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Introduction

The positive effects of competition have long been recognized and have been confirmed both theoretically and empirically. Competition can deliver benefits to economic growth and consumer welfare and boost productivity through a more efficient allocation of resources and by pushing managers to intensify their efforts. In turn, effective Competition Policies have a critical role in creating a competitive, adaptable and dynamic business environment in which markets deliver maximum productivity growth as well as maximum benefits to consumers in terms of low prices, high quality products and services and innovation.

Economists have been involved a lot in recent years in considering issues of enforcement of Competition law and how enforcement can become more effective, such as legal standards, substantive standards, penalties etc. This dissertation, contributes to the above by examining two important dimensions of the enforcement of Competition law: (i) fines and (ii) the requirement of extant market power in forming a presumption that unilateral firm actions or mergers may lead to social harm. Particularly, we study some key issues concerning the calculation of optimal fines by Competition and Regulatory Authorities (Chapter 2), we introduce a new methodology for setting fines (Chapter 3) and we examine the effects of exclusion in abuse of dominance cases with product differentiation and how they depend on the source of market power (Chapter 4). At the end of each chapter we give the conclusions relating to each of the main essays.

Briefly the structure of this thesis is as follows. Chapter 1 serves as an introductory note and presents an extensive review of the economic theory of competition law enforcement and antitrust penalties. Initially, we consider the relevant literature and summarize the basic approaches that led to the introduction of economic analysis in criminal law in general, and then we concentrate on competition law in particular. We continue by presenting the antitrust legislation adopted by the United States and the European Union and examine their enforcement regime. We then describe in detail the methodology used for calculating fines by the major competition authorities in the US and

EU. Finally, we present a number of alternative approaches that challenge the present methodology of calculating fines and suggest new ways to achieve a more efficient enforcement of competition law while minimizing social welfare loss.

Chapter 2 addresses the highly debated issue among antitrust practitioners on how competition authorities (CAs) should set fines and how they actually do so in practice. In most jurisdictions, antitrust fines are based on affected commerce rather than on collusive profits, and in some others, caps on fines are introduced based on total firm sales rather than on affected commerce. We uncover a number of distortions that these policies generate, propose simple models to characterize their comparative static properties, and quantify them with simulations based on market data. We conclude by discussing the obvious need to depart from these distortive rules of thumb that appear to have the potential to substantially reduce social welfare.

Chapter 3 proposes a simple new quantitative methodology that can be used to determine optimal fines, taking into account both restitutive and dissuasive elements. The methodology is used to derive simple formulas on the basis of which an Authority can derive optimal fines, or the likely range of such fines, using information on the price overcharge caused by an action, the intensity of competition in the but-for situation, the size of efficiencies and a large number of other considerations that authorities take into account when setting fines. These considerations include the size of the detection rate, decision errors, desistance and various other aggravating and mitigating factors.

Chapter 4 studies the role of the size of extant market power as a predictor of the size of the reduction in welfare generated by anticompetitive actions. In particular, we concentrate on monopolization or abuse of dominance cases in which an exclusionary action by the dominant firm eliminates one of the rival firms. We emphasize the point that the source of market power is important in understanding how changes in the size of extant market power affect the size of the reduction in welfare, distinguishing between Consumer Surplus and Total Welfare, generated by anticompetitive actions. We also discuss the relationship between the degree of extant market power and market share and the extent to which market share can be a reliable indicator of the change in welfare induced by anti-competitive conduct.

Chapter 1

Review of the Economic Theory of Competition Law Enforcement and Antitrust Penalties

