USING ECONOMIC EVIDENCE IN CARTEL CASES: A PORTUGUESE CASE STUDY

*Cristina Camacho/Jorge Rodrigues**

Abstract: *Sustaining the existence of a cartel solely on the basis of economic evidence is a difficult task. This fact has been highlighted in previous EU and national Court decisions, notably, because economic analysis may not always clearly distinguish between competitive and explicit collusive behaviors. However, economic evidence is quite useful in upholding cartel cases as a complement to other types of evidence. In this paper, we present a cartel case on the Portuguese wholesale market of salt, investigated and fined by the Portuguese Competition Authority, whose decision was later confirmed by the two review Courts. In this case, economic analysis allowed for an assessment of the effects that the conduct had on the national market, thus sustaining the infringement on the basis of both its object and effect on competition. More specifically, economic analysis sustained the existence of a substantial economic benefit obtained by the infringing parties as a result of the conduct. Moreover, this case highlighted the importance of presenting economic reasoning in an understandable but not less precise way to non-economists, in particular, to Judges.*

Summary: 1. Introduction. 2. Economic assessment of cartel cases. 2.1. Using economic evidence to assess the existence of a cartel. 2.2. Assessing the effects a cartel has on the market. 3. Case study: the Portuguese "salt cartel". 3.1. The PCA's Decision. 3.1.1. PCA's investigation and findings. 3.1.2. Object and effect of appreciably restricting competition. 3.1.3. Cartel's *modus operandi*. 3.1.4. Economic benefit. 3.2. First Instance Court (LCC)'s Decision. 3.3. Second Instance Court (LCA)'s Decision. 4. Final comments.

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* Cristina Camacho (Master in Law, ccamacho@concorrencia.pt) is Senior Legal Officer at the International Relations Bureau of the Portuguese Competition Authority and Jorge Rodrigues is Senior Economist (Ph.D., jrodrigues@concorrencia.pt) at this Authority's Economic Research Bureau. The views expressed herein are our own and do not necessarily reflect those of this Authority and respective Bureaus. We would like to thank our colleagues at the Bureaus as well as participants at the ZEW Conference on Quantitative Analysis in Competition Assessments (Mannheim, 21–22.10.2010) and at the Portuguese Competition Authority's external Seminar, of 06.12.2010, for helpful comments. All remaining errors are our own.

1. INTRODUCTION

Law and Economics have always been at the heart of competition assessment. However, over the past years, the complexity of economic analysis used in competition cases has increased. This trend is particularly visible in competition agencies' enforcement, as effects-based approaches are increasingly used instead of formal presumptions, thus implying a more frequent use of economic analysis. Therefore, competition proceedings often involve several economic studies presented both by the parties and by competition agencies, showing antagonizing theories about the same case. Frequently, it is for the Judge to decide which economic theory is more appropriate to assess a particular case.

Regarding this issue, Lianos (2010: 236) observes that "*the influence of economics is not only limited to the integration of economic concepts in law. Quantitative techniques may also be used in order to render these concepts operational*". However, there is no perfect match between legal and economic concepts, which poses challenges to all competition enforcers. As Italianer (2010) pointed out, referring to the European Commission, "*we ultimately have to prove our cases before a court. And when we prove our cases we do not do it to an economic standard, but to a legal one. The key point here is that we are in fact using economic analysis to support the construction of legally robust cases*".

It is often the case that Judges and Public Prosecutors do not have any research or economic staff to assist their assessment of economic analysis. This might be one reason why economic evidence[1] may be more difficult to succeed as the means of proof of antitrust cases, including cartels. A way to provide Judges further insight on economic analysis used in competition assessment is by the use of testimonial evidence and/or by the assistance of independent experts, as required by the parties or determined *ex officio*. In particular, through testimonial evidence, Judges may better comprehend the considered relevant facts underlying the economic methodologies used as well as the selection of these methodologies, along with their functioning, implementation, and obtained results.

