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What can be learnt from econometric studies in cartel cases?

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Abstract

Cartel econometrics has become a well-developed field of research that can contribute to the efficient implementation of competition policy. Beyond the most traditional type of analysis aiming to quantify the impact of cartels on consumer welfare, other methods have been developed lately. They allow economists to check whether the observed behaviour (in terms of public price announcements, price dispersion, or bids in response to tenders) is more likely to have been caused by collusion or by normal competitive interaction. This can facilitate the delineation of the periods effectively affected by coordination, as well as the interpretation of the available evidence when there is no obvious smoking gun. All these methods require great caution in order for their results to be robust and convincing. The currently ongoing effort by competition authorities' economists to define best practices for the submission of economic evidence should make the use of econometric techniques more efficient.

L'économétrie des cartels est devenue un champ de recherche à part entière et peut contribuer à l'application efficace du droit de la concurrence. Au-delà des analyses traditionnelles visant à quantifier l'impact des cartels sur les prix, d'autres méthodes ont été développées au cours des dernières années. Elles permettent notamment de déterminer si le comportement observé sur le marché (en termes d'annonces publiques de prix, de dispersion des prix, ou de réponses aux appels d'offres) est plus probablement dû à un comportement collusoire ou à une interaction concurrentielle normale. Cela peut faciliter la délimitation des périodes effectivement affectées par une entente, ainsi que l'interprétation des indices disponibles en l'absence de preuve évidente. Toutes ces méthodes nécessitent une grande rigueur afin d'obtenir des résultats robustes et convaincants. Le travail en cours au sein des autorités de concurrence afin de définir des meilleures pratiques pour la soumission d'études économiques devrait contribuer à rendre plus efficace l'utilisation des techniques économétriques.

1. Empirical analyses addressing the effects of cartels often arouse scepticism. Two main criticisms are generally leveled at them. First, some argue that these analyses are simply useless: cartels are *per se* illegal and must be severely punished since they are, by nature, harmful to consumers. According to this view, there is no room for complicated analyses of actual effects. Second, these analyses often raise complex methodological issues. They sometimes make their interpretation difficult, especially in the presence of conflicting submissions.

2. The point of this paper is that such scepticism is unwarranted in the light of the latest developments in cartel econometrics. The traditional approach to cartels is to attempt to quantify their impact on price levels. While many recent studies continue to address this issue, different, complementary types of analyses have also been developed. Beyond their diversity, what they have in common is that they aim to assess whether observed market outcomes are better explained by collusion or by competitive behaviour – which allows one to assess whether attempts to collude were successful, or whether some "borderline" behaviour was collusive or not. For instance, econometric analyses can be used to distinguish between public price announcements that are used by firms in order to coordinate and those that are consistent with normal competitive behaviour. Such analyses could be carried out to check whether the evidence on which competition authorities sometimes base their allegations indeed prove the existence of coordination between different firms.

3. It is true that quantitative cartel analyses often raise a number of complex methodological questions. One the one hand, these analyses are generally based on the comparison between observed outcomes (such as prices or market shares) during the alleged cartel period and a simulation of what such outcomes would have been absent any coordination. The simulation of the situation that would have occurred absent any coordination (also referred to as the "counterfactual") involves difficult technicical issues. On the other hand, some frequently used techniques rely on theoretical assumptions that can be difficult to verify empirically. However, even if empirical methods are far from perfect, they are improving, and they can provide insightful results to help investigate the existence and effects of cartels.

4. Even though the abovementioned methodological concerns are often relevant, several quantitative tools are available in order to address them. A lot of different techniques, which we describe hereafter, can be used not only to identify the effects of a given cartel and quantify the damage to the economy, but also to check for the very existence of effective coordination between firms. However, in order to yield meaningful results, these methods need to be applied following rigorous standards. This need is currently being addressed by competition authorities, both at the Community and at the national level, where economists' teams are working on guidelines on the submission of econometric evidence.

I. The different uses of statistical and econometric tools in cartel cases

5. While the majority of statistical analyses of cartels focus on the assessment of their impact on prices, the scope of these empirical analyses has recently broadened. Some studies investigate how a cartel can be detected, going beyond direct, "smoking gun" evidence of price-fixing. Other studies assess the actual success or failure of a cartel. Therefore, one may distinguish between three main uses of statistical and econometric

tools in cartel analyses, which are (i) to provide a measure of the impact of coordination on consumer welfare, (ii) to delineate the period affected by collusion, and finally (iii) to check whether cartel allegations are based on behaviour that could also be explained by normal competitive behaviour.

