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Cartels in Europe: Main features

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@ V. aussi le supplément électronique : *Les oligopoles à produits homogènes ;* et, *Les gains d'efficacité et les arguments pro-concurrentiels*

Cartels in Europe: Main features

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Abstract

This article draws an exhaustive panorama of all the cartels convicted by the European Commission (111 cartels convicted from 1959 to 2009) and depicts the cartel profile in Europe. We analyze our sample comparing our results with those obtained from international and U.S. data. We study cartels duration, the affected markets, the organization of the cartel (number of undertakings, involvement of a trade association, market allocations, exchanges of data, side payments), causes of cartels breakup and recidivism.

Sur la base d'un échantillon inédit rassemblant les 111 cartels condamnés par la Commission Européenne entre 1969 et 2009, nous dressons le portrait robot du cartel européen. Nous comparons nos résultats avec ceux obtenus dans d'autres études menées sur des cartels internationaux et américains. Nous étudions la durée de vie des cartels, les marches affectés, l'organisation et le fonctionnement du cartel (nombre de participants, intervention d'une organisation professionnelle, allocations des marchés, échanges d'informations, paiements transversaux), les causes de dissolution des cartels et la récidive.

I. Introduction

1. From 1969 to June 2009, the Commission has detected and condemned 111 cartels (cases in which fines were inflicted). Based on the information collected from European Commission decisions, we draw the profile of the cartels convicted by the Commission, which has never been done up to date[1]. This picture could improve the « screening » methods of detection, identifying sector at risk and better understanding the functioning of cartels and their organization. Moreover, we compare our results with those obtained in other studies on international cartels or cartels convicted in the United States by the Department of Justice.

2. In the first section, we estimate the average cartel duration in Europe and discuss the methodological issues raised by the measure of cartels lifetimes. In the second section, we analyze the markets affected by cartels: the affected sector, the dimension of the cartel, the size of the market, the market share of the undertakings. In the third section, we study the organization and the functioning of cartels: number of undertakings, methods of coordination. Last, we analyze the causes of cartels break up and recidivism.

II. Cartel Duration

1. Methodology

3. Cartels « lifetimes » are estimated in days; it corresponds most of time to the period between the birth of the cartel and its detection by the European Commission (detection usually triggers cartels break up). Insofar as some cartels terminate before being detected, cartel lifetime corresponds to the period between the birth of the cartel and its "natural" death (and not between the birth and the detection of the cartel).

4. In a number of cases, it is presumed that the cartel lasted longer than the duration retained by the Commission for at least two reasons (hence, durations reported in our empirical work are probably underestimated and must be seen as lower bounds):

→ the begin date of the cartel corresponds to the date on which the first proofs of collusion were found – secret meetings, etc – and not necessarily to the true starting date of the cartel. As the fine is positively correlated to cartel duration, firms have no interest in disclosing the true starting date of collusion. Therefore, it is likely that the cartel's date of birth is in fact earlier than the date put forward by the firms;

→ likewise, it can happen that collusion goes on after detection. For instance, in its decision 94/599/CE relating to the PVC Cartel (1994), the Commission explains that – §49 of the decision –:"*in the absence of information from the producers, it is not even possible to establish whether or not the collusion – in some form or other – has*

1 Previous research offers several surveys on contemporary cartels. However, these works are mostly based on international cartels convicted in the United States (for a review of this literature, see Levenstein and Suslow [2006]). Carree, Günster and Schinkel [2008] study the antitrust policy of the European Commission. Nevertheless, their work is based on all the decisions of the Commission, relating to agreements and other infringements, such as abuse of dominance. And their approach is above all institutional (some variables retained are for instance the type of decision, the duration of the investigation, the length of the decision, the name of the competition Commissioner at the time of the decision). Other studies, such as Gerardin and Henry [2005], and Veljanovski [2007], analyze only the sanction policy of the Commission.

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ever ended. Clearly the cartel continued after the Commission carried out its first investigations into the PVC sector in late 1983". But we will not consider this hypothesis, as it is hard to assess. Therefore, we suppose that detection triggers *ipso facto* the end of the cartel[2].

Moreover, as the duration of each firm's own participation in the cartel is not necessarily the same, we use the global duration of the cartel, as indicated in the Commission's decision.