However, the reason why economic evidence is not, in general, as well accepted as other means of proof in antitrust cases may go beyond the possibly limited economic insights from non-economist bodies such as Courts. In

1 We shall here and henceforth refer to "economic evidence" as the type of evidence resulting from economic or/and econometric type of analysis (see also section 2 below).

fact, it is well known that economic theory does not always provide a clear-cut distinction between competitive and explicit collusive behaviors unless there is additional evidence – complementary to the economic – sustaining that the market outcome would not be possible if the parties had not engaged in a cartel[2]. An example of this is the case of exchange of price information between petrol stations in French motorways, fined in 2003 by the French *Conseil de la Concurrence* as a collusion- facilitating practice whilst the French *Cour d'Appel de Paris* ruled that the evidence of an exchange of price information did not prove that the parties had reached an agreement (or engaged in an explicit collusive behavior).[3]

Instead, the use of economic evidence in antitrust cases is, in general, more well-accepted regarding the definition of relevant markets and the assessment of the effects resulting from antitrust conducts. In particular, in spite of the possible existence of direct or hard evidence (*e.g.*, testimonial or documentary) of antitrust conduct, economic analysis tools are required to infer the effects stemming from the conduct. Therefore, economic evidence proves useful in upholding antitrust or cartel cases, but more as a complementary type of evidence which sustain such conducts.

In this paper, we present a cartel case in the Portuguese wholesale market of salt, investigated and ultimately fined by the Portuguese Competition Authority (PCA) in 2006, and whose decision was upheld by the two review Courts in 2007. This case was proved on the basis of hard (documentary and testimonial) evidence, in which economic analysis allowed for an assessment of the effects that the cartel had on the national market, thus sustaining the infringement on the basis of both its object and effect on competition. More specifically, economic analysis sustained the existence of a substantial economic benefit the infringing parties obtained from the conduct. This was also quite relevant as, under national legislation, the economic benefit is one of the criteria for determining the concrete level of the fine. Moreover, this case highlights the importance of presenting economic reasoning in an understandable but not less precise way to non-economists such as Judges.

2 We shall in this paper refer to "cartel" or "(explicit) collusion" cases as all of the types of prohibitions prevailed in Article 101(1) TFEU.

3 See Press Release from the French *Autorité de la concurrence* regarding "*Décision du 31 mars 2003 relative à des pratiques sur le marché de la distribution des carburants sur autoroutes*", No. 03-D-17 (*cf.* http://www.autoritedelaconcurrence.fr/user/avisdec.php?numero=03-D-17).

The remainder of this paper is structured as follows. Following some theoretical considerations on the economic assessment of cartel cases (section 2), we describe the Portuguese salt cartel case in detail and how the use of economic evidence proved essential to sustain the effects this cartel had on the national market (section 3). We conclude with some final remarks (section 4).

2. ECONOMIC ASSESSMENT OF CARTEL CASES

Over the past years, the complexity of economic analysis used in competition cases has increased. This trend is visible not only in merger and state aid analysis, but also in antitrust proceedings, including cartel cases. More frequently than ever before, competition cases involve different economic studies submitted by the parties and by competition agencies, which often reach different conclusions on the same subject. Although antagonizing conclusions also arise from the legal litigation process itself, the major problem with economic issues lies in the general difficulty of non-economist bodies such as Courts to assess economic analysis.

In antitrust cases, including cartels, the proof of the infringement can be obtained either directly through hard or "smoking gun" evidence and/or indirectly through circumstantial evidence, including economic or communication evidence[4].

Communication evidence is related to the exchange of sensitive information (notably on quantities and/or prices) between the parties in order to coordinate their future behavior. Special types of communication evidence are the so-called "collusive facilitating practices", which include price signaling (*e.g.*, the case on petrol stations in French motorways) as well as the "most favored nation" and "meeting competition" clauses.[5]

As for economic evidence, it can be used in the assessment of a cartel case notably[6] *(i)* to assess the existence of such a conduct as well as the time it has lasted; *(ii)* as an *ex ante* screening device leading to the possible opening of a cartel investigation, if there is evidence that cannot dismiss the possibility of collusion in spite of the possibility that this evidence might also be in favor of a competitive-type of behavior; and *(iii)* during the cartel investigation as

4 See OECD, 2006: 2.

5 *E.g.*, Massimo Motta (2004: Chapter 4) for details.

