity of demand. If demand is unstable and firms imperfectly monitor each others actions, it is difficult to maintain the cartel contract. The reason is that a sudden drop in sales caused by a demand shock may be interpreted by a firm as a signal that another cartel member deviated, which might cause a price war. That cartels tend to break down when slumps are sufficiently large has been argued by Green and Porter (1984). Rotemberg and Saloner (1986), in contrast, argues that cheating occurs more likely during booms even when firms have complete information. Either way, both contributions support the view that cartels are, *ceteris paribus*, more stable the lower the impact of both slumps and booms.

Likewise, infrequent demand makes it more difficult for firms to form a cartel that is sustainable. The less frequent is demand, the more attractive it becomes to defect, all else equal. The reason is that the punishment phase following the period of defection is not materialized until the next period in which demand is positive and, given that the discount factor is strictly lower than one, is therefore less of a threat. In a similar fashion, markets in which firms frequently interact are more prone to collusion. A low frequency of interaction implies that it takes longer before the punishment phase can become effective, which makes deviating more attractive under the assumption that cartel members are less than infinitely patient.

³²See Baumol *et al.* (1982), for an extensive discussion of theories of contestable markets.

Finally, collusion is only an attractive strategy if demand is sufficiently inelastic. Clearly, if demand is perfectly elastic no price increase is profitable and consequently there are no incentives to collude. Hence, there exists a negative correlation between the incentive to collude and the elasticity of demand.³³

Market Transparency

In many cases, cartel members will have to monitor each other in order to ensure compliance with the cartel contract.³⁴ To see that market transparency is an important factor, note that in the context of repeated games the incentive to deviate is negatively correlated with the level of punishment. In the extreme, if fellow members will not observe any change in the event of cheating, deviating will go unpunished, which implies collusion cannot be sustained. More generally, information lags make the future “more distant” and this implies that the punishment is lower, which enhances the incentive to deviate from the agreement. Collusion is therefore, *ceteris paribus*, more likely to occur in markets in which information on, for instance, prices and sales is easily accessible.

Symmetry

Intuitively, more or less identical firms will find it easier to reach an agreement than firms which differ substantially. To illustrate the idea, consider a situation in which potential cartel members have different cost levels. This has immediate implications for what cartel price these firms would find optimal or, to put it less strict, acceptable. Tacit collusion, for example, would be quite a challenge in absence of a natural focal price. However, also in the case of overt collusion asymmetry among parties is unlikely to help cartel formation. Negotiations on what price to set, for instance, will be more difficult and therefore costly, which, in turn, makes joining the cartel less attractive. There exists some theoretical support for the intuition that symmetry among firms indeed facilitates the sustainability of a cartel.³⁵

Number of Buyers

Many dispersed clients that individually do not affect total demand is ideal for cartels. Perhaps the best way to explain why is by taking the other extreme in which all firms are competing for one and the same customer. In this case, the trust level must be extremely high. Per period, only one firm has positive sales. This may imply the cartel will have to use a scheme of side-payments, which makes the cartel organization complex. Alternatively, the cartel can designate every member a certain period in which it “wins the customer”. Yet, this is a risky strategy for members that have to wait long, because those who already made their sale have only a weak incentive to adhere to the cartel agreement.

In addition, a few large buyers may have a stronger incentive to claim antitrust damages compared to many small dispersed clients. Large customers may also be

³³See, for instance, Pindyck (1979).

³⁴Recent evidence from European hard-core cartel cases suggests that monitoring is indeed an important issue for many cartels. See Harrington (2006).

³⁵See Chapter 2 of this thesis.

better informed about the illegality of cartel arrangements. As a result, the chance that an antitrust agency receives signals of antitrust violations via the complaint procedure may be higher in markets in which there is significant buyer power.³⁶ In short, with only a few large buyers the incentive to defect are strong and consequently forming a cartel agreement may be too high of a goal.

Also, markets in which trade is organized through auctions are more vulnerable to collusive conduct the larger the number of contracts or objects offered in a given period. Pesendorfer (2000), for example, studies the bidding for school milk contracts in Texas and Florida during the 1980s. In this period, incomplete bidding rings were active in both states. One ring used a market-sharing scheme, while the other used a scheme of side-payments. Pesendorfer establishes theoretically that both forms of cartel organization almost maximize expected cartel profits provided that the number of contracts is sufficiently large. Consequently, he concludes that a buyer should choose to offer a single contract instead of many small contracts when there exist a substantial risk of collusion. On the one hand, a single or small number of contracts increases the gains from defection, while, on the other hand, it lowers the expected cartel profits for cartels that do not use side-payments, i.e., so-called weak cartels.

4.3.1.1 Ambiguous Structural Factors

The list presented above is not exhaustive and in most studies that take the structural approach more factors are listed. However, these factors typically have an ambiguous effect and form well-known puzzles in the industrial economics literature. They have in common that the effect on the incentive to deviate and the level of punishment is the same in the sense that both are either positively or negatively affected. Consequently, the net effect is unclear and very sensitive to parameter specifications. Three of the most prominent ambiguous structural factors are briefly discussed below.

Type of Product

The type of product is traditionally viewed to be an important determinant of the likelihood of collusion. In general, the argument goes that competitive pressure is positively correlated with the incentive to collude. This competitive pressure is maximal when customers base their purchasing decisions solely on price, i.e., when products offered by firms are from a consumer perspective perfect substitutes. In the other extreme case, products are, from a customer perspective, completely different, which means that sellers do not actually compete. Hence, when products are independent there is no need for firms to reduce competitive pressure. Traditionally, therefore, it has been argued that one is, *ceteris paribus*, more likely to find cartels in homogeneous industries.³⁷

Yet, the degree of differentiation also affects the stability of the cartel. On the one hand, the higher the substitutability of products and services, the more severe is the

³⁶I thank Jan Tuinstra for pointing this out.

