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### Incomplete cartels and antitrust policy : incidence and detection

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# 1

## Motivation and Outline

*“In economic life, competition is not a goal: it is a means of organizing economic activity to achieve a goal.”* – George Stigler<sup>1</sup>

### 1.1 Introduction

Free market competition is one of the cornerstones of a capitalist society. In a free economy, individuals are left free to pursue their own profits and this is widely believed to enhance economic progress. Adam Smith was among the first to express the view that individual market players need not have the objective to promote social welfare.<sup>2</sup> Higher welfare standards for society at large will be the unintended consequence of competition between rivals who are primarily motivated by their own well-being. The idea that a free enterprise system is beneficial for society is founded on the premise that markets are indeed competitive. However, competition, by its very nature, erodes the individual gains of competitors. It is precisely for this reason that firms quite naturally strive for obtaining a position uncontested by competition.<sup>3</sup> A competitive order is therefore persistently threatened by undertakings which, driven by self-interest, attempt to reduce competitive pressure.

One of the most direct ways in which firms can restrict competition is to engage in a cartel. The word “cartel” is a diminutive of the Latin term *charta*, which can be loosely

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<sup>1</sup>See Stigler (1983), p. 5.

<sup>2</sup>Smith (1994). The first edition of this famous book, which is originally titled ‘An Inquiry into the Nature and Causes of the Wealth of Nations’, has been published in London, U.K. in 1776.

<sup>3</sup>See Neumann (2001).

translated as a card, letter or paper.<sup>4</sup> Stocking and Watkins (1948) provide a complete definition of what nowadays is understood by a cartel. They define a cartel as “an arrangement among, or on behalf of, producers engaged in the same line of business, with the design or effect of limiting or eliminating competition among them”. To what extent a cartel is effective depends in large part on the number of undertakings that participate in the agreement. According to Liefmann (1977), a cartel naturally aims at excluding *as far as possible* competition within its range of activity. The limit case is then a cartel that succeeds in embracing all enterprises. Indeed, the conventional wisdom is that the perfect (or full) cartel is one that eliminates all competition in the market.

Many known cartels, however, did not include all firms in the relevant market and consequently were operating in the presence of one or more independent outsiders, which formed a so-called competitive fringe. This dissertation is about such *incomplete cartels*.<sup>5</sup> An incomplete cartel is defined as a cartel with less than one hundred percent market share. In other words, a cartel is incomplete when it does not control all industry supply. A cartel in the North Atlantic shipping industry, for example, controlled approximately 75% of the market.<sup>6</sup> In the carbonless paper industry, the joint market share of cartel members was estimated to be 85-90%.<sup>7</sup> Perhaps the most famous cartel, the Organization of the Petroleum Exporting Countries (OPEC), is not all-inclusive. For instance, major players like the United States and Russia are not a member of OPEC. There are many other examples of cartels that did not encompass all market players.

This thesis consists of two main parts. The first part analyzes the nature of incomplete cartels. The second part is about cartel detection and explores ways in which incomplete cartels can be detected. The dissertation is organized around four main research questions.

- What explains optimal cartel size to be less than all-inclusive?
- What (type of) firms take part in an incomplete cartel and what (type of) firms remain independent outsiders?
- What is the relationship between industry structure and optimal cartel size?
- How can economics be used to detect (incomplete) cartels?

Each of these questions is briefly introduced in the next section.

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<sup>4</sup>See the American Heritage Dictionary of the English Language (1969).

<sup>5</sup>Incomplete cartels are sometimes referred to as *partial cartels*. In this dissertation, both terms are used interchangeably.

<sup>6</sup>See Escrihuela-Villar (2003).

<sup>7</sup>See Levenstein *et al.* (2003).