1. Measuring the impact of coordination on consumer welfare

6. The most frequent use of econometrics in cartel cases is in order to quantify the impact of cartels on prices. This is consistent with competition authorities' focus on consumer welfare.

7. The main idea is to compare the observed prices (or quantities) with what they would have been absent the cartel. However, the simulation of what prices (or quantities) would have been absent any coordination raises some challenging methodological issues, and different methods, described in greater detail below, can be used to tackle these problems.

8. These analyses are useful because they allow competition authorities to take into account the quantification of consumer harm when setting the level of fines in cartel cases, which makes competition policy more efficient. Setting fines independently of consumer harm would indeed deter only the least profitable – and thus least harmful – cartels, it would still be rational for firms to take part to highly profitable cartels. On the contrary, allowing fines to be greater for cartels that had a greater price impact would facilitate the deterrence of all cartel behaviour.

2. Determining the periods actually affected by cartel behaviour

9. In general, competition authorities delineate the chronological bounds of an alleged cartel on the basis of information that is precisely dated (such as public price announcements, or meetings between competitors). This sporadic evidence is often extrapolated, leading competition authorities to describe the alleged infringement as "continuous" over a certain time period.

10. Econometric analyses can allow one to check whether the coordination under scrutiny indeed lasted continuously over the entire period considered by competition authorities. This is important because in practice, many cartels are unstable and are interrupted by periods of price wars. These price wars are easy to understand on a theoretical point of view. A cartel could benefit all its members since each of the colluding firms applies the common line of action (e.g., if each of them sets the announced, or agreed-upon price). However, a cartel member can increase its own profit if it decides to unilaterally deviate from the common line of action (e.g., by slightly undercutting competitors). Doing so, it faces retaliation from the other cartel members (which may, for instance, decrease their prices as well). Deviating from the agreed-upon line of action could be more or less profitable depending on market conditions (such as the rate of demand growth or decline). Changes in market conditions explain why price wars may alternate with successful coordination.

11. Some quantitative analyses can measure whether, and during which periods, the observed behaviour (in terms of price dispersion, or bidding behaviour) is consistent with collusion. In some cases, they may show that the cartel under scrutiny was totally unsuccessful, implying that the evidence on which cartel allegations are based (e.g., information exchange between rivals or public price announcements) only prove an attempt to coordinate. In other cases, they may help competition authorities to distinguish cartel periods from unsuccessful ones.

3. Checking whether the evidence is consistent with normal competitive behaviour

12. Cartel allegations are often based on evidence such as information exchanges between firms or public price announcements. However, such evidence should not be considered to prove the existence of collusion, because some of the behaviour under scrutiny could also result from normal competitive interaction.

13. Consider for instance public price announcements Under some circumstances, a firm has incentives to publicly announce an increase in prices, even absent coordination, since in many markets, the other firms' best response to such an increase is to raise their prices as well.[1] Therefore, public announcements of price increases should not always be considered as evidence of coordination between firms. They could also reflect unilateral profit-maximising behaviour.

14. Econometric analyses can help one to distinguish between price announcements that aim at maintaining and regulating a cartel and those that do not. A recent econometric analysis[2] of the vitamins cartel[3] shows that the price announcements during the alleged cartel period were very different from the announcements made in other periods. For instance, the public price announcements were more frequent during the cartel period than before. During the cartel period, price announcements also occurred at somewhat regular intervals and the announced increases followed a uniform pattern, i.e., always the same increment. Also, the time span between the date of a public price announcement and the date when the announced price was actually set was significant during the cartel period but extremely short before. The delay between announcements and competitors' price changes was also markedly different. Such an analysis could carry over to many different types of cases because by adapting the underlying theoretical model and the empirical technique.

1 Technically, we say that, when firms compete in prices ("à la Bertrand"), prices are "strategic complements".

2 Marshall R., Marx L., Raiff M., "Cartel price announcements: The vitamins industry", *International Journal of Industrial Organization*, 26, 2008, 762-802.

3 Case *United States v. F. Hoffmann-La Roche Ltd*, Crim. No. 3:99-CR-184-R, May 20, 1999.

15. This econometric study provides a recent example of the use of quantitative methods to analyse whether the evidence on which competition authorities base cartel allegations is convincing.

16. To sum up, empirical cartel analyses could provide one with relevant elements regarding the damage to consumers, the chronological bounds of cartel behaviour, and the reliability of the evidence motivating cartel allegations. The corresponding techniques are described below.

