

STABILITY AND COHESION OF CARTELS THROUGH NETWORKS THEORY

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1. INTRODUCTION

Antitrust Laws consider cartel formation to be one of the most serious infractions. A cartel is an agreement among competitors of the same market, illegal and, therefore, secrete, generally complex and continued in the time, which gets for object to impose to the market similar conditions to those that a monopolist would establish (or at least to those of a dominant operator), with the consequent effects on the quantity and the price equilibrium, and carrying the reduction of the general well-being¹.

Empirical literature², which has studied cartels formation and development, has underlined an approach of causality based on the profitability and the duration of cartels as factors of their success. As regards the determinants of profitability, its importance is related to the level of market concentration, the homogeneity of the product or the similarity in the competitor's structure costs, besides more or less low rates of growth in the sales or falls of profits they appraise. As for the duration of the cartel, it is related³ to the number of competitors, the market share controlled by cartelized companies, the size and the frequency of buyers and of purchases, besides the fluctuations of demand, as well as his rate of growth.

Sometimes there are reasons for the break of the cartel. Reasons like constant market growth, appearance of substitutes, or of new inlets, etc., even 'political' reasons –it is said policy and enforcement of competition laws, legal or regulative changes etc.-. Even,

¹ Posner (2001): *Antitrust Law*. University of Chicago Press, Chicago, 2nd edition

² For a general study into successful cartels causes, see paper by M.C. Levenstein y V.Y. Suslow de 2006

³ It is inexcusable in this regard to mention the contributions of George J. Stigler, specially his article "A Theory of Oligopoly "

sometimes any of the pointed reasons encourages opportunist behaviors in the cartelists, boosting their failure.

An important issue about cartels is the internal organization, which can determine its stability, a level of higher profitability and a longer duration for cartels. It is true that a part of the empirical literature has indicated that the organizational aspects of cartels are not relevant to explain his success. Anyway, it has not been advanced very much in the analysis about to what extent different forms of organization of cartels might be more suitable than others to make effective entry barriers or the fulfillment of the agreements of cartelization⁴, besides the critical conditions that determine the own existence of cartels in relation with the weight and the place that each of the cartelists takes up in the organization. There has to be one or more operators or any kind of organization taking charge of the major responsibility in the existence of cartel. This would mean that their leaving out would lead to the own elimination of the cartel. In the same way, cartel organization determines a level of centrality, or decentralization of each one of the agents, yet the capture of decisions can be different depending on the type of organization.

In any case, the existing literature has revealed difficulties of studying and verifying the actual importance of the organizational aspects of cartels. In this respect, the studies of cross- section⁵ have not been able of advancing in a valid set of organizational elements that explain what there should be behind the cartelization, especially behind successful ones. Neither case analysis has allowed advancing in this direction⁶, focusing on the characteristics of the supply of and demand for these markets and, with less attention, on the measure of the agent behaviors.

Nevertheless, studies of case file could carry out beyond the pace of this kind of research. Starting from those idiosyncratic elements of each sector, which move cartels towards a certain organization, or towards a shared strategy that needs a way of relating and of be

⁴ In Mackie-Mason y Pindyck (1987) denies any relevance to the study of organizational aspects of cartels

⁵ A good reference for this kind of analysis is Hay and Kelley (1974)

⁶ There are a lot of papers referred to case file study. Some of them are McGahan (1995) for beer markets, Spar (1994) for diamonds markets, Sjostrom (1999) for shipment markets o Hughes y Barbezat (1996) for steel markets

organizing inside the own cartel, can be reached different results in terms of cartel characteristics.

A different way of seeing cartels and their organization can be addressed across the theory of networks. The adoption of this approach would require to study relevant organizational aspects of cartels as networks.

An important set of questions will arise with this approach. Among them: which are the characteristics of these networks, built on the willing of different competitors to run like a monopoly? or what allows them a successful and lasting behavior in the market? In addition, it is necessary to ask what type of network is provided these operators with the willingness to be cartelized.

Likewise, it would be outstanding in knowing if it were possible to define the organizational characteristics that allow cartel survival, the relations among competitors, and the role of each of them - as sets of nodes and connections -. For extension, it would be interesting to know what of those network characteristics are determinant to support or to destroy cartels, from the double perspective of internal running and the way of external connections that are going to facilitate or to block their existence and continuity.