## 1.2 Motivation

The first main aim of this dissertation is to provide a rationale for the existence of incomplete cartels. Standard economic theory of industrial collusion predicts that the most profitable cartel arrangement is one in which all firms in the market together operate as a multiplant monopolist. The question therefore arises: why did many cartels not monopolize the entire market? From an economic theoretical point of view, this question can be reformulated as: What explains optimal cartel size to be less than all-inclusive? That is to say, under what conditions is an incomplete cartel more profitable than an all-inclusive cartel? A possible explanation is that the full cartel is not viable, because one or more firms lack the incentive to abide by the cartel contract. Alternatively, reaching an agreement between all market players might prove to be too challenging, e.g., when there is a substantial difference in unit production cost. Also, a cartel may consciously exclude one or more firms so as not to attract too much attention from direct purchasers or an antitrust authority.

The next main research topic concerns the composition of a cartel. Given a less than all-inclusive cartel, the question to be addressed is: Who is in and who is out? To put it differently, what are the traits of firms that join the cartel? To be able to analyze this question from an economic theoretical perspective requires a setting in which firms differ in at least one respect. For example, some firms might have a more efficient production process or a better access to valuable information sources. Also, a subset of sellers might be located strategically in the market. Alternatively, we might conjecture that the incentive to collude is affected by the position of a firm in the industry. For instance, larger companies may be more inclined to join a cartel or *vice versa*.

Moreover, in the literature it is well-established that some industries are more prone to collusion than others.<sup>8</sup> In a related vein, we might conjecture that particular industry structures are more conducive to the formation of incomplete cartels as opposed to full cartels. In other words, what is the relationship between industry structure and optimal cartel size? This question is interesting in its own right, but it also potentially yields some important insights that are helpful in antitrust law enforcement.

To safeguard competition in the market place, most capitalist societies have adopted a set of antitrust laws and set up antitrust agents that are given the task to enforce these ‘rules of competition’. The precise content of antitrust laws varies per jurisdiction, but cartel agreements are typically declared illegal. At the end of the nineteenth century there was a growing concern in the United States about the vast increasing economic power of large corporations, which undermined the functioning of dynamic competitive markets and weakened the ability of governmental institutions to prevent excessive business practices. This resulted in the enactment of the Sherman Act in 1890. With the Sherman *Anti-Trust* Act the government had officially established the first measure to prohibit trusts and it gave authority to the federal government to institute proceedings against these practices in order to dissolve them. The first article of the Sherman Act reads:

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<sup>8</sup>See, for example, Chapter 4 of Motta (2004).

“Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal. Every person who shall make any contract or engage in any combination or conspiracy hereby declared to be illegal shall be deemed guilty of a felony, and, on conviction thereof, shall be punished by fine not exceeding \$10,000,000 if a corporation, or, if any other person, \$350,000, or by imprisonment not exceeding three years, or by both said punishments, in the discretion of the court.”

Although there existed a strong consensus about the need for antitrust legislation it was not immediately clear how exactly these rules of competition had to be developed and implemented. One of the reasons is that the act was not well documented and very generally formulated. For instance, the term “restraints of trade” was not defined. As a result, most of the ideas written down in the act could not be applied directly and, consequently, needed further explanation, which was to be given by the Courts in concrete antitrust cases. This rather extensive discretion in effect paved the way for, what later became known as, “the per se rule versus rule of reason debate”. The central issue in this debate was if some business conduct could be held illegal per se, without any further inquiry of its effects on competition.

The main result of the antitrust development in courts is that around 1970 certain business practices were judged under a per se rule and some cases were dealt with by applying a reasonableness test. Today, hard-core cartel arrangements are viewed illegal per se. Simply put, this means that naked cartels are never thought ‘reasonable’ business practice. To prosecute this anticompetitive conduct it suffices to convince the judge that suspect parties indeed made an explicit agreement about strategies that directly have impact on the pricing mechanism.