³⁷From a more practical perspective, we may argue that differentiation makes it more difficult to define strategies that are acceptable to all parties.

punishment, because competitive profits are lower.³⁸ This is in line with the traditional argument that homogeneous industries are more conducive to cartel activity. On the other hand, however, the more differentiated are products the lower the gain from deviating, because lowering the price slightly only attracts some extra customers and not the entire market. It is therefore *a priori* unclear which of these antagonistic forces dominates.³⁹

Excess Capacity and Inventories

Firms can commit themselves to the cartel agreement by limiting production capacity in such a way that the agreed upon output level is the maximum that can be produced in a given period. In such a setting, no incentives to deviate exist, because even though a price-cut will attract additional demand, it cannot be satisfied by the chiseling firm. From this perspective, limiting capacity makes cartels more stable, because it eliminates the possibility of profitable deviations. By contrast, however, the net effect on (4.1) is unclear in light of excess capacity and/or inventories. On the one hand, excess capacity and inventories create an incentive to cut the price and increase production, but, on the other hand, it allows fellow members to credibly punish a defecting member.⁴⁰

Multi-market Contact

Multi-market contact means that firms meet each other in more than one market. Traditionally, it has been argued that multi-market contact facilitates collusion, because punishment is potentially more severe. That is, price wars that are triggered by defection might occur in all markets at the same time, which makes deviating less attractive. However, gains from defection also go up if a firm deviates in all markets simultaneously. Again, therefore it is unclear, which of these effects dominates.⁴¹

4.3.2 Cartel Conduct

Once a “potential crime scene” has been identified, the next step to take is to screen this particular industry in search for signals of cartel activity, i.e., to do some “crime scene investigations”. At this stage, the focus is primarily on firm conduct. At the heart of the behavioral approach in cartel detection lies the idea that firms under a cartel regime behave differently than they do in competition. The key challenge is then to identify these differences. Cartel members often leave, though possibly subtle, traces that can be understood with economics. For instance, Porter and Zona (1999) analyzes procurement auctions for school milk contracts in Ohio. One of their findings is that a

³⁸In the extreme situation in which competition is ‘perfect’ the difference between cartel profits π^c and competitive profits is maximal, because $\pi^N = 0$.

³⁹See Chang (1991), Rothschild (1992) and Ross (1992) for formal analyses of this issue.

⁴⁰For theoretical analyses of the effect of excess capacity on the likelihood of collusion see Benoit and Krishna (1987) and Davidson and Deneckere (1990).

⁴¹For a theoretical analysis of the effect of multi-market contact on collusion see Bernheim and Whinston (1990). In particular, they show that multi-market contact might only have an effect on the stability of collusion in light of asymmetries among firms.

group of firms is suspect, because they submit higher bids on contracts located close by than on contracts located farther away. The competitive model logically predicts a positive correlation between the distance to the school and the level of the bid, which was confirmed by the bid-patterns of non-conspirators.

In order to determine if observed firm behavior is suspect one necessarily needs a point of reference. A first step is therefore to define a sound competitive benchmark.

4.3.2.1 What does Competition look like?

There basically exist three approaches to get an intuition of what competition in a particular industry looks like. If one has information about when the cartel started to operate or when it (temporarily) collapsed, one in principle could take the firm behavior before and after the collusive period as a proxy for competitive conduct. Notice, however, that this approach is only useful if one indeed has information about the date of birth and longevity of the cartel organization under consideration. Therefore, this approach at best is helpful for *ex post* analyses and will only be of limited use in *ex ante* search for cartel activities.⁴² Alternatively, one might analyze similar type of markets to formulate a reasonable competitive benchmark.⁴³

A third method to define a competitive benchmark is by using industry specific information. For example, descriptive studies and industry surveys often contain, albeit sometimes hidden, signals about how firms in that particular market compete. In addition, one could try to collect information by interviewing people that work in the field. Getting in close contact with a particular industry can potentially yield quite some valuable information. For example, one might discover what firms are considered major competitors (e.g., whether or not there is a price-leader, total number of competitors). Also, one may receive a better idea of the main inputs of a product, which might be helpful in assessing unit production costs. One further could obtain information about the importance of transportation and service costs and whether or not these form a significant part of total cost. Together, this (type of) information might be quite helpful in determining what price levels can be expected in competition.

Using questionnaires and similar techniques, however, may be risky, because it potentially could be perceived as a signal that the industry is under close scrutiny by the authorities. Also, the information may not always be reliable. Arguably, however, it is the most promising way to define a reasonable competitive benchmark.

4.3.2.2 What does Collusion look like?

One in principle could argue that in order to spot cartel activity it is sufficient to have a thorough understanding of what competition looks like in a particular industry. All observed conduct that for longer periods substantially differs from the competitive benchmark should then be considered suspect. Such a detection strategy, however, is risky and easily may lead to wrong conclusions, because we often lack confidence about

⁴²It may, however, be very useful to monitor industries in which cartels have been active in the past. Recidivism is a prevalent phenomenon in antitrust practice.

⁴³See, for instance, Posner (1970) who remarks that comparing similar regions may be a practical method to extend the scope of economic evidence in antitrust procedures.

the validity of the competitive model. That is, it is difficult to develop a competitive model that perfectly predicts competitive behavior in a particular market. We can significantly enhance the strength of cartel detection by forming hypotheses about what collusive behavior would look like. A cartel detection test then reduces to determining if either the competitive model or the collusive model better explains observed firm behavior.⁴⁴ This clearly does not tackle the problem of potential misspecification of the models used, but it allows the investigators to draw conclusions with far greater confidence.

In order to understand what collusion looks like, we have to be clear about what exactly we are looking for. Given the secret nature of cartel organizations one of the few things we have at our disposal is *observable* market conduct. The choices made by the cartel are at least partly reflected in market data. Investigators in principle have access to price and output patterns. Also, it may not be too difficult to observe investment decisions and entry and exit in the market, *etcetera*. This sort of information may contain hints that point to potential anticompetitive behavior.

Prices are a prime candidate to be used in the search for cartels, because these are affected by a hardcore-cartel directly and, in addition, are relatively easily accessible. Cartels are, *ceteris paribus*, believed to have higher average prices and a lower price variance. Bolotova *et al.* (2008) have tested this prediction by analyzing price data of the *citric acid* and the *lysine* cartel. The hypotheses on the first two moments of the price distribution is confirmed in the *lysine* case. However, the *citric acid* cartel appears to have had a higher variance in price during the collusive phase. The authors conjecture that the latter, counterintuitive, result may be caused by the relatively long duration of the cartel. If the cartel operates for a longer period it may have to deal more often with chiseling firms and if cheating is not sufficient to make the cartel collapse entirely the variance in price will increase. Also, part of the result may be due to the fact that the data set containing prices charged during the pre-cartel period and post-cartel period was limited, which may have caused a somewhat biased competitive benchmark.

Simultaneously, one may take a dynamic approach and use available price data to identify potential structural breaks in pricing behavior over time. Consider again the *citric acid* and *lysine* cartel. The following two graphs plot the prices charged in both cartelized markets for the relevant period.

Although both cartels differ in many respects, the price patterns in both markets exhibit remarkable similarities. The similarities are summarized in Figure 4.3, which is a stylized figure of a cartel price path.⁴⁵

In both cases, the pre-cartel period is characterized by a significant price volatility.⁴⁶ In particular, average industry prices drop substantially during the pre-cartel period.

