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# SCREENING METHODS FOR THE DETECTION OF CARTELS

Literature  
review

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D43, L11, L41

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## Abstract

*During their everyday activities, the economic operators conclude a multitude of agreements in tacit or written form, such as contracts or conventions, without being exhaustive. Some of these arrangements are necessary for the development of their current activities. These are agreements, which, by respecting the rules of competition, are able to bring benefits to consumers and to the entire economy, as a whole. On the other hand, the economic operators often conclude agreements that are harmful to the economy as well as to the consumers, violating the competition rules. Some examples in this respect are operators' agreements on price fixing, on market or customers sharing. Before investigating the violation of competition rules, the relevant authorities should identify the possibility of the existence of such illegalities. The theoretical models for detecting the cartels do represent a proactive tool concerning the antitrust activity of competition authorities. The present paper furnishes a review of the methods for detecting cartels as well as a part of their current application.*

## 1. Introduction

The economic companies, by virtue of their daily activities, are often in contact one another, and these interactions can sometimes lead to anticompetitive agreements.

Regarding the incidence of anticompetitive agreements within companies' activities – as type of cartels – Adam Smith wrote in his seminal work named “An Inquiry into the Nature and Causes of the Wealth of Nations” (1776) that “*people of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices*”.

There is a vast literature in the field concerning the economic implications of anticompetitive policies. Among the named studies we mention those of Shapiro (1989), Jacquemin and Slade (1989), Connor and Lande (2005), Elzinga and Mills (2004), Porter and Zona (2004), Motta (2004), Whinston (2006).

The authors consider cartels as part of the most serious infringements of competition rules. The competition authorities from around the world have increased their efforts to detect and fight against cartels. At this point, cartels are seen as secret agreements between two or more companies operating on the same market (it is about the notion of "market" within the antitrust theory, namely the concept of "relevant market", or otherwise, they represent horizontal agreements) that have as a result the restriction or distortion of competition. The main types of cartels are those involving price fixing and/or market sharing.

**Connor and Lande** (2005) studied how the cartels arrived to increase prices. The mentioned authors used data concerning the cartels detected on the U.S. market. The findings of their research show that the average of prices increase on a market because of cartel is about 25%. This value

differs in function of cartel's type. In the case of cartels involving only U.S. companies, the average of prices increase was about 17-19% and, for cartels involving organizations outside the U.S.A., the average of prices increase was about 30-33%.

Cartels distorting the best the competition rules are defined in the literature as „*hard core cartels*”. The starting point of this definition could be found among the recommendations concerning the effective actions against *hard-core cartels*, which were published by OECD in 1998. According to OECD, „*hard core*” cartels are anticompetitive agreements of competitors in order to fix prices, to restrict output, to submit collusive tenders, or to divide or share markets.

The European Commission Report on Competition (2001) has described the effects of cartels on the European economy. The named authority considers *the secret cartels as the most serious restriction on competition. These cartels lead to higher prices and fewer choices for consumers. Moreover, they have a negative impact on the European economy as a whole by increasing the cost of services, goods and raw materials for European companies buying them from the members of cartels. Broadly, cartels reduce the competitiveness of the European economy as a whole.*

The most popular ways of forming a cartel consist in price fixing, bid tricking, output restricting or market sharing.

Among the factors determining the existence of cartels, we mention the following ones: the elasticity of demand, the concentration degree of sales and buyers, the barriers to market entry, the existence of information exchanges, the stable or declining demand, the interaction of competitive companies on multiple markets

or even the existence of markets suffering from repeated cartelization.

## 2. Cartel screenings

The detection of price fixing, of bid tricking and of competitors' agreements concerning market allocation do represent a key priority for competition authorities around the world.

The main obstacle occurs when an explicit agreement among competitors could not be easily known or noticed. In that case, we are supposed to resort to looking for patterns or changes in the economic variables (such as prices and sales units) which are inconsistent with a competitive behaviour.

