STATISTICAL TECHNIQUES FOR DETECTING ANTICOMPETITIVE BEHAVIORS OF THE ENTERPRISES[1]

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Abstract

Anticompetitive agreements are usually made by enterprises that interact frequently during their day by day activities. Although some agreements are necessary for the good development of their businesses, some economic operators are concluding secret agreements that are harmful for competition as well as for the final consumers. Detecting such behaviors is in the responsibility of the worldwide competition authorities. They are using either direct proof, got through down raids, or through indirect evidences, obtained by using analytical methods for detecting anticompetitive behaviors. This research paper reveals a series of quantitative methods for detecting cartels and some case studies where these methods have been applied.

Keywords: *anticompetitive behavior, quantitative techniques, enterprises, market shares*

1. Introduction

Cartels between enterprises can be achieved in several ways, among the most well-known ones being: price fixing, bid rigging, output limitation and market sharing. For to find out different techniques and methodologies of cooperative games can use [5,6]

Among the factors that favor cartels' formation, we mention: the elasticity of the demand, the degree of buyers or sales concentration, highly bankruptcy risk markets, market entry barriers, the existence of exchanging information of the undertakings, declining or stable demand, markets with a history of cartelization multiple interactions between the firms and declining or stable demand on a specific market.

2. Literature review in detection of cartels

Even though there are many studies in the area of cartel detection, there is not a certain method for determining cartels. So far, there are four principal methods on detecting anticompetitive behavior.

(i) First approach would be to see if the undertaking's behavior is consistent with the competitive market (method A);

(ii)Second method would be to make an analysis whether there are structural failures in the behavior of the undertaking (method B);

(iii) Third method is to verify the differences in behavior among the undertakings which we assume they are part of a cartel and the other undertaking which are activating on a competitive market (method C);

(iv) Fourth method consists in analyzing if a collusive model is fitting much better to the involved data than to a competitive market model (method D).

As a general rule, the first two methods (in their simplified form) don't provide straight evidence that the firms participated in a cartel. Methods A and B are based on observing the undertaking's behavior and try to explain it by using a competitive model. However, if that does not lead to a conclusion through such model, it does not mean that we should conclude that the company's behavior is a competitive one, and hence the company did not participate in a cartel.

Regarding the first method, Abrantes-Metz et. al [1] stated that the principal problem is to make sure that the formulated competitive model is correctly applied. If the model's specification is not correct, that might be due to the not realistic assumptions which were formulated in terms of demand and costs function, or maybe because some variables were missed.

Further we will describe several ways by which economists implemented some analytical methods to identify the existence of anticompetitive concerns. We will give some examples such as: price fixing, bid rigging, coordination ways for selling prices and for sharing a market.

Bajari and Hortacsu [3] are comparing the competitive and collusive structural methods in order to compare which ones are able to explain in a better way the given data sets. The authors study is referring to the *first-price auction sealed*, where the products are homogeneous and the costs of the bidders are independent. The bidder *i*'s cost function is belonging to a population with a cumulative distribution function $F\left(c_i|z_i,\theta\right): t\left[\underline{c},\bar{c}\right]\to\left[0,1\right]$, in which ϑ is a vector parameter, same for all bidders, and z_i is a vector of observable independent variables, which are unique to each firm (although they are correlated). However, the independence of the variables is essential.

The competition model is attained at the equilibrium point of the game: the profit expected by the bidder *i* from an auction is $\left(b_i-c_i\right)\prod_{j\neq i}\left[1-F_j\left(B_j^{-1}\left(b_i\right)\right)\right]$ and this is when the bidder is winning the auction. $B_i(\cdot)$ is the strategy of the undertaking *i*. Consequently, the profit expected by undertaking is equal to the difference between the auction's winning and the undertaking's cost, multiplied by the probability of winning the auction by the undertaking.

The implementation of a model as described, assumes the estimation of a value capacity for every firm and after that, the testing of the autonomy and compatibility comparing to organizations' cost capacities. The reason for applying a test for independence comprises in confirming whether the unexplained part fitting in with firms' offers is autonomous or not. The part of the compatibility test is to examine whether the assessed coefficients of cost capacities are the same on account of all organizations or for a specific piece of organizations taking an interest at the sale.