⁴⁴See, for example, Bajari (2001) and Bajari and Summers (2002).

⁴⁵This figure has been presented by Joe Harrington in his keynote lecture at the EARIE IO conference, Amsterdam, 2006. For further detailed analyses on cartel pricing dynamics the reader is referred to Harrington (2004, 2005).

⁴⁶The *citric acid* and *lysine* cartel are used as illustrative examples. However, a similar price pattern could be observed for other cartels as well. The *graphite electrodes* cartel forms another example, see Levenstein and Suslow (2001).

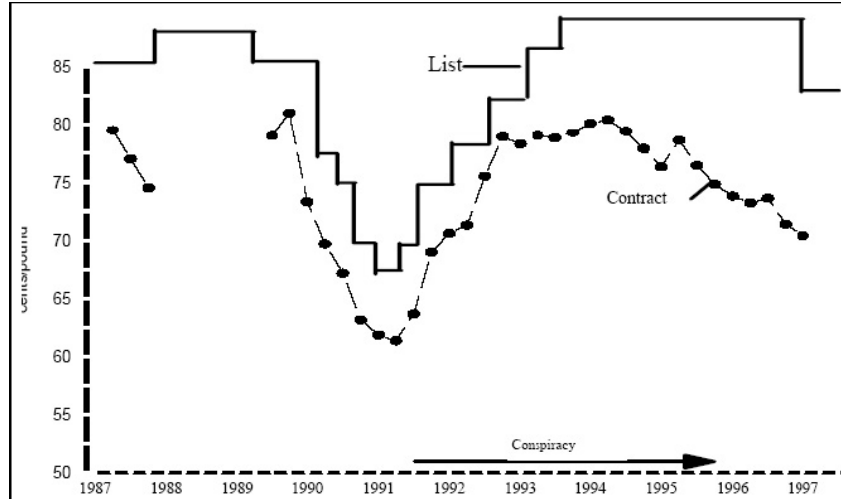


Figure 4.1 Price pattern of the citric acid market 1987-1997. Source: Connor (2001).

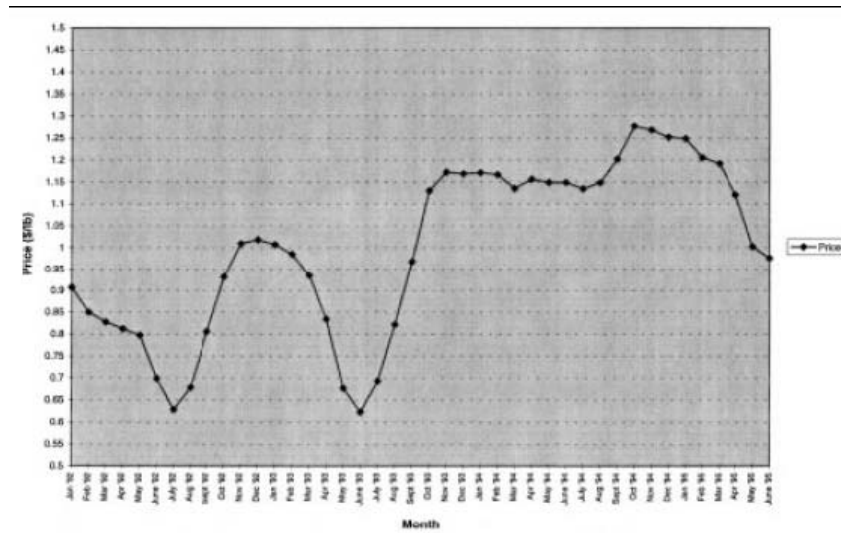


Figure 4.2 Price pattern of the lysine market 1992-1995. Source: Connor (2001).

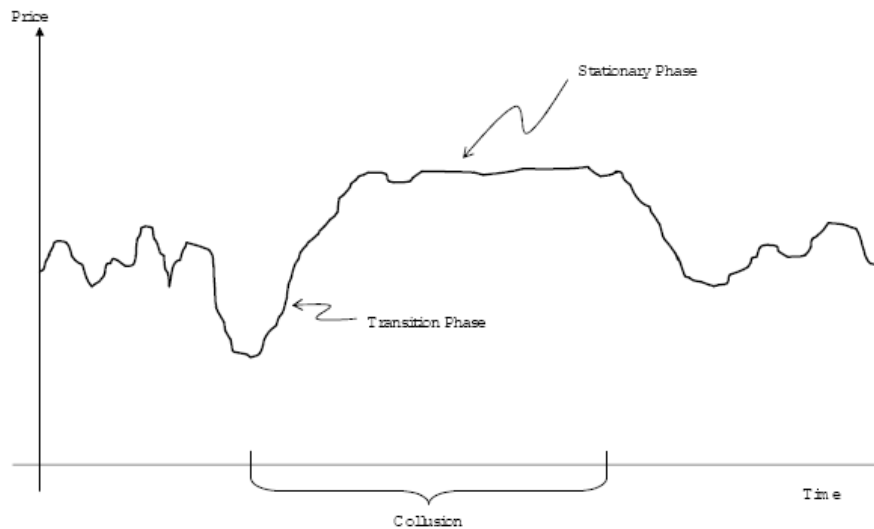


Figure 4.3 Canonical cartel price path. Source: Harrington (2006).

The cartels started to operate when industry prices were at a very low level. After the cartel was formed, however, industry prices increased only gradually. In other words, the cartels took their time to reach the intended cartel price. In Figure 4.3, this is referred to as the transition phase. The transition phase ends when the cartel has reached the preferred price level. Prices remain then remarkably stable for a substantial amount of time. This period is denoted ‘the stationary phase’ in Figure 4.3. The stationary phase ends when the cartel breaks down, which results in a decrease of average prices and prices become more volatile again. This completes the cartel price path. Note that the *lysine* cartel had a temporary break-down and that the cartel price path can be observed twice in Figure 4.2.

The intuition underlying this canonical cartel price path is as follows. The incentives to form a cartel are highest when competition is fierce. Figure 4.1 and 4.2 clearly indicate that the average price level decreased substantially before the cartel was formed. Once the cartel was formed industry prices were rising gradually, perhaps because the cartel did not want to attract too much attention from antitrust agencies and buyers.⁴⁷ We can imagine that a sudden significant price hike would indeed be considered strange in industries for which edgeworth price cycles are uncommon. The stationary stage reflects the conventional wisdom that cartels dislike change. Substantial price fluctuations undermine the stability of the cartel, for example, because an unantici-

⁴⁷See Harrington and Chen (2006).

pated price drop by one of the members may be interpreted as an attempt to defect from the agreement.