Competition authorities usually follow anticompetitive practices of price fixing in three phases: the detection phase, that of investigation and the penalty one. The U.S. and the European competition authorities relied in the past on Leniency for the first phase, the phase of detection. Leniency programs identified cartels in a number of industries. Despite these successes, some agreements remain undetected. Indeed, the simple fact that leniency applications continue to occur at a high level, confirms the assumption that agreements as type of cartels do happen. Moreover, leniency programs tend to discover agreements when they are close to the breaking point, which means that the most sustainable and successful cartels remain undetected. Recognizing the limits of leniency policy, an increased number of competition authorities have begun to look for alternatives in order to detect agreements. One of these alternatives consists in using *cartel screening*.

Screening is the use of some price and/or output models or the use of other economic variables in order to determine whether the behaviour on a particular market

is abnormal or potentially inconsistent with a competitive conduct.

There are several features, which would determine a screening method to be a useful and an informative test.

First of all a screening should be able to distinguish the competitive behaviour from the anticompetitive one as well as to control the effects of other actions and market events. These actions or events could have affected prices, sales or the global output. For example, an increase noticed at the level of prices on the global market could be caused by an attempt to fix prices or by an increase in the price of inputs used by every market participant.

Secondly, *screening* should reduce to a minimum level the number of false positive and false negative results. Too many false-positive results could lead to investigations or complaints although there was no anticompetitive conduct. Too many false-negative results would mean that a series of cases of anticompetitive behaviours would remain undetected and unchallenged.

Third, the analysis should be based on the objective and available information such as prices, costs, offers or market shares. Generally, e-mail conversations, phone records, diary notes and the notes taken by the employees, could be informative. Because of the fact that these types of information are usually noticed or found after the release of an infringement inquiry, it is unlikely that they may be useful as a possibility of building a screening for anticompetitive conduct.

In general, for detecting a cartel, we follow two phases:

- (i) *Screening* – we identify the markets where there is a high probability for cartels to occur;
- (ii) *Checking* – is used in order to differentiate between agreement and competition;

**Economic screening** uses market information in order to identify those markets where there is the possibility for a cartel to occur.

A market detected by means of screening methods is not one where the competition was violated, but one needing a closer investigation. Screening is, in fact, the first phase of a broader process that could lead or not to the identification and punishment of anticompetitive behaviours.

The authors classify the economic screening into two categories: **structural** and **behavioural screening**. While structural screening identifies markets that are likely to form cartels, the behavioural screening identifies markets where a cartel has already occurred.

**Structural screening** identifies markets with characteristics that could lead to anticompetitive agreements. **Behavioural screening** identifies collusion models within companies' behaviour and results (prices, sales etc.). The main factors leading to organizations' anticompetitive conducts are small number of firms on the market, homogenous products, less volatile demand or excessive capacity.

The weakness of a structural analysis is that it could have as a result false-positive errors. For implementing a behavioural screening, we need to have the necessary data and know some behavioural patterns able to determine precisely the type of changes to be sought in the original data series. In general, such an analysis supposes the identification of structural breaks in chronological data series, as for example the substantial changes in the series of prices or of market shares.

Structural screening has as result the identification of some markets on which, there is the expectation of cartels' occurrence. Structural screening is in contrast with behavioural screening which

has as a result the identification of some markets where a cartel has just occurred.

**The behavioural method** focuses on the impact produced on the market by the existence of certain coordination. Suspicions of an anticompetitive agreement on a market could come from similar models of prices or quantities sold by particular entities or from other issues concerning market conducts. For example, buyers could become suspicious because of parallel movements of prices or of their unexplained increase.

For detecting a cartel, we need **two-phase framework thinking**. In order to illustrate this, **Connor (1998)** gives us an example of forming a cartel on the citric acid market, as shown in Figure 1.

The portion of the chart named "contract" is a more accurate reporting of real transaction prices. As shown in the graph, the cartel raised prices significantly from mid-1991 until late 1992. This is the moment when we notice a flat price trend over time during up to the beginning of the decline with the collapse of the cartel.

This example highlights the screening use for observing the transition from non-collusion to collusion. We have to look at the radical changes of companies' behaviour, finding out the differences in conduct compared to the period in which businesses compete. To observe the behavioural differences between the collusive and competitive periods, the easiest thing for us is to try to identify the structural data disruption, whether it is about prices, quantities, market shares allocation or other variables.

### **3. Examples of Cartel Screening Methods application**

In the following section, we will present a series of examples concerning the practical use of the screening methods in order to identify some potential anticompetitive conducts.