Bajari and Hortacsu utilized this model to analyze the general population auctions whose subjects were streets remodels in Minnesota, North Dakota and South Dakota during the period 1994 - 1998. The dataset have included 138 auctions at which 11 organizations

were involved. These auctions were won on the rule of lowest price. The mathematical statement of the offer which ought to have been assessed was:

$$\frac{BID_{i,t}}{EST_t} = \beta_0 + \beta_{i1} LDIST_{i,t} + \beta_{i2} CAP_{i,t} + \beta_{i3} MAXP_{i,t} + \beta_{i4} LMDIST_{i,t} + \beta_{i5} CON_{i,t} + \varepsilon_{i,t}$$

The dependent variable is defined as the ratio between the *i*'s undertaking offer for the project t and the estimated cost of the firm for that project. The LDIST variable is measuring the distance of the undertaking *i* from the project t, CAP is representing the capacity of the undertaking involved in the project, CON is the percentage from the achieved turnover in the state in which the firm is deploying its project. That means, the CON variable is quantifying the degree to which the firm *i* is familiar with local regulators and suppliers of raw materials. The authors draw the attention on the fact that if two undertakings are using the same subcontractor to compute their costs, then they cannot consider that their offers were independent to each other, even though there is no signed agreement between those them.

The other two methods, C and D, allow the economists to make comparison between the collusion and competition in different ways. Method C is making a benchmark with a competitive market or with a number of undertakings in the market which are not part of a cartel (for example, undertakings which are activating on different geographical market). Hence, we will underline the importance of including in data a pre-cartel period, to avoid the inapplicability of this method. Another issue coming from this method is that it refers to the endogeneity of this benchmark. In the case when the benchmark is not coming from two firms who did not take part of the agreement, there is a possibility that these companies different characteristics with respect to the other ones who were participated in the cartel [8].

In the case when the benchmark is situated in a different geographical market on which an agreement was not existent, it is possible that the two markets are not comparable [4]. As an example, if two undertakings do not have motivation and capacity to collude on one of the market, but not on the second.

Lorenz [7] made a comparison of the performance of competitive and anticompetitive models within the auctions that took place in India on wheat market. Before this study, it was stated it took place collusion among the three major buyers who shared 45% of the whole market.

For the competitive market, the authors have chosen the IPV (independent and private values) model with asymmetric distributions: the data coming from three firms, which were suspected of collusion, were part of distributions which were different from the ones belonging to the players of other markets (they all have the same distributions). The anticompetitive model was chosen as the model of rotating the offers.

In the empirical analysis of this study there were involved 421 auctions which took place in 1999. Data had both qualitative and quantitative variables. Athey and Haile [2] came up with a structural model to identify the latent distributions.

3. Practice examples of analytical methods used for detecting cartels

3.1. Detection of bid rigging based on improbable events

An application of the previously described example is the investigation of offers which are identical.

We will take the case when eight companies were participants of a bid. Their offers are independent to each other and the winning bid is the lowest price. The offers were

placed by the eight competitors in different envelopes and are independent to each other. When the envelopes were opened, it came out that all eight bidders offered the same amount: 342,725. The probability for each undertaking to bid on the same amount, considering all the possibilities: $\left(\frac{1}{9}\right)\times\left(\frac{1}{10}\right)^{5}=1{,}11\times10^{-6}$

Now, if we assume that all of the bids were independent to each other, in other words they do not have information about the competitor's offers, the probability that all the seven participants would have chosen the same value becomes $\left[\left(\frac{1}{9}\right)\times\left(\frac{1}{10}\right)^{7}\right]^{8}=\left(1{,}11\times10^{-7}\right)^{8}=1{,}88\times10^{-56}$.

The probability that the eight bidders, behaving independently to each other and making an agreement on their six digit numbers is almost zero and it sends a strong sign that the undertakings which were involved, have had implicitly and explicitly reached a coordination mechanism in the case of their bids.

3.2. Analytical methods based on prices and cost information

We will consider an oligopoly market case with four undertakings. We have computed the weekly average of prices. We will place in the same graph the costs of the raw materials. Thus, the following graph has been obtained.