It must be noted, however, that merely studying visualized price patterns may not be sufficient and could even be misleading. For example, the shape of the price path is partly influenced by scaling, i.e., increments used on the axis. Ideally, therefore, one would like to analyze price data more formally and identify the various cartel phases by determining structural breaks in price patterns. To test for structural breaks in price series, one could apply a Chow test. Yet, a Chow test will only be useful as a screening device if one has an idea about candidate break points. Hence, we need some understanding of when the cartel started to operate or the date of its demise. An example of information that may be helpful in determining candidate break points are the formation of trade associations, which in the *lysine* cartel was formed to cover cartel meetings.⁴⁸

Descriptive cartel studies occasionally reveal behavioral aspects common to cartels. Harrington (2006) studies about twenty recent European hard-core cartel cases and derives some behavioral ‘stylized facts’ that may be indicative of collusion. One aspect is that cartels typically create more ‘uniformity’. For example, as a result of collusion, products tend to become increasingly standardized and there is an increased uniformity of prices, quality of products and services provided. Also, there is a reduced variation in prices offered to customers and market shares tend to be very stable over time. These factors all support the intuition that cartels prefer an easy life and that too much variety and changes in the market make collusion more difficult or even impossible.

4.3.3 Market Performance

The final stage in the application of economic methods of cartel detection is testing hypotheses. Cartel detection yields evidence of collusion when either the competitive model does not very well explain observed behavior or when firm conduct is better explained with some collusive model. It is important to note, however, that the economic approach at best yields circumstantial evidence of collusion. That is to say, economic methods of detection are not designed to find physical evidence of cartel activity and therefore at best will yield indirect evidence of anticompetitive conduct. Yet, in light of the goal of antitrust enforcement, collecting indirect evidence is arguably important. Circumstantial evidence may guide antitrust agencies in their decisions on what (type of) industries need closer scrutiny. When taking into account ‘tell-tale signs’ of collusion, antitrust authorities may increase the probability that in-depth investigations, e.g., search for more direct evidence via ‘dawn raids’, will be successful. As such, cartel detection contributes to the goal of desistance. Cartel detection is also likely to enhance the deterrent effect of antitrust enforcement. The reason being that it increases the probability of being caught, which makes collusion more costly in expected terms. Although difficult to verify, we may conjecture that cartel detection prevents some

⁴⁸See Harrington (2008). Connor (2001) reports that the Amino Acid Manufacturers International Association was formed by members of the *lysine* cartel.

firms from engaging in anticompetitive conspiracies. In addition, a more active detection policy may also render collusion less attractive by reducing (expected) mark-ups of potential cartel members.⁴⁹

The success of a certain detection method depends on a lot of factors and a significant number of potential problems have to be dealt with before one can successfully apply the method and be sufficiently confident about the results. A discussion of these potential pitfalls will be postponed to the next section. For now we may ask what method is the right one, if any? There exists no conclusive answer to this question. That is, there exists currently no manual that tells us when to apply what method. It will ultimately depend on the (type of) industry under consideration, on the available data, on (economic) intuition and even on pure luck. Very often, however, one may increase the chance of rightly determine market performance by using a combination of the various indicators and methods currently available. The following two studies form an illustrative example of how a combination of these factors may be used to discriminate between collusion and competition.

An interesting method of detection has been developed by Bajari and Ye (2003). They propose a model of competitive bidding for procurement contracts with bidders that may have different cost levels, e.g., some firms may be located closer to the project locations than others. Intuitively, bids are ‘conditionally independent’ and ‘exchangeable’ in competition. The first condition means that, after controlling for those costs that are publicly available (e.g., cost of traveling the distance between the factory and the project site), the bids must be independent. The second condition means that costs alone, independent of the identity of competitors, will determine the bid. By contrast, in situations of bid-rigging we may expect correlated bids when members consciously submit phony bids to give competitive appearance. Also, we might find that cartel members do not bid against each other as aggressively as a control group of non-participating firms. Bajari and Ye apply their test to procurement auctions for seal coating. Their test not only suggests when there is collusive behavior, i.e., some firms behaved contrary to the competitive model, but also identifies which firms are likely to be in the cartel.

Baldwin *et al.* (1997) uses a structural model to compare collusive and competitive bidding for Forest Service timber contracts. One of their main goals is to find out if bidding rings were active at the Forest Service auctions in the period 1975-1981. In particular, they also consider the possibility that relatively low winning bids could be caused by the positive supply shocks that occurred at the time. The authors construct five empirical models and find that the winning bids could best be explained by the presence of bidding rings.

4.4 Potential Pitfalls in Cartel Detection

Developing an economic detection method is a challenging exercise. A great many obstacles have to be dealt with before one can be reasonably confident about the

⁴⁹See, for instance, Block *et al.* (1981).

effectiveness of a detection tool. This section discusses some of the major problems that an investigator might encounter in the design and implementation of an economic detection technique.

4.4.1 *No Result, is a Result*

A detection method that rightly identifies a cartel, first and foremost, proves that antitrust enforcement is not fully deterrent. One therefore should be reluctant to judge the quality of a detection technique solely on the basis of the number of cartels that it was able to unveil. Indeed, abstracting from the level of antitrust penalties as well as the time and budget constraints of an antitrust authority, the perfect detection method is one that does not detect any cartel. The main aim of cartel detection is to make collusion more costly in expected terms, thereby contributing to the prime goal of antitrust enforcement; deterrence. This does not imply that a detection method is ineffective if it does not cause full deterrence. In principle, it is effective if it narrows the set of preferred collusive equilibria. Broadly speaking, this means that cartels must put more effort in avoiding discovery. In turn, this makes it, *ceteris paribus*, less attractive for firms to take part in a conspiracy.

In a related vein, a detection method that can be beaten is not ineffective *per se*. In principle, all detection techniques can be beaten. To illustrate how a cartel may avoid detection, consider the method proposed by Bajari and Ye (2003) that was discussed in Section 4.3.3. Suppose bidders had agreed on adding a fixed amount to their competitive bids. This would not affect the ‘conditional independence’ criterion, because adding a fixed amount does not affect the correlation of bids. The criterion of ‘exchangeability’ is also not violated, because the higher bids are related to the true cost levels. A bidding ring that implements this strategy could therefore beat this test. However, adding a fixed amount to competitive bids may not be the optimal collusive scheme in absence of cartel detection.