### 3.1. Screening for tricked bids based on improbable events

This first set of screening methods bases on looking for improbable events during sealed bid auctions. In the case of this type of auctions, companies submit simultaneously their offers. These bids are then opened at a due date. For the public sector, the contract is usually awarded to the offer with the lowest price.

If companies do not make agreements, then they cannot condition their tender on the bid of other entities. As a result, we should expect the offers to be independent after controlling the information that is noticeable to all bidders. This information involves variables influencing the cost or market power. On the other hand, if companies make agreements, then they need a coordination of their activities. However, this coordination frequently destroys bids' independence. We can detect this coordination by testing statistical hypotheses.

We consider suspect an agreement when offers are "too highly correlated" so as they could be the result of bidders' independent actions. The search for identical tenders does represent an application example of this screening type. In this respect, a famous example is that of bids received by Tennessee Valley Authority for installing conductor cables in the 1950s. Seven entities entered identical bids of \$198,438.24.

This is analogous to a player making twenty consecutive winning betting in roulette. The chance of seven bidders, acting independently, arriving to an agreement of all eight figures offers, is nearly zero and it sends a very strong signal that companies, explicitly or implicitly, have reached a mechanism of bids' coordination.

### 3.2. Screening methods based on prices and on costs information

**Abrantes-Metz et al. (2005)** analyses price and cost evolution during and after the conclusion of a conspiracy of tricked bids which took place on frozen perch fillets market by Philadelphia Defence Personal Support Centre between 1987 and 1989, the case being investigated by the U.S. Justice Department. This conspiracy has indicated that agreements concerning price fixing are less volatile and more responsive to changes in cost than competitive prices. These empirical research findings are consistent with a series of theoretical models regarding anticompetitive agreements.

The authors analysed how different price and cost structures varied from anticompetitive agreements to competition. The data obtained highlighted four distinct periods that were consistent with theoretical models of cartels:

- (i) there was a structural break when the cartel collapsed, marked by a slump in market prices;
- (ii) the average price was higher during a cartel than during competition;
- (iii) prices were more stable during a cartel than during competition;
- (iv) prices were more closed to costs during the competitive period than they were during cartels;

We assume that even competition authorities could use these features of the data revealed in order to identify potential agreements or cartels. For example, the existence of large variations in prices could indicate a competitive environment, while a smaller variation may indicate a potential anticompetitive behaviour.

Figure 2 shows us the moment of the end of conspiracy as a result of investigation's unleash. The price of frozen perch decreased dramatically and it remained at a much smaller level compared

to the price for the conspiracy period. For the next period, after the end of the agreement, the price started to change in the same way as the cost and it had a greater variation.

Now we are going to compare the prices and costs in Figure 2 in what we call the “collusion” period (to the left of the vertical line) with prices during the “competitive” period (to the right of the vertical line). We suppose that the period between the two vertical lines represent a transition period from the complicity to competition.

The Graphs in Figure 2 show the average price paid by DPSC Philadelphia for frozen fillets of perch (USD/ pound) during the period January 1987- September 1989. Cost data in Table 1 represents the monthly average price of fresh perch. We could notice from the table in discussion that while the price average decreased by 16%, the standard deviation increased by 263%. In the same period, the *coefficient of variation (CV)* increased by 332%.

### 3.3. Screening used in the detection of cartel formed in order to coordinate sale prices

Economists are able to implement the screening method in order to discover cartels, by seeking prices that seem to be the result of an explicit coordination or prices that do not reflect costs. For example, the U.S.A. Department of Justice suggests that the following features could be treated as indicative to an anticompetitive behaviour. The identical prices may indicate a price-fixing conspiracy, especially when:

- (i) prices remain identical for long periods of time;
- (ii) prices were different at the beginning and they started to become identical;
- (iii) price increases do not seem to be explained by increased costs;

- (iv) discounts are eliminated, especially on markets where reductions were granted in the past;
- (v) economic agents impose higher prices on the local market than on the distant ones;

Abrantes-Metz et al. (2006) present the use of *screening* in the detection of a price-fixing cartel. The authors have built a method in order to demonstrate an agreement of the type mentioned above. They proposed a screening based on the search for small and large variations in prices of petrol stations in a given metropolitan area.