5. Most of the time, firms collude on several markets, i.e. on several products or geographic areas at the same time. And some agreements terminate to revive (successive agreements), as in the case of the acid citric cartel (convicted in 2001). Usually, the Commission regroups these agreements under the aegis of a sole cartel and the decisions only contain the global duration of the cartels (there is no distinction made between the different agreements)[3]. Nevertheless, in some important cases, the Commission distinguished between the sub-agreements on different markets, dividing up their durations and inflicting different fines, such as in the Vitamins Cartel (2001), the Special Graphite Cartel (2002), the Industrial Thread Cartel (2005) and the lifts and escalators Cartel (2007). In these cases, we estimated mean duration for each sub-agreement. For all other intertwined or successive cartels, we took the global duration, as reported in the Commission's decisions.

6. Most decisions contain precise begin and end dates: day, month, year. But in some cases, only the year is given or the most precise identification is to the month[4]. In this case, we estimate a range of lifetimes, using two methods to calculate cartel duration:

→ the first method defines a minimum duration (DUR Min) to be the period from the latest begin day to the earliest end day of the cartel - for instance if the decision indicates that the cartel began in 1971 and continued to at least October 1975, the latest begin day is December 31, 1971 and the earliest end day is October 1, 1975;

→ the second method defines the maximal duration (DUR Max) to be the period from the earliest begin day to the latest end day. In the above example, the earliest begin day is January 1, 1971 and the latest end day is October 31, 1975. These two measures give us a range of values and each is defined to include all cases in the sample.

2 Levenstein and Suslow, [2006] p.45, also mention the case of the Organic Peroxides Cartel convicted in 2003.

3 The Court of First Instance precised that: "*in the context of a complex infringement which involves many producers seeking over a number of years to regulate the market between them, the Commission cannot be expected to classify the infringement precisely, for each undertaking and for any given moment, as in any event both those forms of infringement are covered by Article [81] of the Treaty*", Judgment of the Court of First Instance of 20 April 1999 in Joined Cases T-305/94 to T-307/94, T-313/94 to T-316/94, T-318/94, T-325/94, T-328/94, T-329/94 and T-335/94 *Limburgse Vinyl Maatschappij and Others v Commission*.

4 Particularly in the case of decisions not yet published.

2. Results

7. The average lifetime of a European cartel ranges from 7.1 to 7.5 years – the median is around 5.5, so as the standard error (Table 1) – which corresponds to the average cartel duration obtained in other works, particularly in Levenstein and Suslow [2006b] on a sample of 72 international cartels. Whatever the jurisdictions and periods retained, empirical studies show that the average duration is superior to 5 years and inferior to 8 (Table 2).

Table 1: Cartel duration in Europe (years)

	Median	Mean duration	Standard Error
DUR Min	5.5	7.1	5.2
DUR Max	6	7.5	5.4

Table 2: Comparison with other studies on international cartel duration (years)

	Mean duration	Median	Standard error	Nb of cases
Bolotova and al. [2007]	8.61	na	na	395
Veljanovski, [2007]	6.5	na	na	30
Levenstein and Suslow, [2006b]	7.5	na	5.4	72
Zimmerman and Connor, [2005]	6.3	4.4	na	166
Dick, [1996]	5.3	na	na	111
Bryant and Eckard, [1991]	6.3	4.8	na	184
Griffin, [1989]	7.3	na	6.3	54
Eckbo [1876]	4.6	na	na	52
Posner, [1970]	7.5	na	na	989

na: not available

8. As for the distribution of cartel lifetimes, the standard deviation of cartel duration ranges from 5.5 to 6 years, implying that there is a huge variability in cartel duration: the cartel with the shortest duration survived only a few months – the French Beef Cartel – and the longest lasted more than 20 years – the Industrial Bags Cartel. About half of the cartels lasted between 5 to 10 years, whereas about a third lasted less than 5 years (Table 3). The three other empirical works on international or American cartels duration show a slightly higher proportion of short-lived cartels (less than 5 years) and long-lived cartels (more than 10 years).