One of the aspects, which always seem to be relevant, is the degree of cohesion and stability. When cartels are analyzed as networks, it should be considered what we can call the role that certain agents play inside and outside this organization, depending on their position in the market, turning into central agents of the cartel in some cases. That is to say, without these agents, it might say that some cartels lose their economic sense or at least enough significance to be a cartel, as a thing of aptitude without them.

This could reveal the importance that can get the study of some measures taken from the theory of networks. Some of these measures of cohesion and efficiency of the network are those of distance and clustering. The present work deals with the theory of networks applied to the analysis of markets cartelization, never done before. This analysis is structured around one concerning case file –Vitamins-, sanctioned by European Commission, applying to it a set of measures derived from the theory of networks. Doing so, some results can be obtained, which can be used as a basement for subsequent

approaches, may be better addressed to a good explanation about cartels formation and organization. That is to say, it would be very useful to provide new analytical tools, not only for a better development of competition policy, referred to these pernicious agreements, but also as instruments for their detection, prosecution, and sanction.

The structure of this brief working paper is as follows: Section 2 presents the resulting network that would be obtained through the data of the chosen case file in a European Commission sanctioning file. Section 3 presents some outcomes related to what we have called 'cartel distance' and 'cartel clustering'. Eventually, the section 4 summarizes and develops some conclusions.

2. DATA

The information that is in use comes from a European Commission sanctioning file called ‘Vitamins’ (Case COMP/E-1/37.512-Vitamins). For the present study, it has been chosen a case file related to a cartel formed by pharma undertakings to fix prices and quotas on a basket of products, which are differentiated products. Each of these products is a vitamin and has a cartel agreement, sometimes with different undertakings, but in general with a number of core firms inside of every separated vitamin agreement. The agreement takes as its starting point the historical distribution of market shares – for a given date that cartelists decide to obey as base of these agreements-, for each of these differentiated products - every product is a cartel, but with a common organization for all of them-, that are produced by a variable number of companies. The above mentioned agreements took place between 1989 and 1999. In 1999 the cartel falls apart because one of the companies decides to denounce its existence. It is necessary to indicate that in this period there were an increasing number of inlets in this industry with an increasing size, in spite of which, the cartel was willing to maintain market sharing out by the historical quotas.

As regards the essential elements to define a network, we introduce nodes and links. In our case file, the nodes represent the companies that appear in every product sanctioning process, as actors of the cartel. The links between nodes indicate if there has been some type of agreement to fix prices and/or to share market.

The resulting network presents 13 nodes or companies that we will name with the subscript or:

$$\mathcal{N} = \{n_1, n_2, \dots, n_{13}\}$$

The number of links in this network is 34.

These links between the nodes can turn into a network graph like the Figure 1.

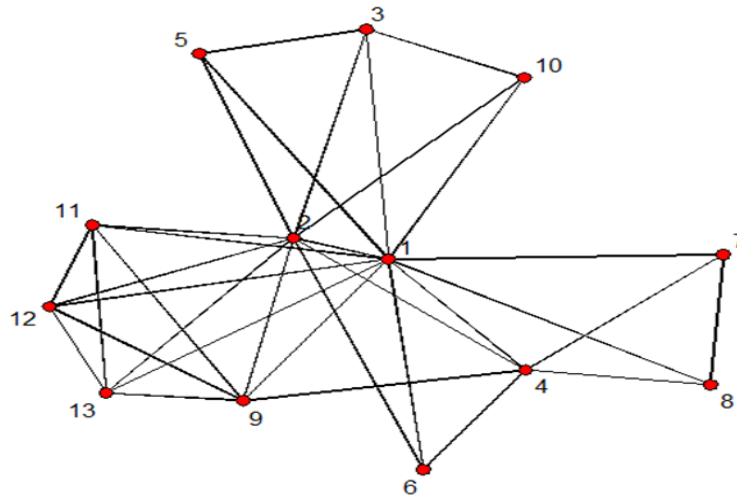


Figure 1. Cartel graphical representation

3. DATA ANALYSIS

In this section we are going to analyze the structure of the network. The aim is to extract the main characteristics of this network that can be more relevant for the understanding of how this cartel was working⁷. As well as those characteristics of the network, especially those related to duration and stability of the cartel. To do it, we will focus on two measures of cohesion of the own cartel. These two measures are 'geodesic distance' and 'clustering'.