6 We leave here aside the use of economic evidence in the *ex post* analysis of cartel cases, after they are duly fined by competition agencies and judged by the respective review Courts.

a device to infer the effects the conduct has on the market and on consumer welfare.

However, since economic evidence may lead to different interpretations more often than hard evidence, proving the existence of a cartel exclusively on the basis of economic evidence turns out to be a difficult task, in particular if the relevant market has a structure which favors parallel behavior (*e.g.*, the case of oligopolistic market structures with rather homogenous products). In such cases, it is a hard task for economic analysis to identify factors (the so-called "*plusfaktoren*" or "plus factors") which can *per se* dismiss the possibility that the observed parallel behavior can be explained by a competitive type of conduct.[7]

For this reason, the presentation of economic evidence before Courts poses several difficulties. Among these difficulties, we note: *(i)* the difficulty of choosing the appropriate economic (or econometric) methodology to rely on, all being subjective in nature and depending on some confidence probability; *(ii)* the inevitable harder litigation process between the parties and competition agencies that the use of such methodologies brings to Courts; and *(iii)* the difficulty of showing the results from these usually complex methodologies in an intuitive way before Courts[8].

To assist their assessment of economic analysis, Courts may opt for the use of testimonial evidence and/or the assistance of independent experts, as mentioned before.

In Portugal, the law foresees that the independent experts' technical, scientific, or artistic opinions are presumed to be outside the scope of free appreciation of the Judge and that Judges must duly justify their assessment whenever they disagree with the experts' opinion[9]. However, this restriction only applies to the expert technical opinion and not to the assessment of the facts on which that technical assessment is based. Therefore, Judges can reject any economic analysis if the underlying facts are deemed to be unfounded. Yet, we have no knowledge so far of a national case where an economic independent expert, in the herein described legal sense, has been called in

7 *E.g.*, Mariano Pego, 2007: 279.

8 Those difficulties are also acknowledged within Competition Agencies. In particular, the German *Bundeskartellamt* "Best practices for expert economic opinions", from October 2010, state that *"The Decision Divisions* [of the Bundeskartellamt] *consist of economists and non-economists. Expert opinions must therefore be comprehensible to a non-economist audience. An expert opinion should always include a non-technical summary* [...]".

9 See Article 163 (1) and (2) of the Penal Procedural Code.

proceedings dealing with an appeal of a PCA's decision. In practice, PCA's economic experts have testified in Court as witnesses.

However, on matters which may go beyond Courts' expertise, such as economic reasoning, the key issue lies on the ability of the parties, including competition agencies, to present their arguments in an intuitive but not less precise and rigorous way to Courts.

Whilst these problems can be considered irrelevant before the formal opening of a cartel case – or for the use of economic evidence as an *ex ante* screening device for the possible opening of such a case –, they become more acute during the case investigation, both on assessing the cartel's existence (subsection 2.1) and its effect on the (relevant) market (subsection 2.2).

2.1. Using economic evidence to assess the existence of a cartel

In the absence of other types of evidence, the exclusive use of economic evidence in assessing or sustaining the existence of a cartel is possible but riskier, as it must dismiss any other plausible explanation that the observed conduct may not emerge from a cartel, and may, also for this reason, prove insufficient to convince Courts. This issue has been clearly illustrated by the judgment of the famous "EC pulpwood case", where it has been ruled by the European Court of Justice (ECJ) that:[10]

> "*In determining the probative value of those different factors, it must be noted that parallel conduct cannot be regarded as furnishing proof of concertation unless concertation constitutes the only plausible explanation for such conduct. It is necessary to bear in mind that, although Article* [101 TFEU] *prohibits any form of collusion which distorts competition, it does not deprive economic operators of the right to adapt themselves intelligently to the existing and anticipated conduct of their competitors*".