4.4.2 *Descriptive Flaws, Empirical Limitations and Theoretical Complications*

There exist quite a few descriptive cartel studies. Many studies use a data set of antitrust cases that is analyzed with the aim to test theoretical predictions.⁵⁰ Most of the structural factors described above find support in these descriptive studies. For example, concentration has been shown to be consistently and positively related to collusive success.⁵¹ Yet, from a methodological point of view, all these studies suffer from one major, fundamental problem.⁵² The data sets used are likely to describe only a subset of all cartels that are operational in a given period. The conclusions drawn

⁵⁰Examples include Hay and Kelly (1974), Arsch and Seneca (1975), Fraas and Greer (1977), Griffin (1989), Levenstein and Suslow (2006).

⁵¹Levenstein and Suslow (2004). Typically, a key role is played by industry associations and national governments for those cartels that comprise say 15 or more participants.

⁵²Of course, descriptive studies have more problems common to all inductive studies, like, for example, the reliability of the data that are used.

on the basis of these cases can therefore only be generalized safely when there exist no significant sample bias. However, because the total pool of cartels is fundamentally unknown we can neither be sure if such a sample bias is present, nor about the magnitude of this bias.⁵³ Descriptive studies of cartels form an important contribution and, at a minimum, provide an intuition about how cartels may operate, the problems they encounter and how they dealt with them. However, not denying the value of descriptive studies, there logically seems to be no way around the sample bias problem. This means we must be careful in designing cartel detection methods that rely heavily on individual cartel cases.

In order to screen markets or verify hypotheses about the likelihood of collusion in a particular market, one typically needs to make use of (econometric) techniques that require data. There are at least two potential limitations in this type of research. First, data may simply not be available or be very costly to collect. Also, even if data are available, they possibly cannot be used for detection purposes due to legal reasons (e.g., because of privacy protection). The latter can be particularly problematic when the strength of a detection technique depends heavily on micro data of individual firms. Alternatively, sometimes use can be made of more aggregate data. Second, it is typically hard to judge the quality of the data set. Clearly, if the data are of poor quality potential results are likely to be biased and may lead to wrong conclusions. Yet, it does not follow that econometric approaches are useless. Many econometric detection studies were, at least in retrospect, able to confirm cartel activity. Examples include Porter and Zona (1993, 1999) and Bajari and Ye (2003). Note that it should come as no surprise that all these studies make use of data that can be observed relatively easy, e.g., quantities, market shares, bids for procurement contracts.

Unlike the previous two approaches, theoretical research is not bound by data limitations. In order to delineate competition and collusion we must be able to predict what the competitive and the collusive situation looks like. We have already discussed the difficulties related to the competitive benchmark. In addition, we are confronted with the problem that the set of collusive equilibria is typically, in the words of Jean Tirole, an ‘embarrassment of riches’.⁵⁴ This problem is particularly severe when solutions of the model belong to the set of competitive and the set of collusive equilibria, i.e., when both sets overlap. If this is the case, then we might be able to understand why firms coordinate on a certain equilibrium, but we cannot be sure if that particular equilibrium is the result of (imperfect) competition, overt or tacit collusion.⁵⁵

⁵³Arguably, the sample bias will be lower for cartel cases in times where antitrust law enforcement was less strict or even absent. Yet, cartels that were legal, probably behave in different ways too, which implies the sample is probably biased in a different way. This certainly holds for the Netherlands, where cartels were sometimes announced in newspapers or otherwise known to almost everyone. It has been argued that in many markets this was due to ‘a culture of cooperation’. The recent cartel in the Dutch construction sector is a good example.

⁵⁴Tirole (1988)

⁵⁵See Harrington (2008) for an extensive discussion of problems related to cartel detection theories.

4.4.3 *On the Problem of Defining a Workable Benchmark*

Determining the competitive benchmark is a delicate matter. To what extent the three approaches that were discussed in Section 3 can be used partly depends on the available information and the idiosyncrasies of the case at hand. For example, one can use the pre- and post-cartel periods as a proxy for what competition looks like in a particular market. However, if one aims to search for cartel activity *ex ante*, the required information may often not be available. As remarked by Posner (1970), it is potentially very useful to look for similar markets in order to get a feeling for what competition may look like in the industry that is under scrutiny. Yet, one always should be very careful when comparing markets for the simple reason that no two markets will ever be exactly the same.

To illustrate that *a priori* obvious cases may still lead to false allegations, consider the *Bakers of Washington* case. From the mid 1950s through 1964, the retail price of bread in Seattle was about 15 percent higher than the U.S. average price, which was used as the competitive benchmark. In 1964, the Federal Trade Commission found the bakers guilty of price fixing mainly based on the peculiar price patterns that seemingly left no room for doubt that these bakers were indeed guilty of fixing prices. Yet, Newmark (1988) provides an alternative explanation, which indicates that the high pricing may not have been caused by a conspiracy. First, he shows that prices were higher in the West than in the rest of the United States due to higher retail margins, higher labour costs and a higher normal rate of return. Second, he provides evidence that the sharp price decline was not so much due to the order by the Federal Trade Commission to cease price fixing, but instead because some cheap low-quality brands of bread were sold in that period, i.e., new low-cost entry in the market.

4.5 Detecting Incomplete Cartels

In this section, we discuss how economic theory can be used to detect incomplete cartels. So far, we did not make a distinction between the detection of an all-inclusive cartel and the detection of an incomplete cartel. From a cartel detection perspective, however, taking account of (expected) cartel size can be of particular importance. In fact, when an investigator suspects a cartel to be less than all-inclusive, it may not be needed to formulate a competitive benchmark in ways described above. The reason is that the behavior of cartel members presumably differs from that of fringe members and, if so, the competitive fringe can be used as benchmark. As remarked by Porter (2005, p. 155),

“...the non-inclusive nature of the cartel may lead to evidence of its existence. A non-inclusive cartel can be easier to detect, as outsiders can serve as a standard of comparison.”

Blair and Romano (1989) is a good example of how economic theory can be used to detect an incomplete cartel. The authors describe a real-world case in which they, B&R Associates, had to provide an argument that would prove the innocence of one of five firms that were accused of fixing prices. The proposed test is based on a simple,

but sound result in economic theory on mergers and cartels. The central idea is that if the firm they represented was indeed innocent it most likely would have increased its output in response to the output reduction by the other four.⁵⁶ The firm was found ‘not guilty’, because its production increased after the date the cartel became effective.