1.1. Introduction - Relevant Literature

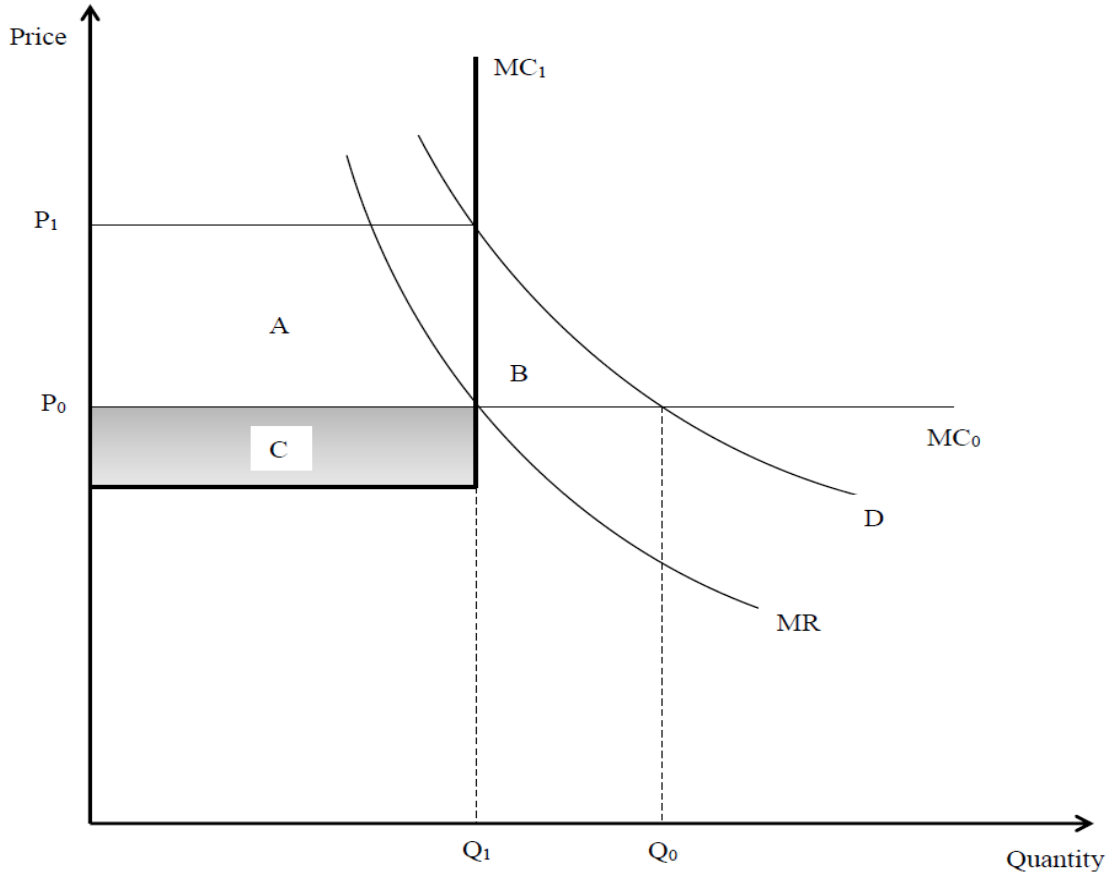
Although the starting point of the economic approach to law is detected long before the 1960s, the connection between the two took several years to be institutionalized. Gary Becker, by publishing his famous work "Crime and Punishment: An Economic Approach" in 1968, was the first who used the theory of economic science in the analysis of criminal law. In his article, Becker, shows that when the cost of enforcement is positive the optimal enforcement procedure is the one that does not eliminate all the offenses. In fact he proves that even in the case where the cost of enforcement is zero, we still do not want to deter all infringements and that's because some offenses are likely to be "cost efficient", i.e. the profit enjoyed by the offender is greater than the harm caused to the victim. In light of the above, Becker examines what should be the amount of resources that will be used and how strict a punishment should be in order to properly enforce different kinds of legislation. Finally, he notes that our objective should be to minimize the loss of social welfare considering the cost of detecting and punishing the offenders as well as the damage caused by the offenses.

In order to explain more thoroughly the above let us assume that all potential violators will enjoy benefit equal to *"B"* if they commit the offense and will face a cost due to law enforcement. If the person or entity committing the crime (or, more generally violation/offense) is neutral towards risk then the cost is equal to the probability of

detection and enforcement of punishment (p) multiplied by the cost of punishment (C). Therefore, the expected profit from the offense equals B-pC and obviously the offense will only take place if it is positive. Becker, ultimately concludes that an optimal fine equals the net loss caused to others (other than the offender) multiplied by the inverse of the probability of the fine being imposed.