One of the properties of this cartel network that deserves to be explored is the distance between our case file companies –the nodes of the network-. We know that when the distances are big, the information can take a great deal of time in propagating among the members and, eventually, the efficiency of the agreements can diminish a lot. In turn, this

⁷ Schweitzer et al. (2009) have underlined that it would be positive to advance in economic networks through a good understanding about what is the role of each agent inside them, their function and their actual influence

drawback makes the continuity of cartels more vulnerable and unstable. However, this disadvantage is not the same for all the nodes. There will be some nodes where the exchange with others becomes very costly, even though it would be technically attainable for them. Although all those companies that are closer to the rest, because of these lower costs, can exercise major power than those more remote. In fact, multiple connections between firms can indicate a stronger connection between companies than the only one connection.

For a deeper knowledge of these aspects, we can use the 'geodesic distance'. Geodesic distance, or geodesics, measures the shortest path between an actor and another one. It is said that a path is a sequence of links connecting a sequence of nodes. Thus, the geodesic path measures the most efficient connection between two nodes (see *Table 1*). A value of 1 indicates direct connection between nodes, whereas a connection with value of 2 indicates that the connection between both nodes must be done by means of an intermediate node.

In our analyzed cartel, the distances are small –no one has more than a value of 2 in terms of geodesic path-, which suggests that the information moves rapidly in this network and, as we already know, any pair of nodes are connected each other, because some path exists between them.

Table 1. Geodesic distance between cartelized operators

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 0 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| 4 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 5 | 1 | 1 | 1 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 6 | 1 | 1 | 2 | 1 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

| | | | | | | | | | | | | | |
|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 2 |
| 8 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 |
| 9 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 0 | 2 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 |
| 11 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 0 | 1 | 1 |
| 12 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 0 | 1 |
| 13 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 0 |

It is possible to derive that the central node is the company 1 as well, because it gets a geodesic distance of 1 with the rest of the nodes. Any couple of nodes can communicate in a maximum of two steps. Nevertheless, if we eliminate the nodes 1 and 2 (Table 2), some companies stop being connected with the rest and, in general, some the geodesic distances increase. That is to say, the communication between several elements of the network breaks or becomes increasingly difficult. Definitively, the cartel loses its level of cohesion and efficiency in a considerable degree.

Table 2. Geodesic distance between cartelized operators eliminating 1 and 2

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|----|----|----|----|----|----|----|----|----|----|----|
| 3 | 0 | -- | 1 | -- | -- | -- | -- | 1 | -- | -- | -- |
| 4 | -- | 0 | -- | 1 | 1 | 1 | 1 | -- | 2 | 2 | 2 |
| 5 | 1 | -- | 0 | -- | -- | -- | -- | 2 | -- | -- | -- |
| 6 | -- | 1 | -- | 0 | 2 | 2 | 2 | -- | 3 | 3 | 3 |
| 7 | -- | 1 | -- | 2 | 0 | 1 | 2 | -- | 3 | 3 | 3 |
| 8 | -- | 1 | -- | 2 | 1 | 0 | 2 | -- | 3 | 3 | 3 |

| | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|
| 9 | -- | 1 | -- | 2 | 2 | 2 | 0 | -- | 1 | 1 | 1 |
| 10 | 1 | -- | 2 | -- | -- | -- | -- | 0 | -- | -- | -- |
| 11 | -- | 2 | -- | 3 | 3 | 3 | 1 | -- | 0 | 1 | 1 |
| 12 | -- | 2 | -- | 3 | 3 | 3 | 1 | -- | 1 | 0 | 1 |
| 13 | -- | 2 | -- | 3 | 3 | 3 | 1 | -- | 1 | 1 | 0 |

Taking into account above said, it needs to be clear that the geodesic distance gives us only the first idea of cohesion and theoretical efficiency of the cartel, specifically from the straightforwardness of the cartel members to be interconnected one to each other.

Nevertheless, it is possible to go beyond and to set the importance of each node in a cartel network⁸. Considering a cartel as a network relies on the idea that a type of relationship among different nodes exists, and this one allows acting together and to the same goal. As far as these goals are concerned, there can be different levels of importance for each cartel member with respect to raise and to consolidate a cartel.

Stepping forward in this direction, we can use a measure of ‘clustering’. The figure 2 shows this kind of dendrogram. This dendrogram allows observing the asymmetry of groups that can be formed in this cartel. We can say that the height that the links acquire is determining the level of importance that has every node or group of nodes in the network.