This detection test is very attractive due to its simplicity and it probably can be applied successfully in quite a few instances. However, the test also suffers from some weaknesses. For example, suppose that there is a positive demand shock around the same time. This may very well lead to an increase in cartel production, which means the cartel could quite naturally pass the test. A potential solution for this problem would be to look at relative changes in market shares instead of changes in firm production, because these are neutral to demand shocks. Another, more severe problem with this test, is that it is often unclear when exactly the cartel started its operations. This information is crucial, because output levels of all firms tend to fluctuate over time. As a result, this test probably is effective as detection tool only in the presence of some other signals of cartel activity.

More generally, detection methods that work on the premise that a cartel is incomplete are effective only when the behavior of insiders and outsiders is *significantly* different. The next subsection illustrates that this might not necessarily be the case.

4.5.1 A Variance Screen for Collusion: an Example (1)

In ‘A variance screen for collusion’, Abrantes-Metz *et al.* (2006) propose a test to screen markets for the presence of hard-core cartel activities. The method aims to identify suspect firm behavior by comparing prices set by individual firms with average market pricing behavior in a given period. It is conjectured that during collusive regimes the average price of cartel members is significantly higher and price volatility is substantially lower in contrast with price levels of non-participants or compared to periods in which competition is not restricted. The intuition for this hypothesis is that a cartel at best only partly responds to exogenous changes in the market, because renegotiations are typically costly and risky. Meetings in ‘smoke-filled rooms’ are therefore likely to be organized only when new circumstances (e.g., cost shocks) imply substantial losses or threaten the stability of the coalition. Two main advantages of the variance screen are that no cost data are required to implement the method and that the test is hard to beat, because it presumably will be difficult for the cartel to coordinate on price patterns with a sufficiently high variance.

Yet, when Abrantes-Metz *et al.* apply their test to the Louisville retail gasoline market for the period 1996-2002, an industry that is known to be sensitive to anti-competitive behavior, no (cluster of) suspect petrol stations could be identified. The authors conclude that the difference in the coefficient of variation, i.e., the standard deviation normalized by its mean, is not big enough across retail gasoline stations to indicate the existence of a conspiracy. Obviously, this somewhat surprising result may simply mean that no cartels were active in this industry from 1996 until 2002. There exists however an alternative explanation, which supports the view that the

⁵⁶See Chapter 2 of this thesis.

Louisville retail gasoline market in fact may well have been infected, but quite naturally escaped detection by the variance screen. The reason is that the best response of non-participants to the pricing policy of the cartel may be such that their mean prices and price volatility closely follow that of cartel members.

To analyze how the pricing policy of an incomplete cartel may affect prices set by outsiders consider a market with n firms with identical cost structures of the form $TC(q_i) = cq_i + F$ that face the following Shubik-Levitan demand function for differentiated products,

$$q_i = a - (1 + \gamma(1 - \frac{1}{n}))p_i + (\frac{\gamma}{n}) \sum_{j \neq i} p_j, \quad (4.2)$$

with $\gamma \in [0, \infty)$ being a parameter that indicates the degree of product differentiation. When $\gamma = 0$, products are independent, while as $\gamma \rightarrow \infty$ products are standardized and, from a consumer perspective, close substitutes. Firms maximize the following profit function,

$$\max_{p_i} \pi_i = (p_i - c) q_i = (p_i - c) \left[a - (1 + \gamma(1 - \frac{1}{n}))p_i + (\frac{\gamma}{n}) \sum_{j \neq i} p_j \right].$$

Taking the first-order condition equal to zero yields the competitive equilibrium price, which is the same for all firms and equal to,

$$p^N = \frac{a + (1 + \gamma(1 - \frac{1}{n}))c}{2 + \gamma(1 - \frac{1}{n})}. \quad (4.3)$$

Now suppose a subset of k firms collude in price and that $f = n - k$ firms form a competitive fringe of independent outsiders. Let K denote the set of cartel members. Obviously, such an incomplete cartel is only reasonable for intermediate values of γ . The cartel maximizes the following profit function,

$$\max_{p^c} \pi^c = (p^c - c) q^c = (p^c - c) \left[a - (1 + \gamma(1 - \frac{k}{n}))p^c + (\frac{\gamma}{n}) \sum_{j \notin K} p_j \right].$$

Maximizing with respect to p^c and rearranging terms yields the best-response function of the cartel,

$$p^c = \frac{a + (1 + \gamma(1 - \frac{k}{n}))c + (\frac{\gamma}{n}) \sum_{j \notin K} p_j}{2(1 + \gamma(1 - \frac{k}{n}))}.$$

Independent outsiders maximize the following profit function,

$$\max_{p_i^o} \pi_i^o = (p_i^o - c) q_i^o = (p_i^o - c) \left[a - (1 + \gamma(1 - \frac{1}{n}))p_i^o + \gamma \frac{k}{n} p^c + (\frac{\gamma}{n}) \sum_{\substack{j \neq i \\ j \notin K}} p_j \right].$$

Taking the first-order condition and leveling to zero yields the best-response function of an individual outsider,

$$p_i^o = \frac{a + (1 + \gamma(1 - \frac{1}{n}))c + \gamma \frac{k}{n} p^c + (\frac{\gamma}{n}) \sum_{\substack{j \neq i \\ j \notin K}} p_j}{2(1 + \gamma(1 - \frac{1}{n}))}.$$

The equilibrium prices of fringe firms and the cartel can now be determined by combining the best-response functions. In equilibrium, the cartel and the fringe respectively set the following prices,

$$p^c = \frac{a(2n + \gamma(2n - 1)) + c(2n + \gamma(4n - 2k - 1)) + \gamma^2(\frac{f}{n})(2n + k - 2)}{4n + 2\gamma(3n - k - 1) + \gamma^2(\frac{f}{n})(2n + k - 2)}, \quad (4.4)$$

and

$$p^o = \frac{a(2n + \gamma(2n - k)) + c(2n + \gamma(4n - k - 2)) + \gamma^2(\frac{f}{n})(2n + k - 2)}{4n + 2\gamma(3n - k - 1) + \gamma^2(\frac{f}{n})(2n + k - 2)}. \quad (4.5)$$

Note that $p^c > p^o > p^N$ for $k \geq 2$, which holds trivially. That is, the cartel sets a higher price than in competition, but this creates a positive externality for fringe firms, which optimal response is to increase their price levels too, although by a lower amount. Notice that if the price increase of the competitive fringe is sufficiently high, applying the variance screen may not lead to the conclusion that cartel members have ‘unusual high means’. Yet, even if cartel members have an unusually high mean, this may be due to other circumstances. Indeed, as the authors rightly explain, one has to be careful drawing conclusions based solely on relatively high mean prices of a cluster of firms, because other factors may cause these effects. For example, if gasoline stations take a strategic position in the market (e.g., a main highway) it seems natural that, *ceteris paribus*, average prices will be higher than average prices of stations located in less advantageous positions.⁵⁷ An unusual price-variance may therefore be a better ‘tell-tale sign’ of anticompetitive behavior.