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Table 3: Distribution of cartel duration

	% of cartels lasting less than 5 years	% of cartels lasting more than 10 years
Combe and Monnier [2009]	36%	19%
Eckbo [1876]	57%	18%
Griffin [1989]	43%	32%
Dick [1996]	39%	24%

III. Affected markets

1. Affected industries

9. If cartels convicted by the European Commission affect a broad range of industries, some sectors are more affected than others (Table 4 summarizes the incidence of cartels by affected sectors)[5]. The most affected industries are that of the chemical sector with about one cartel out of three operating within this sector, and manufacturing of intermediary products, about half of the cases, with 16% of cartels involved in the metals and minerals sector – with multiple cartels convicted in steel products, 12% of cartels relate to machinery and equipment – among them carbon and graphite products – and 11% to wood, paper, rubber and plastic products. A significant number of cartels – 16% – have also been discovered in the service industry – mainly transport and banking, but also fine art auctions. Cartels in the food, beverage and tobacco industry make up most of the remaining part of the sample with 12% of the cases. Levenstein and Suslow [2006b], studying a sample of 72 international cartels, find essentially the same results: chemical products top the list – 42% – the other categories being other manufacturing – 38% – water transport – 14% – followed by construction – 4% – and services – 3%.

10. As for Europe, Veljanovski [2007], who studied 30 cartels convicted by the Commission from 1999 to 2006, shows that cartels affect mostly the chemical industry (more than 44% cases), then intermediary and industrial products (21%) and food processing industry (18%). Carre, Günster and Schinkel [2008] find that most of convicted cartels affected manufacturing products (62.2%)

11. In most cases, cartels included firms primarily selling to intermediaries and wholesale dealers. These results are consistent with the economic theory according to which cartels primarily affect sophisticated and intermediate manufactured goods. Hence, the only categories of products that are not well represented in our study are final retail goods and services (except financial services). Moreover, many cartels affect industries with high barriers to entry (as the chemical sector) and those whose price elasticity of demand is low (intermediary products). Hence, our results are consistent with the economic theory, which predicts that the occurrence of cartels is higher in industries with high barriers to entry and where price elasticity of demand is low.

Table 4: Incidence of cartels by affected sectors

Sectors	Number of cases	Number of cases in%
Metal and non metallic mineral products	18	16%
Machinery and equipment	13	12%
Wood, paper, rubber and plastic products	12	11%
Textile, construction	5	5%
Chemicals and chemical products	32	29%
Of which:		
Basic chemicals	13	12%
Pharmaceutical preparations	8	7%
Other chemicals	11	10%
Services (business activities, banking and transport)	18	16%
Food products, beverage and tobacco	13	12%
TOTAL	**111**	**100%**

12. Cartels operating in the Food products, beverage and tobacco industry last on average less than cartels affecting other industries (5 years against more than 7 years, see Table 5). The longest cartels affect the basic chemical products.

Table 5: Cartel duration by sector

	Duration Min (years)			Duration Max (years)		
Sector	Median	Mean	Standard Error	Median	Mean	Standard Error
Metal and non metallic mineral products	5.6	7.1	4.4	4.7	7.4	4.6
Machinery and equipment	5.9	6.9	3.7	5.9	7.2	4
Wood, paper, rubber and plastic products	5.1	7.4	5.7	6.1	8.3	6.1
Textile, construction	5	7.4	5.6	6	8.1	6.2
Chemicals and chemical products	5.9	7.5	5.8	6	7.9	5.8
Of which:						
Basic chemicals	6	8.8	2.9	6	9.4	2.9
Pharma-ceutical preparations	5.6	6.4	2.1	5.9	6.7	2.1
Other chemicals	5.5	6.7	4.2	6.5	7.2	4.1
Services (business activities, banking and transport)	4.9	6.2	5.2	5.2	6.3	5.4
Food products, beverage and tobacco	3.7	5.5	5	3.7	5.5	5
Total	**5.5**	**7.1**	**5.2**	**6**	**7.4**	**5.4**

5 Industries are classified according to the NACE Code.

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2. Geographic Scope

13. Three types of cartels can be distinguished, according to the geographical area of the affected markets:

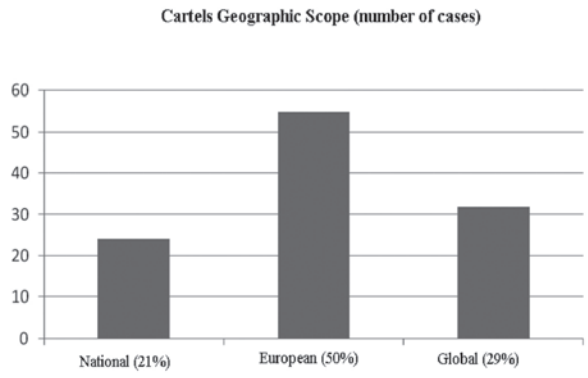
→ National cartels have a national scope, but "*may affect trade between member states*"[6]. They operate within a single country of the European Union or within Benelux.