Complementing Becker's approach and extending it under a competition law framework, Landes (1983), argues that the key to the calculation of optimal fines is the assessment of offenses as cost – efficient or not. In order to illustrate his concept Landes presents a simple example. In a diagram similar to Diagram 1.1, he denotes the marginal cost as MC_0, which is considered constant and equal to the supply curve under competitive conditions. The competitive output is given by Q_0 and the respective price by P_0. Then he assumes that a cartel is formed (although the analysis is similar for other competition law infringements) which reduces the output to Q_1 and increases the price to P_1. He further assumes that the cartel, or other anti - competitive practice, imposes a loss in social welfare (deadweight loss) equal to \$50 (area *"B"*) and generates profits as a result of the price increase (aggregate overcharge) equal to \$100 (area *"A"*). Therefore, the total loss for consumers will be equal to \$150, i.e. the sum of the above two. The rationale behind the designation of a cartel as illegal is not the very high price it charges or the redistribution of income from consumers to the members of the cartel, but the fact that it restricts output causing social welfare loss (area *"B"*). To prevent this loss penalties should be imposed on members of the cartel such as to deter their formation. For convenience we assume that all parties are risk-neutral, all enforcement costs are zero, the fine is pecuniary and the probability of detection and conviction constant and equal to one.

Diagram 1.1



Given the above assumptions a possible penalty would be equal to the loss of social welfare, i.e. $50. This is because, since enforcement costs are zero and the penalty is certain, the offender will be required to pay an amount exactly equal to the loss of social welfare caused by its conduct. However, in this context, despite the penalty, it may still be profitable to form a cartel. In the above example a penalty equal to $50 would be too low since firms could recap from the $100 cartel profits. An alternative approach could be to assume a very high penalty, many times greater than the loss of social welfare. For example, a $10,000 penalty would deter firms from forming cartels in order to gain $100. However, deterrence alone is not the aim. The purpose of penalties, as argued by Landes following Becker's model of crime and punishment, should not be simply to deter any offense but the prevention of inefficient offenses.

To explain further and generalize the above example, assume that the cartel has the potential to reduce production costs and may do so only by restricting output. Returning to Diagram 1, we assume now that MC_1 is the marginal cost of the cartel. Note that MC_1 is below MC_0 until the output Q_1 and at this point the marginal cost curve of the cartel becomes perfectly inelastic. In this case the additional benefit for the cartel from the cost reduction is equal to *"C"*. If *"C"* is greater than \$50, this implies that the infringement is economically efficient because the benefit it provides to the members of the cartel due to the cost reduction is greater than the social welfare loss it generates. If for example we assume that *"C"* equals \$51 the net gain for the cartel is \$1 (if the fine is 150). Now if we add *"C"* and the price overcharge (*"A"*), we have that the cartel's total gain is \$151 and therefore a fine greater than this amount will deter its formation. However, as mentioned above, this would be inefficient as it would deter the creation of a cartel which is beneficial (in terms of social welfare). Similarly, if *"C"* was equal to \$49 a fine of less than \$150 would be inefficient. This is because if, for instance, we assume a fine equal to \$148, this implies that firms will choose to form a cartel (\$149 profit minus \$148 fine leaves the cartel with a net gain of \$1). In this case, however, the social welfare loss is greater than the cost savings due to the cartel (\$50 > \$49) and therefore the offense is deemed inefficient.

Landes concludes that the optimal fine should be equal to the total consumer's loss (in this example, \$100 due the price increase plus \$50 social welfare loss). Therefore, the cartel would only take place if the gain to the offender is greater than the harm to others and would be deterred only if the gain is less than the net harm to others.[1]

A more recent article which is based on Becker's findings is that of Polinsky and Shavell (2000). The purpose of their article is to answer the following questions: what is the optimal amount of society's resources that should be used to detect and punish offenders, whether we should define the liability of the offender objectively (strict liability) or subjectively (fault-based liability), and, finally, what form of sanction should be used, a fine, imprisonment, or a combination of the two? The last question will not concern us in this analysis as we, mainly, refer to monetary fines.