The variance in prices is determined by both the frequency and magnitude of price changes in a given period. Arguably, the cartel will modify its price level less frequently and when it does these changes are likely to be significant. In the gasoline market one may think of oil shocks or substantial changes in the exchange rate. Within the setting above, the effect of a change in marginal costs on the competitive price level is given by,

$$\frac{\partial p^N}{\partial c} = \frac{1 + \gamma(1 - \frac{1}{n})}{2 + \gamma(1 - \frac{1}{n})} > 0, \quad (4.6)$$

⁵⁷In fact, Abrantes-Metz *et al.* (2006) finds unusual high means on major cross roads and for gasoline stations that, in most cases, do not have a close competitor. The remaining part of the high means are located in the center of Louisville.

while for the cartel and the fringe firms the effect of a cost change on the price level is respectively,

$$\frac{\partial p^c}{\partial c} = \frac{2n + \gamma(4n - 2k - 1) + \gamma^2(\frac{f}{n})(2n + k - 2)}{4n + 2\gamma(3n - k - 1) + \gamma^2(\frac{f}{n})(2n + k - 2)} > 0, \quad (4.7)$$

and

$$\frac{\partial p^o}{\partial c} = \frac{2n + \gamma(4n - k - 2) + \gamma^2(\frac{f}{n})(2n + k - 2)}{4n + 2\gamma(3n - k - 1) + \gamma^2(\frac{f}{n})(2n + k - 2)} > 0. \quad (4.8)$$

Note that $\frac{\partial p^N}{\partial c} > \frac{\partial p^o}{\partial c} > \frac{\partial p^c}{\partial c}$ for $k \geq 2$, which always holds. That is, cost changes have the lowest impact on the cartel price, but the fringe firms also pass on a lower amount to consumers than they would have done in competition. Hence, in the presence of an incomplete cartel the variance in prices of non-participants will be, *ceteris paribus*, lower than in competition.

When the competitive fringe ignores the pricing behavior of the cartel, the variance screen is likely to be an effective method of detection. However, the pricing behavior of the competitive fringe is typically positively correlated with that of the cartel. If the variance screen is able to discriminate between cartel members and the competitive fringe therefore essentially depends on the magnitude of the effects described above.

4.6 The Need for Industry Specific Detection Tests

A great many problems have to be dealt with before the results of a cartel detection technique can be convincingly used as indirect evidence of collusion. However, at least part of the problems mentioned so far can be overcome by the development of industry specific detection methods. Not every market is the same and detection methods that potentially work well in one industry cannot automatically be applied to other industries.⁵⁸ In this respect, cartel detection could perfectly fit the school of New Empirical Industrial Organization (NEIO), which, in many ways, is a response to the classic structure-conduct-performance approach. Simply put, within this relatively new paradigm, the focus is on a single or small collection of industries, which are analyzed with the help of game theoretical and econometric techniques.

Taking the NEIO approach in cartel detection has several advantages. First and foremost, it allows for a better understanding of a particular industry. This, for example, will make it easier to define a reasonable competitive benchmark. Industry studies often contain detailed information about how a particular industry functions. Also, people who are working in the field (e.g., managers, employees, customers) potentially can provide valuable information about what competition normally looks like. In addition, it is possibly easier to understand what collusive behavior would look like within a particular environment. In many cases, focusing on one (type of) market

⁵⁸That economic tests must take account of the specific characteristics of an industry is, for example, argued by Baker and Bresnahan (2007).

allows for a more precise model and consequently makes it easier to take account of the specificities of that particular industry.

A good example of this approach is the study on the American automobile industry by Bresnahan (1987). He uses data from the American Automobile Industry in the years 1954, 1955 and 1956. The paper concludes that the developed competitive model better explains the year 1955, which was characterized by an extensive supply expansion, while the collusive variant of the model better fits the years 1954 and 1956. The model that has been used is one of product differentiation and the central hypothesis is that noncompeting firms are likely to have a different effect on comparative statics of price and quantity with respect to demand elasticities. The idea is that whether your closest neighbor belongs to you or another firm does not matter so much under a collusive regime, while in competition it matters a great deal if your closest substitutes belong to you or not. Therefore, if there exists a sufficient number of firms in the market (in that enough substitutes are available) competitive behavior will be significantly different from collusive behavior. The way to test this is by keeping structural hypotheses about cost and demand constant, while changing the behavioral hypothesis from collusive to the competitive equilibrium and then apply a likelihood model to determine which one is best able to explain the situation.

Another example is the study conducted by Porter (1983). He uses aggregate time series price and quantity data for the period 1880-1886 in order to examine if switches took place between collusive and noncooperative behavior. The cartel under consideration is known as the Joint Executive Committee, which is an anticompetitive agreement between railroad companies formed in 1879. The author finds evidence that the cartel broke down a couple of times (1881, 1884 and 1885), i.e., a reversion to noncooperative behavior. He conjectures that these reversions were caused by an unanticipated change in demand reflected by an unusually low market share for at least one firm.⁵⁹ These reversions, in turn, can be used to identify periods of collusive conduct. In particular, Porter finds that periods of cooperative behavior are best described by Cournot behavior, which essentially means that the cartel successfully restricted competition, but at the same time failed to set joint profit-maximizing prices.⁶⁰

We can imagine that methods like these can be applied by an antitrust authority *ex ante* given that sufficient data are available. Admittedly, however, such approaches are potentially quite sensitive to model specifications as is illustrated by the contributions of Porter (1983) and Ellison (1994). Yet, even though both these studies yield significantly different results, they have in common that collusive periods could be identified. As such, the design of economic detection tests that are tailored to certain (type of) industries is promising.

The following example illustrates the potential problem of a cartel detection method that fails to take into account the special characteristics of the market to which it is applied.

⁵⁹For a theoretical foundation of this behavior, see Green and Porter (1984).

⁶⁰Ellison (1994) analyzed the same data set, but with a slightly different model. In particular, he takes into account possible serial correlation in the error term of the supply equation. He finds evidence that the cartel approximately set prices that maximized joint profits during collusive periods.