In contrast to developments in the United States around the year 1900, European governments expressed quite a different attitude towards cartels. It was not uncommon to tolerate explicit cartel agreements, although such contracts were often not enforceable by courts. A great many cartels were openly sponsored by governments. This changed at the beginning of the European Union when there was a growing concern about free trade between Member States. Cartel practices have been declared incompatible with the common market in the Treaty of Rome of 1957. Article 85(1) of the original treaty (nowadays Article 81(1)) reads,

“The following shall be prohibited as incompatible with the common market: all agreements between undertakings, decisions by associations of undertakings and concerted practices which may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the common market, and in particular those which:

(a) directly and indirectly fix purchase or selling prices or any other trading conditions;

(b) limit or control production, markets, technical development, or investment;

- (c) share markets or sources of supply;
- (d) apply dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage;
- (e) make the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.”

In Europe, like in the United States, the agreements between firms that are considered most harmful are those that have a direct effect on the price mechanism.

In order to ensure compliance, an antitrust authority must know if and where antitrust laws are violated. There currently exist three ways in which antitrust agencies find out about cartel activity. These are,

- Complaint procedures
- Leniency programs
- Cartel detection

The complaint procedure allows customers and competitors of the cartel to file a complaint with the antitrust authority. Also, (former) employees may decide to ‘blow the whistle’. Simultaneously, authorities learn about cartels due to the leniency program. This program offers firms that take part in a cartel agreement an opportunity to self-report in exchange for partial or full immunity of the fine depending on the position a firm takes in a sequence of self-reporters. Typically, the first to self-report receives the highest discount. One of the main advantages compared to the complaint procedure is that the information that self-reporters bring to the authority is likely to be much more detailed, which makes conviction, *ceteris paribus*, easier. In addition, the antitrust agency may start to search for cartel activity upon its own initiative. Note that the first two enforcement instruments are passive in the sense that the antitrust authority moves second, while the third instrument is pro-active.

The second part of this dissertation is about the scope and limits of *economic* methods of cartel detection. In particular, the focus is on detection methods that can be applied to screen markets for incomplete cartels. Understanding what type of industries are prone to the formation of incomplete cartels may shed some light on whether or not a cartel detection test is likely to be effective. For example, a detection technique may require the competitive fringe as benchmark and, as a result, will fail to identify collusion when the cartel is all-inclusive. Furthermore, the detection of incomplete cartels is of special interest, because the behavior of outsiders presumably differs from that of cartel members. In principle, economic theory can help to identify such differences.

### 1.3 Methodology

This dissertation is almost exclusively theoretical. Occasionally, use is made of descriptive cartel studies and concrete cartel cases, but these are primarily meant for

illustrative purposes. Like with any other theory, the results derived are based on a limited set of implicit and explicit assumptions. Consequently, conclusions are not guaranteed to hold if any of the assumptions are violated. The theories that are discussed and developed make extensive use of concepts that are commonly applied in the (classic) industrial economics literature. In particular, firms are thought of as single decision entities with profit maximization as their sole objective. In other words, undertakings are taken to be a black box and potential organizational issues, although very interesting in their own right, are beyond the scope of this thesis.

Following the industrial economics literature, the technical parts of this thesis uses game theory. Game theory is a discipline that takes a mathematical approach to study situations of conflict and was originally developed to analyze parlor games more rigorously. However, there appears to be many similarities between competition in the market place and ordinary games like chess, checkers, monopoly, *etcetera*. For example, in both situations there is a limited number of rivals that aims to achieve a particular result, while taking into account the rules of the game. Simply put, a cartel can be viewed a coalition among cheating players who violate the rules of competition to their own advantage.

The games that are analyzed in this thesis are noncooperative games. The main difference between noncooperative games and cooperative games is that with the latter players can form binding agreements. As we have described above, cartel arrangements are typically illegal and, as a result, a cartel agreement between firms is not binding, at least not from a legal perspective. It is therefore natural to take a noncooperative game approach to study cartels. An important solution of these type of games is the Nash equilibrium. A particular outcome of a game is a Nash equilibrium when each player maximizes his payoff given the strategies chosen by the other players. Thus, given the strategies adopted by all rivals, none of the players has an incentive to change its own strategy. Hence, a cartel is a Nash equilibrium of a game when all cartel members *individually* prefer to abide by the cartel contract and all outsiders *independently* stick to their strategies. As a result, all solutions to the games that we analyze are self-enforcing.