Hence, economic evidence must show that the observed market outcome could not have been possible under a competitive market behavior. This is to say that this type of analysis must distinguish between the observed situation allegedly under a cartel and the unobserved market state in the absence of the cartel. This may require the identification of an *a priori* competitive counterfactual to the observed situation. However, unless this counterfactual

10 See Ahlström and Others v. Commission, Cases No. C-89/85, C-104/85, C-114/85, C-116/85, C-117/85 and C-125/85 to C-129/85, ECJ decision, 31.03.1993, § 71 (European Court reports 1993 Page I-01307).

is clearly defined, it must be inferred econometrically, thus being subjected to statistical uncertainty, which renders it more subjective in nature than other types of evidence.

Although some econometric methods allow, with a reasonable degree of certainty, to assess counterfactuals as well as the existence of the cartel and the periods it has lasted (*e.g.*, the screens methodology introduced by Abrantes-Metz *et al.*, 2006 and illustrated in Abrantes-Metz & Froeb, 2008), these methods often involve difficult technical issues and may rely on theoretical assumptions that may be difficult to justify on empirical grounds (*e.g.*, Chapsal & Spector, 2009). The "subjectivity" of the assumptions on which these methods rely implies a higher risk for competition agencies and parties in sustaining their analysis before Courts, especially if the market has always been characterized by (explicit) collusion.

In either case, the way these methods are selected and applied must be sufficiently convincing to overcome the litigation process and be accepted by Courts. Therefore, both competition agencies and firms face the challenge of presenting their economic analysis in an intelligible way in Court, without putting at risk the scientific robustness of the analysis.

2.2. Assessing the effects a cartel has on the market

Once there is proof of a cartel, the case can be successfully decided on the sole basis of its object (of a significant harm to competition), under EU and national competition law. In fact, since the effects of a cartel may be hard to quantify, there is solid EU and national decisional practice on cartel cases solely fined on the basis of its object.

If hard evidence is the strongest type of evidence in sustaining the existence of a cartel, only economic evidence can assess the effects stemming from the cartel. However, using economic evidence in such an analysis presents the same type of difficulties as the ones mentioned above, notably, on the determination of a counterfactual that mimics the market structure in the absence of the cartel. Accordingly, the use of economic evidence in addressing this issue is likely to require other complementary types of evidence.

The Portuguese "Salt Cartel" case[11] illustrates how economic evidence proved useful to determine unobservable effects the cartel had on the national

11 PCA's Antitrust Case No. 21/05, opened in March 2005 and decided in July 2006 (*cf.* PCA's Press Release No. 17/2006, of 17.07.2006, available at the PCA's website).

market and in a situation where this type of evidence was complemented with substantial hard (testimonial and documentary) evidence on the cartel's existence and *modus operandi*. The hard evidence that was collected during dawn raids and other fact-finding measures proved the existence of the cartel and was complemented with economic analysis to determine the effects the conduct had on the national market (see section 3 below).

In that regard, there are two effects-related concepts to be taken into account, namely those of "economic damage" and "economic benefit". The "economic damage" defines the cumulated effects stemming from the conduct on social welfare, whereas "economic benefit" is the part of economic damage which is captured by the infringing parties (the loss in producer welfare). Hence, the economic damage (loss in social welfare) equals the sum of the economic benefit and the loss in consumer welfare.

Theoretically, both the economic damage and the economic benefit are quantifiable, although the former is more difficult to quantify than the latter as it requires, in addition to the economic benefit, inferring and comparing the market structures between the unobserved situation in the absence of the cartel and the observed market state characterized by the illegal conduct.

In practice, however, part of the economic benefit may not be quantifiable. Hence, one can only hope to obtain an estimate of its real value, which is, in principle, lower than that of the (overall) economic damage.