→ European cartels affect at least two countries in the European Union (except if the cartel affects only the Benelux; in this case, considering the limited size of this market, it is categorized as national).

→ A global cartel is defined as a cartel operating in the European Union and at least one other continent – North America or Asia for instance. Global and European cartels are both international.

14. On the basis of this classification (figure 1), it appears in our sample that, although most cartels are international in membership, they do not all have a global reach. Many of them appear primarily to be active in the European Union – about half of the cases – such as the Lifts and Escalators Cartel (2007), 21% confined their activity to one country – the French Beef Cartel (2003) and the Bitumen Cartel in Netherlands (2006) for instance. Global cartels – some of which having worldwide effects – represent more than a quarter of the sample – the Vitamins Cartel (2001), the Graphite Electrodes Cartel (2001) and the Lysine Cartel (2000) are famous ones. These cartels were convicted in Europe as well as in the United States (see Connor, [2007a] for more details on these cases).

Figure 1: Geographic scope



15. Connor and Lande [2005], who studied cartels convicted by the Department of Justice (DOJ), find that 46% of them are national and 54% international (20% are global), which implies a higher proportion of national cartels convicted in the United States. This difference can be easily explained as most of national cartels condemned in Europe are convicted by national antitrust authorities and not by the European Commission who concentrates on large infringement. Connor and Bolotova [2006], who analyzed 395 cartels, conclude that 80% of the cartels from their sample are international. Nevertheless, these authors define cartels as international in membership. Thus, they consider that a cartel is international if a high proportion of its members are multinational firms (nationality criteria). On the contrary, Zimmerman and Connor [2005], retain the same definition as we do (they focus on the reach of the cartels rather than on their membership structure) and they show that global cartels represent only 20% of the cases of their sample.

3. Size of the affected market

16. In 64 cases out of 111, we can estimate the size of the affected market, defined as the value of sales (in million euros) in the European Economic Area affected by the price increase due to the cartel on the total duration of the collusion (the Commission enforces competition rules for the whole of the EEA which comprises the EU Member States plus Norway, Liechtenstein and Iceland). These estimations are straightforward as antitrust authorities collect through their investigations information on the relevant market (products and geographic area). Nevertheless in some cases, data on affected markets are not yet available or remain confidential, which led to the eviction of these cases from our database.

17. Moreover, the decisions of the Commission provide the amount of the overall market on which collusion took place. Therefore, it is necessary to estimate the market share of the cartel and to apply it to the related market in order to exclude trade from outsiders (firms in the industry who are not members of the cartel). The market share of the cartel is known for 48 cases only. When this information is not available we retain a market share of 80%, which corresponds to the average on the 48 cartels. Last, the decisions of the Commission report the annual affected market; therefore the global affected market is computed by multiplying the annual amount by the duration of the cartel in years.

18. On our 64 cases, the annual affected market is on average equal to 291 million (euros). The median is around 200 million and the standard error amounts to 598 million, which implies that there is a huge variability. Some cartels affect very small markets (3 million per year for the methyglucamine cartel convicted in 2002) whereas other operate within very large ones (2 billion per year for the flat glass cartel convicted in 2009). Figure 2 classifies cartels according to the size of the affected market. Most of our cartels affect an annual market smaller than 200 million, more than a third a market comprised between 200 and 600 million and less than one fifth a market that is superior to 600 million (we retain as lower threshold the median and as upper threshold the standard error of the sample).

6 Guidelines on the effect on trade concept contained in articles 81 and 82 of the Treaty, OJ C 101, 27 April 2004, pp. 0081 -0096.