[1] Landes, William M. (1983).

Polinsky and Shavell, in line with the above, assume that an infringement will take place if the offender's expected utility from the unlawful conduct, given the probability of being caught and sanctioned, is greater than his utility if he does not commit the offense. Whether an offender who has been detected will be sanctioned depends on the rule of liability. In the case of strict liability, penalties are imposed regardless of the behavior and intent of the infringer. For example, a firm that pollutes the environment can be considered guilty even if it had taken all necessary precautions to prevent the accident. On the other hand, under fault based liability, penalties are imposed only if the offender's conduct is considered socially undesirable.

Assuming that:

g = the gain obtained from engaging in the unlawful conduct

p = the probability of detection and

f = fine

Polinsky and Shavell conclude (similar to Becker) that, in the case where we have strict liability and assuming that the potential offender is risk-neutral, in order for the wrongdoer to commit the offense the gain from the infringement must be greater than the expected fine i.e. $g > pf$. In the alternative case where the offender is risk-averse the gain from the infringement should be greater than before in order to commit the offense.

Under the assumption of fault-based liability the results vary slightly. As mentioned above an offender in this case is held liable only if his conduct is considered socially undesirable. Alternatively according to Polinsky and Shavell the offender will be held liable if he committed the harmful act when his gain was relatively low. This sets a benchmark *"$\hat{g}$" (fault standard)* such that if a potential wrongdoer committed an offense when the benefit is less than *"$\hat{g}$"* he would be found liable, otherwise he will be considered innocent. Therefore, when the gain is greater than or equal to *"$\hat{g}$"*, the offender will undertake the action as he will not be held liable. In the opposite case where the gain from the violation is less than *"$\hat{g}$"*, if detected, he will be considered liable and thus he will engage in the infringement if and only if $g > pf$, as above.

Polinsky and Shavell, also incorporate in their study the factor of social welfare and note that it is not directly affected by the level of the fine, as they assume that fines don't lead to social costs. It is, however, affected indirectly since the fine by definition specifies who will commit each infringement, as it defines the gain that may accrue to the offender if he would engage in a harmful activity. With appropriate calculations, Polinsky and Shavell, conclude that the optimal fine is equal to the ratio of the net harm from the infringement to the probability of detection. Alternatively the expected fine is equal to the net harm. This conclusion holds for both liability cases, strict and fault-based, and is in accordance with Landes' results.[2]

The relevant literature, as seen above, clearly sets the basic principles on which antitrust enforcement and the calculation of antitrust penalties should be based, however, the current fining policy adopted by most jurisdictions is not always consistent with those principles. This is the reason a number of alternative approaches have recently emerged in articles concerning the theory of antitrust enforcement and optimal penalties. In line with that tendency this thesis provides such alternative approaches. But first let us present the current antitrust legislation and its enforcement by the major competition authorities in the US and EU, as well as the fining policy that is currently adopted.

1.2. Competition Law Enforcement

Depending on the legal framework in which we refer to, the enforcement of competition law varies.

[2] Polinsky, Mitchell, and Shavell, Steven (2000).

1.2.1. United States

Modern competition policy started in 1890, when the US federal government passed the Sherman Act, aimed at stopping the anticompetitive behavior of cartels. More specifically, the Sherman Act prohibits anticompetitive practices and attempts at monopolization. Section 1 of the Act prohibits: "Every contract, combination in the form of trust of otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations". Section 2 of the Sherman Act states that it is illegal for any person to "…monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations….". These sections contain the two central key principles of modern antitrust policy.