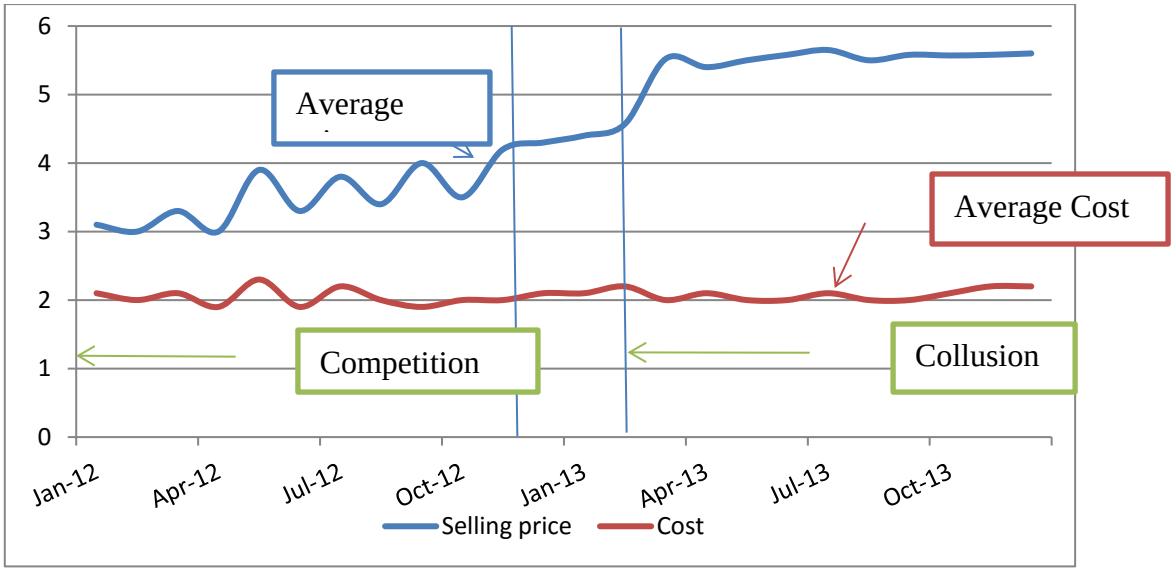

Figure 1. The prices and costs evolution corresponding to the analyzed undertakings, during 2012-2013

Source: own processing of the data

The figure from above is showing us the ending moment of the anticompetitive agreements between the four undertakings. Then we compare the costs and prices of the two distinct periods: the anticompetitive period (on the right side of the picture) and the left period which corresponds to the competitive period. We also assume that between the two lines there is a period of transition.

We observe that the average price of the sold product dropped dramatically and then remained much lower compared it to the anticompetitive period. During the anticompetitive behavior, the prices started to move accordingly with the costs and it had greater variations. The table from below is giving us a better picture of the mean prices and costs' variation as they show in the period analyzed.

Table 1. Distribution of market shares during 2010-2013

Statistics	Competition	Collusion	Differences
Price			
Average	3.35	5.44	62.65%
Standard deviation	0.36	0.07	-76.56%
CV= Std. Dev./ average	0.12	0.03	-85.15%
Cost			
Average	2.04	2.16	1.47%
Standard deviation	0.13	0.11	-38.12%
CV= Std. Dev. / average	0.06	0.039	-38.89%

Source: own processing of the data

The table above is showing us the facts that, while mean prices increased by 62.65%, the standard deviation dropped by 76.56%. During the same time period, the coefficient of variation dropped by 85.16%.

3.3. Detecting the agreements on sales prices coordination

We will make an analysis which is based on a research of large and small price variations of 36 undertakings in a given metropolitan area. The undertakings are selling a homogenous product.

Our analysis is based on graphical method in which the horizontal axis represents the average prices, while the vertical axis highlights the standard deviation of the homogenous product. Our goal consists in observing a group of undertakings for which the sale price has a high mean and small standard deviation compared to the other undertakings. This makes us think that the investigated undertakings agreed to have maintained a high mean price of its products, while the variation was small during the same period of time. That makes us think that the undertakings collude to keep a high mean price for its products, while the variations of the prices were low.

In other words, the investigation was performed on the data on the 36 subjects. For all of them, one by one, we have computed the mean price, the dispersion of prices and the coefficient of variation of the data.

The following graph is showing us the oscillation of the standard deviation in the case of the mean prices of the homogenous product.