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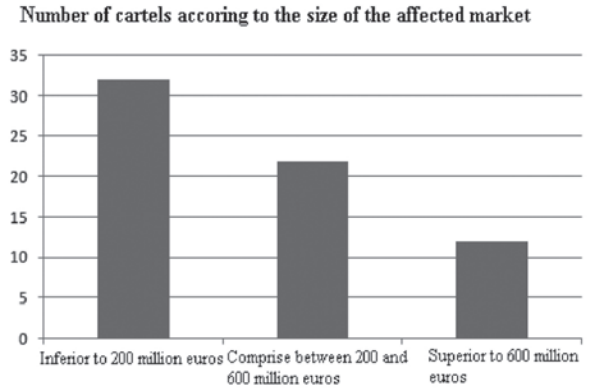
Figure 2: number of cartels according to the size of the affected market



4. Concentration of the industry and market share of the cartel

19. Economic theory demonstrates the influence of the market structure on cartel stability, which is verified empirically. Dick [1996], Marquez [1994], Zimmerman and Connor [2005], show that cartel duration rises with the market share of the cartel. Hay and Kelley [1974] prove that the concentration of the industry is associated with an increase in cartel duration.

20. To measure the concentration of the market, several indicators can be used in empirical studies: Grout and Sonderegger [2005] retain the three-firm concentrations ratio (C3), which corresponds to the sum of the market shares of the three largest firms on the market (in terms of market share). Hay and Kelley [1874] the C4 ratio, Eckbo [1976] the Herfindahl-Hirschmann index, Levenstein and Suslow [2006a] the C1, C2, C3, C4 ratios. The economic literature considers that the market share can also be used as a proxy of the concentration on the market. This parameter allows to assess the market power of the cartel: the higher the market share, the greater the market power. Empirically, Eckbo [1976] and Griffin [1989] show that the profitability of cartels rises with the market share of the cartel *ceteris paribus*.

21. In our sample, we could measure the market share of the cartel in 58 cases out of 111. It amounts on average to 80% and varies between 30% and 100%. More than two third of the cartels have a market share superior to 75%. As we can see in Table 6, our results are similar to those obtained in other studies. Zimmerman and Connor [2005] find that the average market share of the cartels in their sample is equal to 85%. Griffin [1989] obtains that 35% of his cartels have a market share of at least 75% and 17% of 90% and more. Levenstein and Suslow [2006b] put forward a C4 ratio amounting to 79% on a sub-sample of 48 cartels for which sufficient data were available to compute it. The three fourth of their cartels affect industries for which the C4 ratio is superior to 75% or to a Herfindahl-Hirschman index exceeding 1800. Hay and Kelley [1974] estimate that in 76% of their cases, the concentration ratio is superior to 50%.

Table 6: Concentration ratio and market share of the cartel

	Combe and Monnier [2009]	Levenstein and Suslow [2006b]	Zimmerman and Connor [2005]	Griffin [1989]	Hay and Kelley [1974]
Market share	80%	na	75%	>75%	na
Market share >75%	70%	na	na	At least 35%	na
Concentration ratio	na	(C4) 79%	na	na	C4>50% in 76% of the cases

na: not available

22. We can deduce from these results that collusion is easier to reach in concentrated industries and/or when the illegal agreement brings together most of the firms in the industry. Nevertheless, the concentration of the industry and the market share of the cartel are endogenous variables. In fact, a high concentration or market share can result from the cartelization of the market as cartels often block the entry or exclude competitors, using for instance collective boycott. For instance, the members of the Graphite Electrodes Cartel (2001) prevented access to technology, restricting the flow of technical information to outsiders, necessary to compete in global markets. Undertakings of the acid citric Cartel (2001) launched price wars against Chinese outsiders on the European market. Levenstein and Suslow [2006b] estimate that about a quarter of their cartels engaged in some type of exclusionary tactics.

IV. Cartel organization

23. As Levenstein and Suslow [2006b] and Genesove and Mullin [2001] underline that organizational issues are critical to the success and stability of cartels.

1. Number of undertakings and the involvement of trade association

24. The number of firms is an organizational variable that previous studies and the economic theory have analyzed. Models suggest that the fewer the number of firms, the more likely it is that collusion will occur. A large number of undertakings can lead to coordination problems and generate transactions costs (Selten [1973] distinguishes between small and large cartels depending on whether they comprise more or less than 5 firms.). It also increases the incentive to cheat and makes the members' behavior more difficult to control. This reasoning is supported by the following results.