Game theory is well-suited to analyze the core topics of this thesis, but taking this approach has some important implications. Throughout this dissertation it is assumed that firms are perfectly logical players that are solely interested in maximizing their own profits. Therefore, ‘winning the game’ in this context does not mean “to beat all your opponents”, but it refers to achieving as much personal gain as possible. The goal of firms is to maximize their own profits and, in pursuing this objective, they are supposed to take into account the strategies adopted by competitors. Firms are therefore assumed to behave purely in their self-interest and, for instance, will not refuse to take part in a cartel agreement on moral grounds, e.g., because it is against the law. That is to say, if the strategy “colluding” dominates “competing” a firm will take part in the cartel.

The assumption of perfect rationality is arguably unrealistic. However, the degree of realism in the assumptions made is only of modest importance. By definition, every model is a simplified representation of reality, but this does not mean that models are useless. For example, a city map undoubtedly leaves out many interesting details. Yet, the map may be sufficiently realistic to find your way in town and if that is your

goal, the map is useful. What matters, therefore, is if the model is *sufficiently* realistic in the sense that it yields insights that are useful. In this respect, the rationality assumption is probably far less restrictive for business firms than for individuals. Firms, unlike individual persons, take decisions that are the result of interactions between individuals working within the firm. Arguably, this will neutralize a large part of irrational or emotional driven decisions of individuals. This is not to say that this approach allows us to perfectly predict firm behavior, but it should give us sufficient confidence that the rationality assumption is workable.<sup>9</sup>

Collusive market behavior has been of interest to economists ever since the start of industrial organization as a distinct discipline in economics. The theory of industrial organization developed almost hand in hand with the theory of imperfect competition, which is rooted in the 1930s.<sup>10</sup> The theory of imperfect competition and, in particular, the theory of oligopoly was generally felt to describe market competition more accurately than the classic theories of perfect competition and monopoly.<sup>11</sup> Like many real-world markets, collusion is not easily explained with the traditional models of perfect competition and monopoly. The theory of monopoly trivially excludes the possibility of collusion, while the theory of perfect competition supposes all market players to be *price takers*. Clearly, it is difficult to see how firms can fix prices if the price decision is assumed exogenous. Hence, to study cartels properly requires a setting in which sellers have some market power.

Traditionally, cartels are believed to be potentially viable only in markets with only a few sellers. As a result, collusion is commonly studied in oligopolistic models. At the heart of the theory of oligopoly lies the hypothesis that in industries consisting of only a limited number of sellers, firms will realize their mutual interdependence. Hence, a strategic action by one firm not only has an impact on its own profit level, but will also affect the profits earned by others. With only a small number of undertakings this mutual recognition is thought to be conducive to a coordination of actions, which in the extreme case may lead to monopolistic market performance. Or as Chamberlin (1933) has put it,

“If each seeks his maximum profit rationally and intelligently, he will realize that when there are only two or a few sellers his own move has a considerable effect upon his competitors, and that this makes it idle to suppose that they will accept without retaliation the losses he forces upon them. Since the result of a cut by any one is inevitably to decrease his own profits, no one will cut, and although the sellers are entirely independent, the equilibrium result is the same as though there were a monopolistic agreement between them.”<sup>12</sup>

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<sup>9</sup>For an in-depth and extensive discussion of the rationality assumption in economics the reader is referred to Smith (2008).

<sup>10</sup>Theories of Imperfect Competition have as their subject markets with more than one seller that are not perfectly competitive. Theories of Industrial Organization are concerned with the strategic behavior of firms and how this affects the workings of markets and *vice versa*.

<sup>11</sup>A particular example of theories of imperfect competition are theories of oligopoly, which focus on markets with only a limited number of sellers.

<sup>12</sup>See Chamberlin (1933), p. 48.