Looking at the legal framework, the concept of "economic damage" is not explicitly mentioned in the Portuguese Competition Law (Law No. 18/2003, of 11th June, henceforth "PCL"), other than being possibly considered as an aggravating circumstance in the determination of the level of fines, either by itself or as one of the factors to be considered when assessing the infringement's gravity. On the other hand, the concept of "economic benefit" is expressly mentioned in the PCL as one of the criteria for determining the fine, as "[t]*he advantages that the offending undertakings have enjoyed as a result of the infringement*" (Article 44(b) of the PCL)[12], which is closely linked with the deterrent effect of fines[13].

12 At the EU level, the European Commission's Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003 state that "[...] *the Commission will also take into account the need to increase the fine in order to exceed the amount of gains improperly made as a result of the infringement where it is possible to estimate that amount*" (paragraph 31).

13 Davis & Garcés, 2010: 347.

3. CASE STUDY: THE PORTUGUESE "SALT CARTEL"

The Portuguese "salt cartel" was detected in mid-2005 and sanctioned by the PCA, in June 2006. Many lessons may be drawn from this case in Portugal for two main reasons:

(i) It was the first hard core cartel case to be assessed and upheld by the Lisbon Commercial Court (first instance Court, henceforth "LCC"), albeit with a reduction in the total fine, from €910,728 to €704,500, and whose decision was totally confirmed by the Lisbon Court of Appeal (second instance Court, henceforth "LCA"); and

(ii) It was the first cartel case with an assessment of the economic benefit the four infringing parties (firms) obtained from the agreement, which, according to the PCA, amounted to around € 5.2 million (€M 5.2).

This case's proceedings together with the two jurisdictional instances' judgments are summarized in greater detail hereafter.

3.1. The PCA's Decision

The PCA defined the relevant market as the wholesale of salt to the food distribution and industrial sectors in Portugal, which the cartel members termed "families" within their agreement. The geographic dimension of the market was mostly justified on the basis of transportation costs.[14] Apart from its importance to the food sector, salt (sodium chloride, *NaCl*) is an important raw material for several other industries (*e.g.*, construction, glass manufacturing, chemicals, and metalworking), and thus is a relevant input to economic activity in general.

3.1.1. PCA's investigation and findings

Following dawn raids and other evidence gathering actions, the PCA found hard (documentary and testimonial) evidence showing that, from about October 1997 to January 2005, four salt producers and wholesalers had been involved in a hard core cartel. In pursuance of this cartel, they held regular secret meetings in order to coordinate their commercial behavior, fixed target and/or minimum prices, agreed target sales quotas among themselves and

14 According to the EC, the wholesale of salt ranges from 400km to 800km around the distribution centres, delimiting, *in casu*, the geographic market to the national territory (*e.g.* EC Merger decisions IV/M.1522 – *CSME/MSCA/ROCK*, 11.06.1999, and COMP/M.2176 – *K+S/SOLVAY/JV*, 10.01.2002).

monitored the progress of the said collusive arrangements. These four firms controlled altogether a substantial part of the relevant market.

The agreement involved the wholesale of salt to two "families" of customers: the industry (family 1) and the general food distribution sector (family 2), the latter grouping, notably, general food distribution chains and the HORECA (hotels, restaurants, and cafés) channel.

3.1.2. Object and effect of appreciably restricting competition

The PCA concluded that the agreement had the object and the effect of significantly restricting and distorting competition in the whole national market, thus infringing competition law.

The cartel's duration (seven years, at least), its object of a significant harm to competition, and the proof provided by the PCA of a substantial economic benefit the infringing firms obtained from the agreement, necessarily, implied the cartel had also an effect of appreciably restricting competition. However, evidence only allowed for determination, on the basis of the cartel's *modus operandi*, of the minimal value of the economic benefit, and thus only part of the total economic damage to the market as a whole (subsection 3.1.4 below).

3.1.3. Cartel's *modus operandi*

The four firms established their target sales quota for the two families of customers (industry and food distribution) on the basis of their historical annual sales (in tons of salt)[15] over the period 1995-1997. In order to ensure the cartel's sustainability, the firms set a compensation scheme which imposed that, at the end of each year, firms whose (effective) realized annual sales exceeded their quota would pay compensations to those selling below their quota.