They have applied the graphical method in which the vertical axis represents the standard deviation and the horizontal axis represents price average of the 95-gasoline product. The aim has been to observe a group of petrol stations that have a high sale price average and a low standard deviation, compared to the other stations. This leads to the idea that market players have agreed to keep a high price average for 95-gasoline product, even if the prices have not known a great variation during the analysed period.

More exactly, the analysis was conducted on the data got from 279 fuel stations in Louisville. The authors calculated the average, the dispersion and the coefficient of variation for every station in part. The graph in Figure 3 shows us the oscillation of the standard deviation of pump price according to the average.

As could be seen in this chart, gas stations having higher average prices have also high standard deviations. Therefore, we recommend looking first at the so-called “outliers”(in statistics, *outlier* is a value that is at an abnormally large distance from the rest of the data. Outliers are generally excluded from the analysed data series). Such type of *outliers* does not exist in practice.

If there had been coordination in the case of competitive behaviour concerning pump prices of 95-gasoline product, they would have been grouped in the bottom right corner of the chart above. These are prices, which as we have just stated, would have symbolized a higher average and a lower standard deviation than the others. The statistical analysis of the prices does not indicate the possibility of the existence of prices coordination on market.

### 3.4. Screening based on market shares

Another potential method of using screening in practice is given by the information concerning market shares. The literature in the field, as well as the evidence from previous cartels demonstrates that cartels might try fixing market shares. There are different cases in which we could apply the screening method:

- (i) in the case of market shares which seem to be very stable over time, and
- (ii) in the case of market shares of all the economic agents on a particular market, those market shares being negatively correlated over time;

In the first situation, we will detect an agreement of the cartels concerning market division.

Examples of cartels with stable market agreements include cartels within copper plumbing tube industry, that of organic peroxides and of vitamins (A, E and folic acid).

The second situation appears in the dynamic models of cartels. In those models, if a cartel's member deviates from the agreement, the other members of the cartel will be expected to compensate for this deviation in subsequent periods.

As a result, abnormally high rates characterizing a particular period should be followed by a reduction in those rates in the future.

### 3.5. Screening based on mathematical laws

*Benford's Law*, also called the First – Digit Law, refers to the frequency distribution of digits in many (but not all) real-life sources of data. In this distribution, the number 1 occurs as the leading digit about 30% of the time, while larger numbers occur in that position less frequently : 9 as the first digit less than 5% of the time. More exactly, the first digit distribution is logarithmic. Benford's Law also concerns the expected distribution for digits beyond the first, which approach a uniform distribution. This mathematical formula describes the frequency distribution of digits in many but not all real-life sources of data. Studies have shown that the law applies to many fields: electricity consumption, words' frequency and daily earnings of Dow Jones.

Because of the fact that Benford's Law is a model existing naturally in many sources of data, law's violations have been used in order to detect manipulations of data or of financial indicators.

### 4. Conclusions

The methods presented during this research work are not useful only for competition authorities, but they could also become a powerful tool for plaintiffs and defendants in the cases of anticompetitive policies. During these procedures, victims may address to national courts, for example, in order to claim compensations for the damage that they suffered.

It is very important for us to highlight that these methods do not prove anticompetitive agreements. *Screening* only isolates the improbable or abnormal results and the ones that normally would need a more attentive analysis. These methods will exhibit both the false positive results and false negative ones.

A good screening should have the following properties:

- (i) to reduce the number of false positive and false negative results;
- (ii) to be easily implemented;
- (iii) to be costly for traders and to hide the anticompetitive behaviour;
- (iv) to have an empirical support;

The use of market *screening* based on statistical analysis, could be a method for identifying possible coordination of market competitive behaviour. There are a series of variations in applying this concept.

The best setting for price-fixing tests uses competitive benchmarks, such as certain points in time, when it was known that there was competition in the named industry or in other comparable, specific competitive industries. However, the screening method seeks for agreements between all kinds of industries. Screening needs a systemic approach, which is not based on data about known or suspected price-fixing periods.