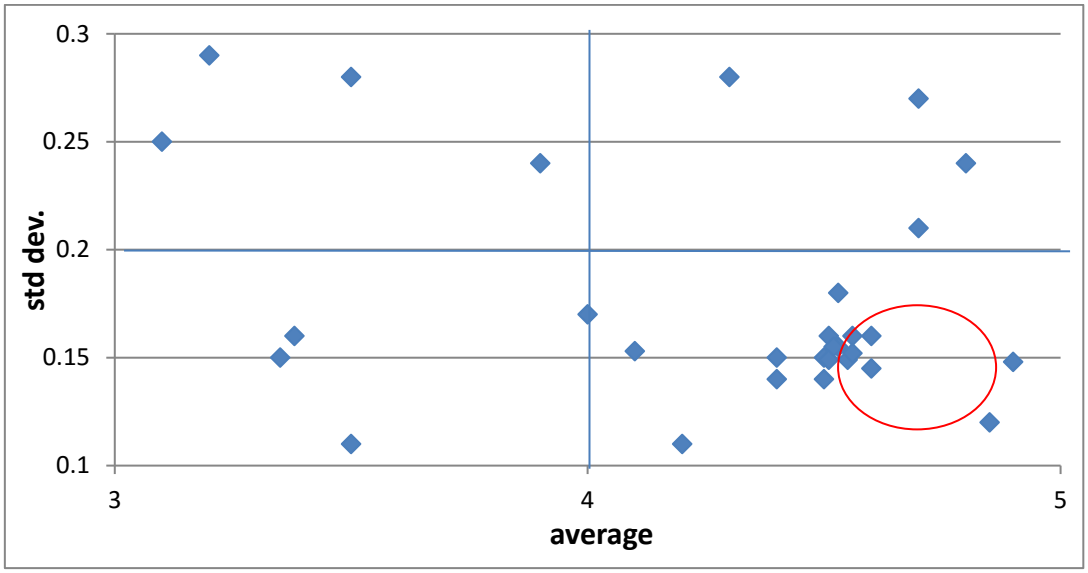

Figure 2. Variation of standard deviation in the case of homogenous product (36 undertakings)

Source: own processing of the data

As we could see, the undertakings which have high mean prices also have a high value of the standard deviation. We will start with looking at the outliers, but such outliers do not exist.

If there was collusion between the analyzed undertakings on the homogenous product, they would have been placed on the bottom right of the chart. As we stated before, that would correspond with high prices and low variations compared to others. The statistical analysis on prices would indicate the possibility of market coordination regarding the prices. It is about the price coordination between the undertakings where the prices were grouped.

3.4. An analysis of the evolution of the market shares

Another method used for analyzing the collusions, is given by the evolution of the market shares of the undertakings. We will start with considering a case in which, on some given market, there are four undertakings with market shares given in the following table.

Table 2. Market shares distribution during 2012 – 2015

	Market share %			
	2012	**2013**	**2014**	**2015**
Enterprise A	33	32	33	33
Enterprise B	23	24	23	23
Enterprise C	19	19	18	18
Enterprise D	16	16	17	17
Others	9	9	9	9

Source: own processing of the data

The evolution of the market share could be shown into the graph below:

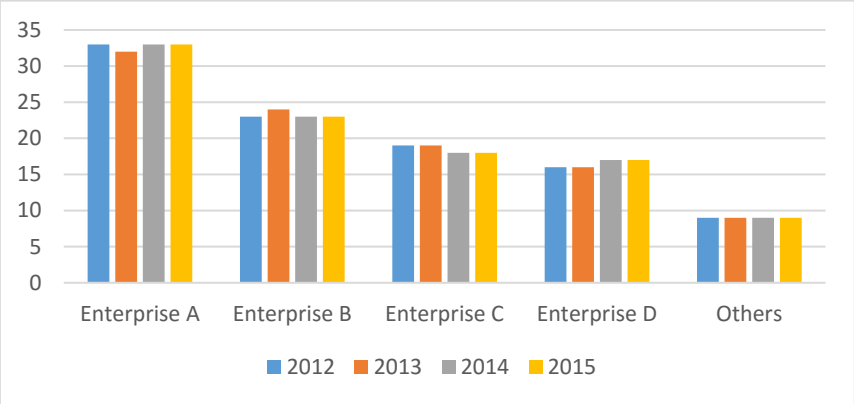

Figure 3. Market share evolution of the analyzed undertaking during 2012-2015
Source: own processing of the data

From the graph above, we could conclude that:

(i) The market shares of the undertakings appear to be stable over the analyzed period of time, and

(ii) The market shares of all undertakings on the given market are negatively correlated.

This statistical method could make us conclude that, there is a potential agreement between the undertakings in terms of sharing the market.

4. Conclusions

The statistical methods for detecting cartels are used more and more often by the competition authorities all over the world in their work of investigating anticompetitive agreements and also by the undertakings which could apply for compensation whenever they are harmed by the existence of a cartel on the market they are operating. The use of statistical models based on time series data could be a useful method to observe the anticompetitive behavior on any market. By using these methods the competition authorities cannot prove directly the anticompetitive behavior of the investigated undertakings, but they could highlight the improbable results which require careful attention. These methods are primarily used to avoid the false negative and false positive results. A false negative result states that there is not an anticompetitive behavior on the market, while actually is, and a false positive result are those in which is stated that there exists a cartel on the market although it does not exist, actually. Moreover, the use of all these statistical methods must have an empirical support, not being too costly to be implemented, and be easily to be implemented.

5. References

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