Compensations could be paid either in monetary value or in quantities. Both corresponded to a fixed monetary value for each ton of salt sold over the quota. That compensation value was set at €12,5/ton and €17,5/ton of salt sold to the industry (family 1) and to the food distribution sector (family 2), respectively.

The firms also engaged in a well-organized exchange of highly sensitive information scheme, whereby one of the firms was appointed as the

15 Except if otherwise mentioned, we shall here and henceforth refer to "sales" as expressed in quantities (volume), in tons of salt, *i.e.* in the way they were defined within the agreement.

"manager", collecting, processing and distributing among themselves sensitive information, mostly on monthly volumes of sales. The "manager" would report the evolution of total sales from the four firms, discriminated between families 1 and 2, the difference between the firms' actual and agreed quota sales, and the respective compensations.

3.1.4. Economic benefit

The substantial amount of documentary evidence that was collected during the investigation, including the dawn raids, allowed for the determination, in a simple and strongly intuitive manner, of the minimal value of the economic benefit the cartel members obtained from their agreement, over the period 1998-2004 (see Appendix for details).

From the time the agreement lasted (during 7 years at least), it was possible to conclude that at the end of each year, a firm selling below its quota would obtain an economic benefit, at least, equal to the value of its compensation. Reciprocally, firms exceeding their quota would enjoy from the cartel a unitary economic benefit (per ton of salt) equal to, at least, the amount they paid as compensation for each ton of salt sold above their quota. Therefore, firms selling above their quota obtained an economic benefit at least equal to what they got from their increased sales (above their quota) discounted by the compensation they paid to the remaining cartel members.

On the basis of the four firms' total sales and the amount of compensations paid and received, the PCA concluded that the four firms obtained, altogether, from the agreement a minimal economic benefit equal to around €M 5.2 during the seven years period 1998-2004.

3.2. First Instance Court (LCC)'s Decision

Following the appeal of the PCA's decision by the addressees, the LCC upheld most of the PCA findings, including the proposed methodology to evaluate the economic benefit, dismissing an alternative methodology proposed by one of the cartel members, albeit with a reduction in the amount of the fine.

Regarding the economic methodology used, the LCC engaged in a critical and thorough analysis of both the economic model used by the PCA to assess the economic benefit value as well as the underlying facts. The LCC further assessed the correctness of the PCA calculations, in order to make its own decision, which shows that the Court adhered to the PCA methodology.

Although the LCC dismissed the PCA finding on the concrete economic benefit value,[16] it upheld the PCA methodology, by stating that:[17]

> "*The PCA departs from two evident premises* [...] *It is thus safe to state* [as claimed by the PCA] *that between the minimal value of the economic benefit and the compensation value there is a direct cause-effect relationship* [...] *Therefore, those who pay compensations* [by exceeding their quota] *have an economic benefit, at least, equal to the total amount of compensations they paid*" (*cf.* Judgment, pp. 97 and 100), and "*if* [the firm which paid compensations] *endured, during seven years, in an agreement which forced it to pay annual compensations to the other parties* [...] *that is because what* [it] *paid* [as compensations] *allowed it, even in that way, to gain in a market whose underlying uncertainty was strongly limited by the agreement, being certain that such limitation cannot be dissociated from the obtained gains*" (*see* Judgment, p. 100).

Moreover, in consonance with the PCA, the LCC considered irrelevant for reducing the economic benefit value the fact that the cartel members had not effectively paid due compensations, concluding that:

> "*In fact, when not effectively paying due compensations, the infringing party has an additional economic benefit: it obtains the agreement's benefits increased by the amount it should have paid but did not*" (*cf.* Judgment, p. 101).

The economic analysis related to economic benefit calculation was presented in Court (LCC) by the PCA, not only through its written reply to the firms' appeal (which contained a further economic analysis proposed by one of the defendants, counter-arguing the PCA's economic benefit methodology), but also by means of testimonial evidence of PCA economic experts. PCA experts presented economic reasoning in a complete but intuitive way, resorting to a simplified, although not less rigorous, language.