As a result, to come up with an ex-ante rule for the variation of the needed minimum price (for example, compared to the average prices), means to end up being somehow really ad-hoc. In this case, the analysis would eventually rise to nothing more than detecting peak prices and erroneous data. The problem with this approach is that the abnormal data are rare, even those generated randomly. Moreover, some erroneous data result simply from errors in data collection, which means that there are a high percentage of false positive results.

The experience of the Federal Trade Commission (FTC) proves the challenges associated with a blind analysis and the probability of generating false positive results. In order to perform its test, the Federal Trade Commission looked for price increases, observing the end of the most recent business cycle under the hypothesis

that other explanations for price increases would have been likely to seem important. It was expected that price increases as well as the capacity constraints would have been likely to appear at the end of a business cycle. The screening identified 600 possible industries that had presented an “inappropriate” behaviour. The Federal Trade Commission analysed closely 25 from the 600 industries and found that only three of them needed supplementary investigations. The commission discovered reasonable explanations for price increases noticed in 22 of the 25 analysed industries. Among the three industries that required supplementary investigations, one has just been investigated for anticompetitive behaviour, while the inquiries within the other two industries have been dropped. Thus, screening produced a large amount of false alerts and it seems that it was not able to identify new cases of price-fixing.

As a general conclusion, we assume that screening methods should be combined with specific data of the applicable law and of the current economic context for not creating distorted images on economic reality. Used with discretion by the trained personnel in competition field, screening techniques are able to furnish to the users the necessary clues for market analysis, both the structural and behavioural ones.

## REFERENCES

- [1] Abrantes-Metz, R. M., Froeb, L. M., Geweke, J. F., & Taylor, C. T. (2005). A variance screen for collusion. *FTC working paper no. 275*.
- [2] Abrantes-Metz, R. M., et al. (2006). A variance screen for collusion. *International Journal Ind. Organ.* (24), 467–486.
- [3] Connor, J. M., & Lande, R. H. (2005). How High Do Cartels Raise Prices? Implications for Reform of the Antitrust Sentencing Guidelines. *Working paper no. 01-04*. American Antitrust Institute.
- [4] Connor, J. M. (1998). The global citric acid conspiracy: Legal-economic lessons. *Agribusiness Journal*. 14 (6), 435-452.
- [5] Elzinga, K. & Mills, D. (2004). The brand name prescription drugs antitrust litigation. *The Antitrust*

Revolution: Economics. *Competition and Policy* (4<sup>th</sup> ed.). Oxford University Press, New York, 301-320.

[6] Jacquemin, A., & M. Slade (1989). Cartels, collusion, and horizontal merger. *Handbook of Industrial Organization*, Amsterdam, (1) 415-473.

[7] Motta, M. (2004). *Competition Policy: Theory and Practice*. Cambridge University Press, Cambridge.

[8] Porter, R., & Zona J. (2004). Bidding, bid rigging, and school milk prices: Ohio v. Trauth. *The Antitrust Revolution: Economics, Competition and Policy* (4<sup>th</sup> ed.) Oxford University Press, New York, 211–232.

[9] Shapiro, C. (1989). Theories of oligopoly behaviour. *Handbook of Industrial Organization*, Amsterdam, (1) 329-414.

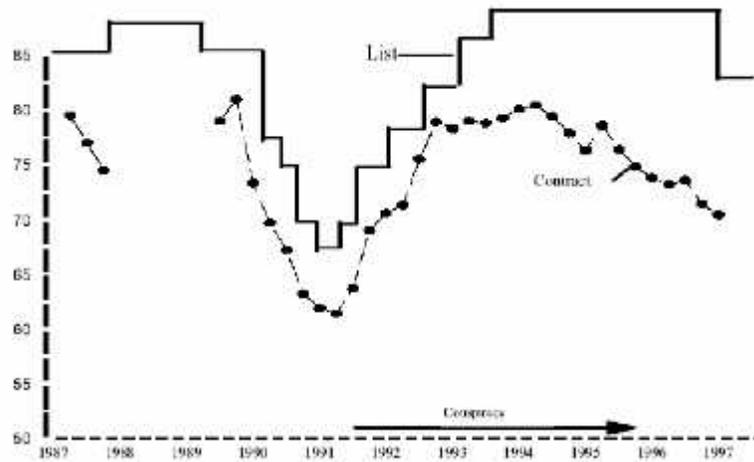
[10] Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*. W. Stratan and T. Cadell, London, 1 (1 ed.).