4.6.1 A Variance Screen for Collusion: an Example (2)

The effectiveness of a detection device very much depends on the idiosyncrasies of the industry to which it is applied. Dynamic pricing in retail gasoline markets often exhibit a cyclical pattern similar to that of so-called Edgeworth cycles as described by Maskin and Tirole (1988).⁶¹ Such a cycle typically starts with a relatively high market price after which firms alternately undercut each others prices slightly, which implies slowly decreasing average market prices. Note that an important feature of Edgeworth cycles is that firms set their prices sequentially, which implies there exists a system of leaders and followers. At the cycle bottom firms face a coordination problem, because even though there is an incentive to hike the price, nobody is willing to be the first to relent. This coordination problem is more severe when more parties are involved. One way to escape from this prisoner's dilemma is by installing a system of collusive price-leadership in which the incomplete cartel announces a new high price that may or may not be followed by fringe firms.⁶² If the attempt to hike prices is successful, i.e., followed by non-participants, a new Edgeworth cycle starts.⁶³ This system of cyclical pricing patterns and collusive price-leadership has certain implications for the price variance of both the cartel as well as the fringe firms.

Competitive firms tend to adapt their prices also in case of minor cost changes, which, *ceteris paribus*, will yield a higher variance in prices. Note, however, that when the incomplete cartel operates as price-leader in markets that exhibit cyclical price patterns there exists another important price effect in particular when market prices are at the bottom of a cycle.⁶⁴ Consider the same scenario as described above and suppose the cartel announces a new high price. Such a price-hike is successful only when all outsiders relatively quickly respond by increasing their own prices. However, followers typically raise their prices by a lower amount, which means that the price-variance of cartel members *increases* compared to that of non-participants. The impact on the difference in price variance is even stronger when the attempt to hike the price is unsuccessful.⁶⁵ Indeed, when followers do not react or do not respond fast enough they will force the cartel back to the original price level. Again, this makes prices set by cartel members *more* volatile than that of the competitive fringe. The net effect on the price-variance of a cartel acting as price-leader in markets with cyclical price patterns is therefore at best ambiguous.

⁶¹See, for example, Castanias and Johnson (1993) who recognize that price cycles observed in Los Angeles in the late 1960s and early 1970s are closely resembled by Edgeworth price cycles. See also Eckert (2003) and Noel (2007).

⁶²Collusive price-leadership in gasoline markets is confirmed by Scherer and Ross (1990). A real-world example of collusive-price leadership in gasoline markets is analyzed by Wang (2005).

⁶³Note that high prices may be sustained for a while, because station operators recognize that reducing their own prices induces price cutting at rival stations and, moreover, once the undercutting process starts it may take some time to return to higher margins. See Borenstein and Shepard (1996).

⁶⁴Note that during the 'price war phase' everybody is undercutting everybody so that huge differences in price variance between firms are likely to be absent.

⁶⁵Attempts to hike the price tend to fail frequently as is illustrated by Wang (2005).

4.7 Discussion

The economics of cartel detection is an emerging field. Currently, most developments occur in academics, but an increasing number of antitrust agencies is starting-up an active detection policy. With firms becoming increasingly aware of antitrust enforcement and the risk of taking part in a cartel agreement we cannot rely on finding too many “smoking guns”, i.e., direct evidence of cartel meetings, in the future. Fortunately, it is typically beyond the power of firms to hide the results of the agreement and a substantial part of these effects is likely to be present in economic data and market indicators. Historically, economic theory has proven to be very valuable in identifying markets that are conducive to collusion, but it will in all likelihood become increasingly important in the assessment of firm behavior in those markets in the near future.

At the same time, it must be admitted that the number of cartel detection methods that is currently available to carry out such “crime scene investigations” is at best modest. In addition, this chapter reveals that the development of a workable method of detection is quite a challenge. Yet, as has been stressed already several times, it is arguably worth the effort in the long run. At this point, it is important to re-emphasize that part of the reward will naturally remain invisible. Taking part in a conspiracy becomes, *ceteris paribus*, less attractive, the higher is the chance of being caught and there are good reasons to believe that firms do take these (expected) costs into account. For example, we know that in procurement auctions some firms consciously submit phony bids or refrain from bidding to make sure that the ring remains unnoticed. Furthermore, the studies by Christie and Schultz (1994) and Christie *et al.* (1994) suggest that market players collectively defect from the agreement once “the heat is around the corner”. In summary, cartel detection helps to achieve one of the prime goals in antitrust enforcement; deterrence.

Part of the benefits of cartel detection that in principle can be assessed in money terms should stem from cartel cases that were the result of a successful application of one or a combination of detection techniques. To the best of our knowledge, so far none of the detection techniques discussed have been successfully applied in antitrust practice *ex ante*.⁶⁶ Consequently, only time will tell if the methods currently available are successful in the pro-active search for anticompetitive conduct. However, it is important to keep in mind that if a certain cartel detection method appears to have led to wrong conclusions in a particular case this not automatically implies that the method is ineffective. One can never be one hundred percent sure if some cartel activity takes place, i.e., cartel detection is utterly probabilistic. Hence, no matter how solid the cartel detection technique that is used is, there will always be room for an alternative explanation for observed firm conduct.

To what extent cartel detection can help to achieve the goal of desistance will not only depend on the quality of detection methods. In part it will also depend on legal developments. One key issue, which has been ignored in this chapter, is if and to what extent judges will accept circumstantial evidence of collusion to constitute ‘reasonable

⁶⁶To be clear, by detection techniques we mean here those methods that focus on cartel behavior.

doubt' that legitimizes further in-depth investigations. Currently, there seems to be no conclusive answer to this matter, although in all likelihood econometric evidence alone will not be sufficient.⁶⁷ In light of future research, a comprehensive legal analysis that relates potential economic detection results to the amount and quality of evidence that is needed to file a case would be a very welcome contribution. In this respect, a better understanding of what distinguishes overt from tacit collusion will prove to be important. That is, in-depth investigations typically imply a violation of some basic rights, which is easier to defend when there exists a significant chance of finding direct physical evidence. Economic research should therefore aim to find ways in which market data and other economic indicators could be used to delineate implicit and explicit cartel agreements.

Next to that, the development of economic detection methods that can be applied to more regular markets should be encouraged. This chapter shows that already quite some tests have been developed to detect bidding rings. This is understandable, because the data that are needed to implement the test are relatively easily accessible. Also, cartels are a prevalent phenomenon in auctions. Yet, a substantial part of cartels that have been discovered were operating in industries that were not organized by means of auctions. More generally, potentially a lot of progress can be made through the development of detection devices that are specifically designed for a certain (type of) industry. An example of such a detection method is presented in the next chapter.

⁶⁷See, for example, Froeb and Shor (2005) who claim that "Econometric evidence alone is unlikely to meet the burden for criminal prosecutions, though it may form a substantial part of evidence in a civil trial."