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16 First, the LCC did not consider the economic value for 2004 and second, according to the Court, the PCA should not have updated, as she did, the economic benefit value to current prices of the last relevant year (2004), by using the general inflation index cumulated over the period 1998-2004.

17 Only the Portuguese version of both the two Instances' decisions is available and authentic. Translations are our own.

3.3. Second Instance Court (LCA)'s Decision

In its decision of 7 November 2007, the LCA confirmed the first instance's decision, corroborating, in particular, the reasoning behind the PCA methodology to calculate the economic benefit. In particular, on this latter, the LCA stated that:

> "*In what concerns the existence and value of the economic benefit (if the latter cannot, at least in part, be considered a factual finding and is, for that reason, not subtracted from this court's assessment), it must be noted that the amount received as a compensation by the parties selling below their quotas* [...] *effectively represents a benefit (the minimal benefit, as stated in the* [first instance's] *judgment* [and in the PCA decision]*) which those parties would not have received if the cartel would not have been constituted. Therefore, that benefit must be considered as a factor in the determination of the fine.*" (*cf.* Judgment, p. 40)

The LCA thus points out the extent to which the assessment of economic evidence may go beyond the factual scope. This allows it, in case of appeal, to be subject to the additional legal assessment of a second jurisdictional instance, although the LCA did not deliver a conclusive answer on this issue.

4. FINAL COMMENTS

The enforcement of competition law is intertwined with economic analysis, which is increasingly complex in all areas. Therefore, although economic evidence might not always be successful in Courts, there is a clear trend for the assessment of competition cases and the respective appeals before the Courts to rely increasingly on economic analysis. Because Judges and Public Prosecutors, like other legal experts in general, may still lack, in more complex cases, sufficient economic expertise to clearly decide on which type of economic evidence to rely on, the challenge for competition agencies and appealing parties is to present economic reasoning in a sufficiently simple and intuitive, but not less precise and rigorous way in Court.

The fact that lawyers and economists work as a team within competition agencies has undoubtedly contributed to a better mutual understanding of each other's thinking and scientific languages. In Portugal, this experience has produced positive results, as shown by the salt cartel case. The salt cartel case is an important example which demonstrates that the use of economic evidence may be successful in Courts. Indeed, the simplified language and

the strong underlying intuition of the used economic analysis have been, perhaps, the main reasons why this case was so well accepted by the two Portuguese review Courts of competition cases. Nevertheless, the underlying intuition of this case's economic analysis was only possible given the substantial information that was collected during its investigation. Without such information, perhaps a more complex econometric methodology would have been required, the explanation of which might not have been of such an intuitive nature.

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APPENDIX – MATHEMATICAL PROOF OF THE ECONOMIC BENEFIT IN THE PORTUGUESE "SALT CARTEL" CASE

Given the evidence provided by the case proceedings, on:

(i) The four cartel members' effective annual sales (in tons of salt), denoted by q_i for firm i, over the period 1998-2004;

(ii) The four firms' target sales quota, denoted by q_i^* for firm i, discriminated between the two families of customers (industry and food distribution), that each firm should satisfy at the end of each year;

(iii) The unitary compensation value (k), discriminated between the two families of customers; and, finally, the fact that

(iv) At the end of each year, firm i pays a total compensation (in €) equivalent to $k(q_i - q_i^*)$ in case she sells above her quota ($q_i > q_i^*$) or receives that same amount in case she sells below her quota ($q_i < q_i^*$),

It was straightforward to show that the minimal value of the economic benefit (henceforth "EB") each firm got from the cartel differs depending on whether a firm sells above or below her quota, being favorable to firms selling above their quota. Whilst a firm selling below her quota, gets always the compensation value (her minimal EB), a firm selling above her quota benefits from her increasing sales (above her quota) discounted by the compensation she pays to the remaining cartel members. Since this firm knows that she must pay compensations to the remaining cartel members, this implies that what she receives from selling above her quota must be more than enough for her to be willing to pay the compensation for the remaining cartel members. We prove how hereafter.