II. The main statistical and econometrics methods applied in cartel analyses

17. There are two main categories of quantitative cartel analyses, which correspond to two strands in econometrics. Some analyses used what is called "reduced form estimation", and directly estimate the impact of a cartel without modelling and estimating all the parameters of the underlying economic model. In contrast, the second category, using "structural estimation" techniques, consists in the entire specification and estimation of a stylised model of the functioning of the market. It requires a complete modelling of demand and supply functions or of bidding behaviour, and the precise specification of the entire relevant market.

1. Reduced form estimations of the effects of cartels

1.1. Price level comparisons

18. The main method yielding a direct and global measure of the impact of a cartel on the economy without estimating all the parameters of supply and demand curves is the comparison of observed prices (or quantities) with an estimate of what they would have been absent any coordination. The definition of this "counterfactual" is of paramount importance. It can be constructed using different methods.

19. The simplest way to measure the effect of a cartel on relevant outcomes (such as prices) is simply to compare prices during the cartel period with prices outside of this period. In that case, the definition of the counterfactual is based on the assumption that nothing – but the cartel – affected prices. This assumption is extremely restrictive. One way to get around this difficulty is to take into account other determinants of prices (such as input costs, taxes, or factors affecting demand, such as the prices of complements and substitutes) by introducing "control variables" in econometric regressions. However, this solution is not always fully satisfactory because there may exist "omitted" variables affecting prices that cannot be properly accounted for in an econometric analysis.

20. Another standard method may allow econometricians to solve this problem. It consists in comparing the evolution of the prices of the products that are affected by the cartel (defining a "treatment group") during and outside of the alleged cartel period, with the evolution of prices of similar products known not to have been affected by the practices under scrutiny (defining a "control group"). This method, known as the "differences-in-differences" estimate, amounts to comparing the evolution of prices for products possibly affected by the alleged cartel (the "treatment group") and products known to have been unaffected. In this case, the counterfactual relies on the assumption that whatever happened to the control group over time is what would have happened to the treatment group absent any coordination. In other words, all the variables (except coordination) that may affect the prices of the products belonging to the "treatment group" are supposed to similarly affect the prices of the products belonging to the "control group" – and this assumption is of course testable. Such a method generally delivers an estimate of what the prices would have been absent coordination.

1.2. Analyses of price dispersion and volatility

21. Another commonly used test for collusion, which does not require a complete modelling of the market under scrutiny (e.g., a modelling of supply and demand functions, or bidding behaviour) is the examination of price volatility.[4]

22. Prices should be less volatile and more uniform when firms coordinate, for the following reasons.[5] First, price dispersion (across firms at a given point in time, or across time for given firms) makes it difficult to monitor compliance with a tacit or explicit agreement, since a firm cannot easily tell whether a competitor's low price results from normal price volatility or from a deviation away from a hypothetical agreed-upon line of action. Second, defining a common line of action is simpler when it can be expressed in terms of a single price or a small number of prices not subject to many adjustments. In other words, it is more difficult and less profitable for cartels to adjust prices as conditions change than it is for firms that fiercely compete.

23. Several empirical studies confirm this reasoning. For instance, a study of firms "prosecuted by the Antitrust Division of the US Department of Justice for rigging the bids for supplying seafood to military installation"[6] finds that after the cartel period, the mean price decreased by 16% while price dispersion increased by 263% or even 332%, depending on how it is measured. Such a test is frequently used because of its simplicity. Computing price variations is generally easy. Furthermore, this test for collusion does not raise challenging methodological issues. Such a test is applicable irrespective of the details of the market under consideration.

4 Abrantes-Metza R, Froeb L, Geweke J. and Taylord, C., "A Variance Screen for Collusion", *International Journal of Industrial Organization*, Volume 24, Issue 3, 467-486, May 2006.

5 See, for instance: Athey S., Bagwell K., Sanchirico C. W., "Collusion and price rigidity", *Review of Economic Studies*, vol. 71 (2), 317– 349, 2004; J.M. Connor, "Collusion and Price Dispersion", *Applied Economic Letters*, vol. 12, 2005.

6 Abrantes-Metza R, Froeb L, Geweke J. and Taylord, C., "A Variance Screen for Collusion", *International Journal of Industrial Organization*, Volume 24, Issue 3, 467-486, May 2006.