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25. In our sample, the number of undertakings across the industries varies from 2 (two of the Vitamins Cartels convicted in 2001 encompassed Hoffman-Laroche and BASF) to 42 firms (the cement cartel convicted in 1994). The overall average number of undertakings is equal to 7.7 firms and the median is equal to 5. Most of the cartels involved fewer than 10 members – two third of the cases – and half of the cartels regrouped less than 5 members.

26. Table 7 presents the average number of undertakings per cartel according to sector. Cartels who involved the smallest number of participants affected foremost the chemical sector with less than five members per cartel. On the contrary, cartels who affected manufacturing of intermediary products regrouped the highest number of participants.

Table 7: Average number of undertakings per sector

Sector	Number of undertakings (on average)
Metal and non metallic mineral products	12.1
Machinery and equipment	8.1
Wood, paper, rubber and plastic products	13.6
Textile, construction	12.8
Chemicals and chemical products	4.8
Of which:	
Basic chemicals	5.1
Pharmaceutical preparations	3.2
Other chemicals	5.6
Services (business activities, banking and transport)	6.8
Food products, beverage and tobacco	5.5
Total	**7.7**

27. Cartels can rely on trade association to organize the cartel, in order to solve internal coordination problems and/or to perform monitoring activities. These trade associations play a role of conductor. In our sample, 25% of the cartels relied on the active involvement of a trade association, particularly when cartels included a large number of firms: in one third of the cases implying more than 10 firms and in all cartels with more than 16 members a trade association was involved. For instance, the European Cement Association (Cembureau) was in charge of the organization of the cement cartel convicted in 1994, and who regrouped 33 producers and 9 trade associations.

28. If we compare our results with those obtained in other studies on international cartels, we can note that the average number of undertakings varies from 7.25 to 29 firms. In fact, Posner finds that the average number of members per cartel is equal to 29. However, he adds that his result is biased as two third of his sample regroups 10 members or less. Some of the cartels he studied encompassed more than 90 members which drives up the average. In fact, we can note that most of the time, cartels regroup less than 10 firms, whatever the sample retained: 79% for Hay and Kelley [1974], 60% for Fraas and Greer [1977] and 64% for Posner [1970]. Concerning the role of trade association, Hay and Kelly [1974] obtained that a quarter of the cartels of their sample and 7 cartels out of 8 relied on a trade association when more than 15 firms were involved. Levenstein and Suslow [2006] found that 29% of the cases in their sample involved a trade association.

Table 8: Number of undertakings and trade association involvement

	Combe and Monnier [2009]	Levenstein and Suslow [2006b]	Zimmerman and Connor [2005]	Fraas and Greer [1977]	Hay and Kelley [1974]	Posner [1970]
Average number of firms	7.70	na	11.20	16.70	7.25	29.00
<10 members	76%	43% (< 5 firms)	na	60%	79%	64%
Trade Association involvement	25%	29%	12%	36%	29%	44%

na: not available

2. Organization mechanisms

29. Table 9 presents the repartition of cartels according to their organization techniques. In the European Union, it appears that more than 75% of cartels adopted market allocation mechanisms, which include production quotas and customers, products, and/or geographic area allocations. This high prevalence of market allocation in Europe can be explained as follows:

→ the existence of national barriers to entry in Europe before the adoption of the single European market, has facilitated the emergence of "non aggression pacts" [Brenner 2009];

→ market allocation, particularly by area, allows to better detect cheating attempts. For instance, in the case of the vitamins cartels (convicted in 2001), Hoffman-LaRoche, the largest producer of vitamin B2 detected Takeda's cheatings, using exports data from the Japanese government, given that Takeda was the only member of the cartel producing on that location.

→ according to Levenstein and Suslow [2006b], cartels who used market allocation techniques were less likely to break up than those who did not.

30. Many cartels exchange information to reduce imperfect information and individual monitoring problems: two third of the cartels of our sample exchanged confidential information (output, sales, and prices data) putting in place sophisticated monitoring mechanisms (as in the case of the Vitamins cartels convicted in 2001 and studied by Connor [2007a]). Some cartels even turned to a third party to collect and process data, and monitor the implementation of the agreement. For instance, the famous cartonboard Cartel convicted in 1994 engaged the services of a fiduciary

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company who managed exchange of information systems for various industrial sectors (Fides) to assist in individual data collection.