[11] Whinston, M. (2006). *Lectures on Antitrust Economics*, MIT Press, Cambridge.

[12] European Commission Report on Competition, No. XXXI (2001), section 32.

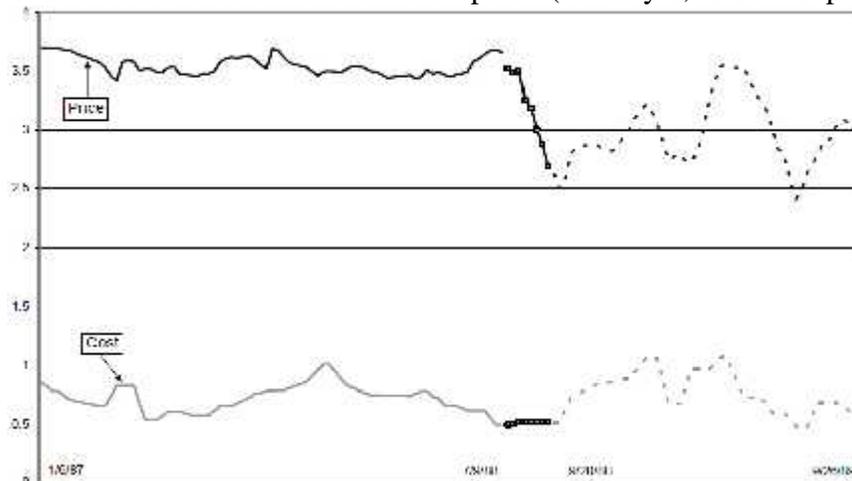
*Appendix Tables and Figures*

*Figure No. 1. Prices evolution on the citric acid market during 1987-1997*



*Source: Connor (1998)*

*FigureNo.2. Price and cost evolution for the frozen perch (January 6, 1987 – September26, 1989)*



*Source: Abrantes-Metz et al. (2005)*

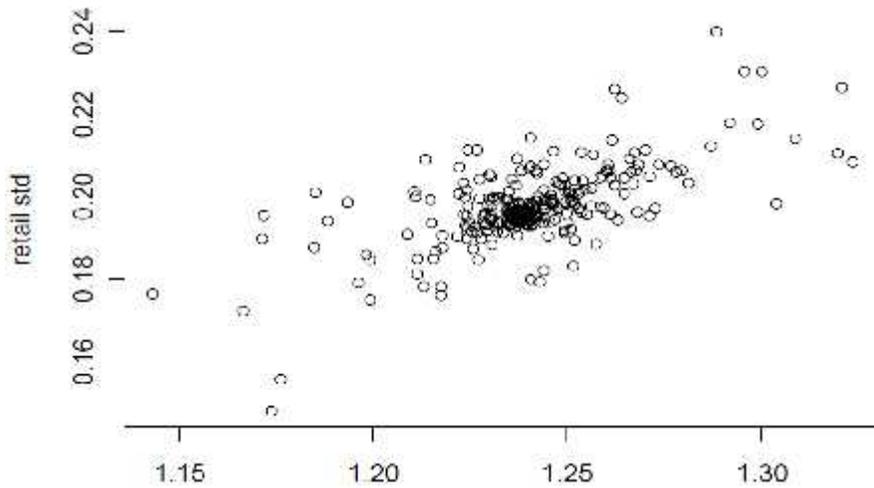
TableNo.1

The average and standard deviation for price and cost series in the case of the named product: perch (\$/pound)

Statistics	Collusion	Competition	Differences Across Regimes
<b>PRICE</b>			
Mean	3.544	297	-16.20%
Std. Dev.	0.078	0.283	263%
CV = Std.Dev / Mean	0.022	0.095	332%
<b>COST</b>			
Mean	0.722	0.711	6.80%
Std. Dev.	0.144	0.173	51.80%
CV = Std.Dev / Mean	0.158	0.224	41.80%

Source: Abrantes-Metz et al. (2005)

Figure No. 3. The oscillation of standard deviation of pump prices compared with the average price (279 gasoline stations)



Source: Abrantes-Metz et al. (2005)