As referred in the text, from the collected information on the four firms' sales during the time the cartel lasted and the respective compensation values, it was possible to compute the minimal EB value, which, when cumulated across all the four infringing parties, amounted to around €M 5.2 during the seven years period, 1998-2004.

Consider, first, the determination of the unitary EB in a given year, denoted by m_i for firm i (*i.e.*, the unitary margin firm i obtained from the cartel in addition to what she would have obtained absent the cartel). Theoretically, m_i equals the mark-up differential between the observed antitrust behavior

(cartel) and the unobserved state of a competitive market (in oligopoly) absent the cartel.

Given the time the agreement lasted, during at least a seven years period (1998-2004), should there had been no compensation scheme, firm i would have got a total (annual) EB equal to $m_i q_i$. Given compensations, this latter amount is increased by $k(q_i^* - q_i)$ in case she sold below her (target) quota and cut by $k(q_i - q_i^*)$ in case she exceeded her quota. Mathematically, this means that the (annual) EB is, in general, given by:

$$EB_i = m_i q_i - k(q_i - q_i^*), \tag{1}$$

In case firm i satisfied her quota ($q_i = q_i^*$), she would not have received or paid any compensation and had thus:

$$EB_i^* = m_i q_i^*; \tag{2}$$

Firms selling below their quota always received, at least, the compensation $k(q_i^* - q_i)$, albeit not selling ($q_i = 0$). Such firms had thus always an incentive to cooperate *i.e.*, to sustain the agreement.

Yet, *ab initio* when setting the agreement and at the beginning of each year, cartel members ignored how the market would have cleared at the end of the year and thus whether they would have met their quota, *i.e.* whether or not they would have had to pay a compensation. Therefore, the existence and the sustainability of the agreement (during, at least, seven years) implied that the benefit each cartel member got by exceeding her quota covered, at least, the benefit she would have obtained should she had satisfied her quota.

In other words, expressions (1) and (2) above must, at least, be equal, namely:

$$[m_i q_i - k(q_i - q_i^*)] \geq m_i q_i^*; \tag{3}$$

i.e.,

$$(m_i - k)(q_i - q_i^*) \geq 0, \tag{4}$$

Given that, as afore referred, this constraint only mattered for firms exceeding their quota ($q_i > q_i^*$), expression (4) was satisfied for these firms if and only if,

$$m_{(q>q^*)} \geq k, \tag{5}$$

In other words, a *sine qua non* condition for the agreement to last (as it has lasted), *ab initio* when it was established (in October 1997) and *a posteriori* given its duration (up to January 2005), was that the EB each firm retrieved from one ton of salt (*m*) covered, at least, what she was prepared to pay as compensation (*k*) for that same quantity (in case she exceeded her quota).[18]

Given the result in (5), it follows from expression (1) above that the EB a firm exceeding her quota retrieved from the cartel was, *at least*, equal to:

$$EB_{(q>q^*)} = kq_i - k(q_i - q_i^*) = kq_i^*; \tag{6}$$

Whilst result in (2) above ensures that $m_i > 0$ (for all i), as a firm selling below her quota received always, at least, the compensation, it is irrelevant for her the way her m_i is determined. In other words, whilst result in (5) above holds for firms exceeding their quota, firms which sold below their quota might have an unitary EB (*m*) satisfying the condition "$0 < m_i < k$", the EB they retrieved from the cartel would always be, at least, equal to the value of their compensation, namely

$$EB_{(q<q^*)} = k(q_i^* - q_i), \tag{7}$$

Q.E.D.

18 It might be argued that in order to ensure the cartel's sustainability, optimally *m* should equal *k*. However, it is not plausible that a cartel member would accept to only get from the agreement exactly what it would have paid as compensation for each ton of salt sold above its quota (*m* being the unitary EB, for each ton of salt sold).