31. Last, some cartels adopted formal compensation rules between members in case of cheating (in 25% of the cases). The most common compensation mechanism is to require firms who have sold more than their share to purchase output from those who have sold less (another way to achieve compensation is with side payments but it increases the probability of being detected by antitrust authorities). This rule allows to prevent cheating. On the case of the vitamin A cartel, firms who sold more than their allocated quota were required to slow down their sales, so as to enable others to catch up. If it were not sufficient, at the end of the year, they had to purchase vitamins from the other undertakings of the cartel in order to compensate them for the shortfall in their quota (Levenstein and Suslow [2006b] study other mechanisms allowing to dissuade cheating).

32. Our results are similar to those obtained by Levenstein and Suslow [2006b] who focus on international contemporary cartels: a trade association is involved in a third of their cases. On the contrary, Posner [1970] finds a much stronger involvement of such associations, (44% of the cases) and a smaller proportion of market allocation (26% of the cases). Moreover, he finds that only 4% of the cartels adopted compensation rule. Nevertheless, Posner [1970] retained only cases in which members adopted side payments mechanisms.

Table 9: Organizational mechanisms

	Combe and Monnier [2009]	Leven-stein and Suslow [2006b]	Gallo and al. [2000]	Fraas and Greer [1977]	Hay and Kelley [1974]	Posner [1970]
Market allocation	76%	81%	27%	26%	35%	26%
Exchanges of information	64%	72%	na	na	na	na
Compensation rules	24%	28%	na	na	na	4%

na: not available

V. Causes of Cartel Breakup and Recidivism

1. Causes of cartel breakup

33. The exhaustive analysis of cartels breakup allows us to categorize the reasons for cartel failure (Table 10). Over the whole period, investigations were the first cause of cartel breakup (42%, – these investigations can be originated by an anonymous denunciation or they can result from investigations relating to another cartel, such as " follow on " cases – head of leniency applications, (32%), official complaints from clients or competitors (14%), as for instance the case of the FETTSCA cartel convicted in 2000, the other causes of dissolution (natural causes) and notifications. Leniency applications caused the termination of almost one cartel in three, but since 2002 (the adoption of the new and more effective programs), two thirds of cartels fined by the European Commission broke up due to leniency applications.

34. In some cases, the date at which the cartel breaks up does not correspond to its detection, and it happens that firms can prove that the cartel was no more active since many years. These cartels are naturally dead.

35. Several causes of "natural death" can be identified, such as cheating, irreconcilable disagreements among undertakings, growing fringe or a new entrant. More precisely, cartels face two types of problems [Dick 1996]:

→ the factors related to internal coordination problems (such as monitoring and cheating issues). For instance; the Vitamin B cartel ended because of cheating;

→ the reduction of profits derived from collusion (until its coordination costs exceed the colluding profits). This situation occurs when there is a fast growing competitive fringe. For instance, the acid citric cartel convicted in 2001 terminated because of the cheating of one of the participant and also because of Chinese exports.

Table 10: Causes of cartel breakup

	Number of cases	Nb of cases in %	Number of cases since 2002	Number of cases in % since 2002
Leniency programs (denonciation)	34	31%	30	62.5%
Complaints (official)	15	14%	1	2%
Notifications	6	5%	0	0%
Investigations	46	41%	14	29%
Natural causes	10	9%	3	6.5%
Total	111	100%	48	100%

36. Empirical studies put forward that cheating and external shocks are the first causes of cartel dissolution. Eckbo [1976] finds that 43,5% of cartels natural death result from cheating, 30,4% from an external shock, 26% from the entry of a new competitor. Griffin [1989] shows that 33,3% of naturally dead cartels terminated because of cheating, 50% of the breakup are due to an external shock, 33,3% to the entry of a new competitor and 9,3% to a technical change (the sum exceeds 100 as in some cases several causes contribute to explain the dissolution of the cartel).