The *monopolistic agreement* Chamberlin refers to is an implicit contract, which cannot be enforced by legal means. However, due to the illegality of cartel arrangements, explicit cartel contracts cannot be enforced by law either. This implies that any successful cartel must be self-enforcing and it is widely believed that firms will have a great many difficulties in forming an effective cartel. At least since Stigler (1964), economists are well aware that one of the most prominent threats to a cartel is the incentive of firms to chisel on the arrangement. To take account of the incentive to cheat, the vast majority of theories on collusion uses a dynamic approach to study cartels. Indeed, modern theory on collusion is based on so-called supergames. In a supergame the one-shot or stage game is played multiple times. A popular solution concept in these type of games is the Subgame Perfect Nash Equilibrium (SPNE). A SPNE requires players' strategies to constitute a Nash equilibrium in every subgame of the supergame.

The theory of incomplete cartels that is developed in this thesis also takes a supergame approach. In a supergame, market players are assumed to believe that interaction will take place for multiple periods and to sustain some level of collusion it is typically required that firms believe the game has no end date or that the end date is unknown. Friedman (1971) was among the first to show that, when interaction occurs for an infinite number of periods, firms can sustain some level of collusion if they are sufficiently patient.<sup>13</sup> In these type of settings, collusion can be sustained when firms adopt some credible punishment strategy. One of the main shortcomings of this approach is that it typically fails to distinguish between tacit and overt collusion. It therefore remains unclear how sellers coordinate actions to select a particular equilibrium.<sup>14</sup>

The oligopoly models that are analyzed in the first part of the thesis are known as 'representative consumer models' or aggregate demand models. These type of models do not consider the behavior of individual customers, but simply assume there exists some (aggregate) demand for a certain product. In the second part of this dissertation, we take a different route and develop a spatial model of imperfect competition. In a spatial (or location) model, firms as well as customers are characterized by their location. Hence, products of firms are typically imperfect substitutes due to their geographical dimension. The literature that takes this approach dates back at least as far as Hotelling (1929). It is quite generally assumed that differentiation exists in a

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<sup>13</sup>In fact, any individual rational outcome can arise in an infinitely repeated game given that players are sufficiently patient. In the literature this is sometimes referred to as the 'Folk Theorem'. See, for instance, Tirole (1988).

<sup>14</sup>Basically, there exist two strands of literature that attempt to solve the coordination problem. On the one hand, there is the literature on 'cheap talk', i.e., communication that does not directly affect the pay-offs, which deals with the question whether or not communication can influence equilibrium outcomes. For an overview, the reader is referred to Farrell and Rabin (1996). On the other hand, there is a literature that asks how revealing private information may affect the equilibrium outcome. See, for instance, Athey and Bagwell (2001). See also Compte (1998) and Kandori and Matsushima (1998) who study communications in settings in which sellers receive private but imperfect signals about past play.

bounded one-dimensional world, i.e., sellers compete on a line or circle.<sup>15</sup> By contrast, we develop a two-dimensional spatial model.

## 1.4 Outline

As mentioned, this dissertation consists of two parts, both of which contain two chapters. The first part (chapter 2 and 3) analyzes the nature of incomplete cartels. The second part (chapter 4 and 5) focuses on economic methods of cartel detection, with a special emphasis on the detection of incomplete cartels.

Chapter 2 discusses the economics of incomplete cartels. It provides a survey of the relevant economic literature and some questions are distilled to which the literature provides no satisfactory answer. The major part of the chapter deals with three main issues concerning cartels that are not all-inclusive and these are discussed in reference to five oligopoly models. First, we examine under what conditions incomplete cartels are profitable. This question is of interest, because the competitive fringe could potentially undercut the cartel price and attract a significant number of customers, which might render an incomplete cartel unprofitable. Second, we ask when incomplete cartels are sustainable. In particular, we ask whether or not collusion is more likely to be sustainable when more firms are included in the conspiracy. The third issue concerns the incentives to take part in the cartel or to remain a fringe member instead. In the remainder of the chapter, we briefly discuss some cartel formation games with externalities and survey some theoretical contributions that study incomplete cartels with heterogeneous firms. Finally, we consider incomplete collusion in auctions. The chapter concludes with a discussion, which paves the way for the analysis in Chapter 3 by listing omissions and potential extensions of the existing literature.