2. The structural estimation of cartels

24. Structural estimation requires a modelling of the market and an estimation of demand and supply functions (or the bidding functions). The theoretical model yields a description on how firms should be expected to behave under competition and under collusion, which allows one to assess whether the observed price levels are more consistent with competition or with collusion.[7]

25. In order to provide some insight into these complex methods, we summarise hereinafter a particular application that was used to test for collusion in a bidding market.[8] The first step is the modelling of firms' bidding behaviour in the case where firms compete rather than collude. The model describes certain relationships that should normally exist between the various firms' bids, the information publicly available, and objective cost parameters (as is explained in greater detail below).[9] The comparison between the bidding behaviour that should be observed in theory under competition, and of actual bidding behaviour then allows one to check whether competition or collusion better explains the actual bids.

26. In a competitive market, there should be a close statistical relationship between each firm's costs and its bids across the various tenders it participates to. On the contrary, in a collusive market, only the winning bid is a "true" bid, and this statistical relationship should thus be observed only for winning bids, but not necessarily for the other, phony bids. Porter and Zona,[10] in a classic empirical analysis of bid-rigging, apply this test to the market for state highway construction in Long Island. They show that among losing bids, one cannot find any meaningful statistical relationship between bids and costs. This suggests that the losing bids where "phony" bids aiming to create the false impression of competition.

III. Robustness issues

27. The techniques described above can yield robust and interesting results if they are applied following rigorous rules ensuring that the possible technical problems that could make them irrelevant and properly tackled.

28. One of the criticisms that competition authorities sometimes address to the abovementioned techniques in their decisions is that the counterfactual could not be defined with sufficient certainty and precision. This criticism can take several forms. In some cases, the quantification exercise relies on the econometrician knowing precisely enough when the alleged cartel began and ended. This brings the following questions: when did the cartel under scrutiny really end? Is the date of the beginning of a competition authority's investigation a likely end date? Are the results still robust if a firm anticipated such an investigation, or if, on the contrary, it took some time before adjusting its behaviour? Different solutions can be proposed to such a problem.

29. First, in some cases, there are good reasons to consider that a cartel ended on specific date. For instance, when a firm decides to cooperate with a competition authority, it commits to put an end to its participation to the cartel, which normally should cause the cartel to unravel. Therefore, the date of the first leniency application (possibly with a few weeks' or a few months' delay to account for the possibility that the competition authority requested the applicant not to change its behaviour so as to avoid arousing suspicion) is often a plausible end date, especially, if the first applicant is a large company so that the end of its participation cannot but completely disrupt the cartel.

30. In other cases, there are several dates that could be considered as plausible end dates, such as the date when all cartel participants were informed of the competition authority's investigation, or the date when a non-cartel firm entered the market and destabilized the cartel. In such cases, econometricians should conduct robustness checks, i.e., they should perform different variants of the same analyses, considering different time frames. Finding that the results are similar across these variants would make them more convincing.

31. Finally, some of the abovementioned techniques (such as the analyses of the evolution of price or market share volatility) sometimes shed light on the most likely date of the end of a cartel. Also, the confrontation of different econometric techniques could provide a useful robustness check if converging results are obtained.

32. These issues are but a small sample of the problems that are the bread and butter of quantitative economists. In spite of these difficulties, econometric studies could contribute to the efficient implementation of competition policy, including with respect to cartels. But this requires competition authorities to be confident that the expertise submitted to them has properly addressed the pitfalls that can make results irrelevant. The current work on the definition of "best practices" for the submission of economic evidence is a welcome step. It is also worth mentioning that the existing case law provides useful guidance for the application of quantitative analyses. For instance, the European commission's extraordinarily detailed and pedagogic *Ryanair/Aer Lingus* decision[11] contains a long and complete discussion of the standards to which econometric analyses should be held. It also preaches by example: different variants of the Commision's analysis are presented, various robustness checks are discussed, the results are precisely interpreted, and their limitations acknowledged. An equally detailed and well-motivated discussion of economic evidence in a cartel case would be an important step. There is little doubt that it will come in a not-too-distant future. ■

7 For a specific example of such a study, see, for instance, Bresnahan, T. F, "Competition and Collusion in the American Automobile Industry: The 1955 Price War", *Journal of Industrial Economics*, vol. 35(4), 457-82, 1987.

8 These tests are applicable for sealed-bid auctions, which are the most frequent forms of procurement auction.

9 For further details, see the literature review by Bajari P. and Summers G., "Detecting collusion in procurement auction", *Antitrust Law Journal*, 70(1), 143-170, 2002.

10 Porter R. and Zona D., "Detection of Bid-Rigging in Procurement Auctions", *Journal of Political Economy* 101 (1993), 518–538.

11 Case No COMP/M.4439, *Ryanair/Aer Lingus*, available at: http://ec.europa.eu/competition/mergers/cases/decisions/m4439_20070627_20610_en.pdf.

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