So, the companies 1 and 2 form a clear group I with respect to the whole rest of the group. It might say that this cartel loses much of its height when the undertakings 1 and 2 are not. Even any one of them might question the own existence of the cartel in their absence, since there would remain separated all the possible unions of the node 4 and of the 9 with 11, 12 and 13 and, in turn, any of these with the others.

In the same way, lower steps and so less importance are companies 4 and 9. In case of the node 9, once lost the connection overhead, the only thing that it does is gathering as a part

⁸ Goyal y Joshi (2000). Sometimes the structure of networks are asymmetric and non-transitive, giving to certain nodes a critical importance inside the network

of the group of the nodes 11-12-13. As for the node 4, it is still capable of connecting two different groups. The rest are extreme nodes, which disappearance does not eliminate for themselves the corresponding group.

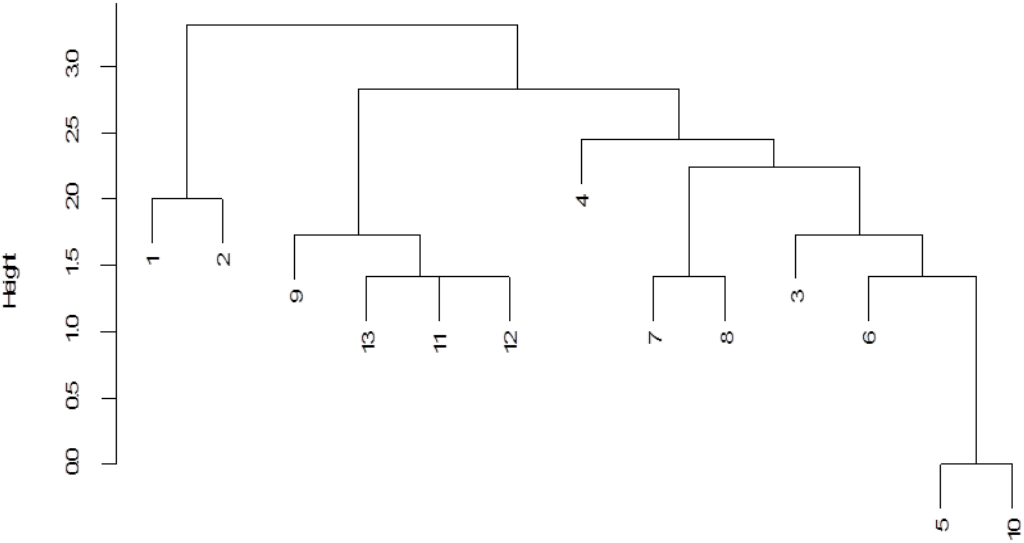


Figure 2. Clustering of a cartel with asymmetric importance operators

This clustering analysis has said up to what point this cartel network is more or less compact, since there are some nodes more important than others definitively⁹. Precisely, this measure of clustering reveals the unequal importance between nodes, appearing towards some nodes without which the network might not be understood, whereas the presence or absence of others is not definitive for the own structure of this cartel network.

In this case, the measure of clustering points at the necessity of studying the structural location and opens a new path to go ahead with more research about organizational structure when firms decide to act in markets by cartels.

⁹ In social and economic networks, some researchers have underlined the existence of a selection inside the network, with leaders who obtain more profits. See Zimmermann y Eguiluz (2005)

4. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The organizational structure of a cartel, probably derived from the position of every cartelized agent in these markets, can explain as well as others approaches some aspects referred to the cohesion and stability of cartels. In this respect, a conception of cartels like organizations allows to study them as networks. Across the theory of networks, the cartelization of markets can be observed as a structure of network in which some nodes occupy a position that draw together and justify the stability of the own cartel. Whereas others nodes, with independence of its adhesion or elimination, are not capable of changing the own coherence of the raised cartel.

First measures used with the networks theory in this paper, geodesic distance and the clustering, have revealed the need to continue penetrating into the use of this theory as an useful tool to the analysis of markets cartelization. It is evident that the first results presented here allow, at a first glance, to throw some doubts over the design of some programs of antitrust authorities referred to cartels like the programs of clemency, provided that there exist cartels that simply would not exist or be very unstable without the concurrence of certain companies.

In any case, the most relevant thing to conclude would be the ability of the networks theory to advance in the analysis of cartels and, with it, to help to the detection, sanction and elimination of these illegal organizations by more effective means.

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