37. In our sample, contrary to what economic theory suggests (Stigler [194]) convicted cartels are most of the time still active when the Commission starts its investigations, and terminate collusion after this intervention. Only 10 cartels out of 111 convicted cartels are naturally dead. Levenstein and Suslow [2006] also find that that only 12% of cartels terminated from natural causes. It can be explained by the fact that cartels are time-bared in Europe (5 years) which implies that some cases, detected too late, are excluded from

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our sample, as four vitamins cartels (B6, folic acid, B1 and vitamin H).

38. The determination of the causes of cartel breakup can nevertheless be difficult to assess:

→ first, there are sometimes multiple factors which contribute to cartel breakup ;

→ the motives that trigger denunciation remain unknown. For some cartels, natural death (for instance due to a new entry) could be immediately followed by a denunciation. In this case, this cartel will be classified as a cartel terminated because of leniency whereas it is in fact naturally dead;

→ cartels can terminate naturally but under the threat of an investigation (for instance, in the case of the vitamin C, an investigation was launched in the United States which induces the cartel to end up their agreement in Europe).

2. Recidivism

39. We define the percentage of recidivism as the proportion of cartels including at least one firm already convicted by the European Commission for its participation in a previous cartel. In our sample, recidivism is significant. Indeed, in 24% of the cases, there was at least one firm part of the conspiracy that was a recidivist. More precisely, recidivists intervened in half of the cartels in the machinery and equipment industry sector. One third of the convicted cartels in the chemical sector were formed of at least one firm already convicted for its participation in another price fixing agreement. And all the cartels regrouping 3 recidivists affected the chemical industry.

40. Overall, 35 firms were recidivists. 66% of the cases involved only one recidivist, 18% two and the remaining 14% three. Some undertakings turned out to be multi-recidivists such as Solvay, Shell, ICI, Degussa, Hoffman-Laroche, Bayer, ENI, Saint-Gobain, Hoechst and Arkema[7]. Hence, these numerous examples of recidivism could reflect the fact that antitrust policy is not sufficiently effective in deterring cartels, implying that penalties could be lower than illegal profits (see Combe and Monnier [2010]).

Table 11: Recidivism by sector

	Number of cases	Recidivism (% of the cases)
Metal and non metallic mineral products	18	28%
Machinery and equipment	13	54%
Wood, paper, rubber and plastic products	12	25%
Textile, construction	5	0%
Chemicals and chemical products	32	31%
Of which :		
Basic chemicals	13	38%
Pharmaceutical preparations	8	0%
Other chemicals	11	45%
Services (business activities, banking and transport)	18	0%
Food products, beverage and tobacco	13	15%
Total	111	24%

41. We surveyed all the cartels convicted by the European Union from 1969 to 2009. We presented preliminary evidence on whether these stylized facts regarding cartels characteristics corroborate economic theory predictions. We can draw the European Cartel profile:

→ Our examination of cartel duration concludes that cartels are neither short-lived nor long-lived; they are both, and the average duration is quite long (7 years), which is in contradiction with Stigler's assertion (most of the authors and the European Commission consider that cartel duration is long when it exceeds 5 years);

→ if cartels affect a broad range of sectors, they affect particularly the chemical industry. They therefore seem to affect some sector more than others and recidivism also varies according to the industry. Nevertheless, collusion may be easier to detect in some sectors (but not more frequent);

→ the market share of cartels is high on average (80%). We could therefore conclude that cartels are more frequent in concentrated sectors. Nevertheless, concentration is an endogenous variable. The cartels of our sample affect on average a market of several million euros per year (391 million euros);

→ the average number of undertakings is superior to 5 (7,7) and in a quarter of the cases a trade association contributed to organize the cartel. Exchanges of information are quite frequent (one third of the cases);

→ more than 75% of our cartels adopted market allocation;

→ recidivism is frequent (a quarter of the convicted cartels regrouped at least one firm already convicted in a cartel case);

7 The undertakings most often convicted for cartel offences are Arkema, which took part in four cartels condemned by the European Commission between 2003 and 2006, and Hoechst convicted for its implication in four cartels between 1986 and 2006.

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→ cartels in the European Union terminate first because of the investigations of the European Commission, and after because of leniency programs, which became the first cause of cartel dissolution since 2002;

→ some cartels are naturally dead, which illustrates the instability of these organizations.

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