Chapter 3 builds on the previous chapter and develops a novel theory of incomplete cartels. The main goal of this chapter is to provide an answer to the first three research questions as formulated above. To that end, we develop a price setting supergame in which firms differ in terms of production capacity, which is taken as a proxy for firm size. In this setting, we first explore what is the optimal cartel size. We find that the optimal cartel size is all-inclusive when colluding is costless, but less than all-inclusive when colluding is costly and the smallest firm in the industry is sufficiently small. Then, we explore what type of firms have a stronger incentive to collude. It is shown that larger firms are more inclined to join a cartel. In particular, we show that sufficiently small firms have no incentive to join any cartel. Moreover, a cartel comprising the largest producers is proven to be a subgame perfect equilibrium of the game. In addition, we examine whether or not firms have an incentive to form the most profitable cartel and find that the answer is in the positive when its smallest member is sufficiently large. It is noteworthy that these results find considerable support in examples of real-world incomplete cartels. Finally, we discuss changes in the size distribution of firms, for instance, due to a merger between two or more companies. We

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<sup>15</sup>Hotelling (1929) analyzes competition in a ‘linear city’. Competition in a ‘circular city’ has been studied by, for example, Salop (1979).

show that firms have an incentive to merge only if they are in the cartel or become part of the cartel post-merger. Particularly, our results suggest that the most severe coordinated effects may come from mergers involving moderate-sized firms.

In the second part of this dissertation, we redirect attention to cartel detection and antitrust law enforcement. The main aim of Chapter 4 is to provide an overview of economic methods of cartel detection and to explore its potential. As a start, the goal and scope of cartel detection are discussed. In particular, we make the case that economics is likely to play an increasingly important role in cartel detection and that cartel detection itself will become a key instrument in antitrust enforcement. Then, we survey the economic literature on cartel detection and list some potential pitfalls in the use of these methods. Several detection methods work on the premise that the cartel does not encompass all firms. These techniques typically attempt to discriminate between cartel and fringe behavior so as to establish the existence of collusive conduct. It is shown that these methods might fail to delineate competition from collusion, because it can be advantageous for fringe firms to closely follow the cartel policy. Finally, we illustrate that an economic method of detection is vulnerable when it fails to take into account the idiosyncrasies of the industry to which it is applied. As a result, we argue that substantial progress can be made through the design of economic detection techniques that are tailored to a certain (type of) industry. An example of such a detection tool is presented in Chapter 5.

In Chapter 5 a novel detection method is designed that can be used to screen markets in which firms apply a so-called basing-point system. Historically, these type of industries are well-known to be prone to collusion. Examples include markets for lumber, iron, steel and cement. The detection test requires information on customer project locations and transaction data, i.e., prices and quantities. This information is shown to be sufficient to recover base-point locations from which the delivered prices were calculated. Base-point locations are useful to determine the likelihood of collusion. In a theoretical framework, we establish that in equilibrium all firms use a mill location as basing-point, whereas a collusive base is always located sufficiently far from the production centers. In particular, basing-points situated relatively close together and significantly far from mill locations are indicative of collusion. The likelihood of collusion is captured with a measure that takes a value between zero and one, with higher values corresponding to a higher likelihood of collusion. A software is developed in order to be able to deal with large data sets as well as with noise in the data. Finally, it is noteworthy that basing-point pricing is especially well-suited to facilitate collusion among a subset of firms that are located relatively close together. There exist some real-world examples of incomplete cartels that applied single basing-point pricing to protect local markets against distant competitors.

In the final chapter, Chapter 6, we summarize and discuss the main findings of this thesis. We further discuss implications for antitrust policy and outline some avenues for future research.