Since the Sherman Act lacked provisions on mergers, the federal government passed the Clayton Act in 1914. More specifically, section 7 of the Clayton Act is the principal statute for governing merger activity. Other sections of the Clayton Act address particular types of conduct. Section 2, which was amended and replaced by Section 1 of the Robinson-Patman Act in 1936, prohibits practices such as price discrimination and Section 3 of the Clayton Act prohibits exclusive dealing arrangements and "tied" sales.[3] The Clayton Act was most recently amended by the Hart-Scott-Rodino Antitrust Improvements Act of 1976, which requires firms planning significant mergers to notify the government in advance. Generally, since their inception, these acts have been amended repeatedly, but remain the source of US antitrust policy.

The US is nearly unique among competition law countries in having two enforcement agencies, the Federal Trade Commission (FTC) and the Department of Justice (DOJ). In some respects their authorities overlap, but in practice the two agencies complement each other. Over the years, the agencies have developed expertise in particular industries or markets. For example, the FTC is responsible for consumer protection issues, whereas criminal violations of Sect. 1 of the Sherman Act (e.g., price fixing) are the

[3] Rubinfeld, Daniel L. (2001)

responsibility of the Antitrust Division of the DOJ. Before opening an investigation, the agencies consult with one another to avoid duplicating efforts.

An in-depth discussion of competition issues can be found in the *Guide to the Antitrust Laws* provided by the FTC's Bureau of Competition and as long as the first Section of the Sherman Act is concerned the FTC and DOJ, also, published, in 2000, detailed *Antitrust Guidelines for Collaborations among Competitors*. According to these guidelines, nowadays, competitors interact in many ways, through trade associations, professional groups, joint ventures, and other industry groups and such dealings often are not only competitively benign but procompetitive. However, there are antitrust risks when competitors interact to such a degree that they are no longer acting independently, or when collaborating gives competitors the ability to wield market power together. Certain types of agreements are so likely to harm competition and to have no significant procompetitive benefit that once identified, they are challenged as per se illegal. Such types of agreements include agreements among competitors to fix prices or output, or market allocation agreements. All other agreements are evaluated under the rule of reason. Rule of reason analysis examines the situation where the agreement exists, as compared to the counterfactual situation where the relevant agreement is absent. The Agencies' analysis begins with the examination of the nature of the agreement. In some cases, the nature of the agreement and the absence of market power together may demonstrate the absence of anticompetitive harm. In such cases, the Agencies do not challenge the agreement. If the initial examination of the nature of the agreement indicates possible competitive concerns, but the agreement is not one that would be challenged without a detailed market analysis, the Agencies analyze the agreement in greater depth. They typically define relevant markets and calculate market shares and concentration as an initial step in assessing whether the agreement may create or increase market power. Furthermore, the Agencies examine the extent to which the participants and the collaboration have the ability and incentive to compete independently. Finally, they evaluate other market circumstances, e.g. entry, that may foster or prevent anticompetitive harms. If the examination of these factors indicates that there is no evidence for anticompetitive harm, the Agencies end the investigation without considering if procompetitive benefits exist. If, on the other hand, investigation indicates anticompetitive harm, the Agencies examine whether the relevant

agreement can achieve procompetitive benefits that likely would offset the anticompetitive harms.[4]

Section 2 of the Sherman Act, as already mentioned, deems as unlawful any attempt to monopolize trade or commerce. However, most Section 2 claims involve the conduct of a firm with a leading market position (dominant firm). As the FTC's *Guide to Antitrust Laws* clearly states, the first step in investigating cases that fall under Section 2 of the Sherman Act is for the courts to ask if the firm has "monopoly power" in the market. This requires the examination of the firm's products and the alternative products consumers may turn to if the firm attempted to raise prices. In order to assess the firm's market power courts look at the firm's market share, but typically do not find monopoly power if the firm has less than 50 percent of the sales of a particular product or service within a certain geographic area. Some courts have required even higher percentages. In addition, that leading position must be sustainable over time. In the next step, when monopolization cases are concerned, courts ask if that leading position was gained or maintained by exclusionary or predatory acts. In abuse of dominant cases the relevant question is whether the dominant firm had abused its market power. This means that only abuses of dominant positions can be declared illegal and not dominance per se.

Finally, for mergers and acquisitions cases that substantially lessen competition, or tend to create a monopoly, the FTC's *Guide to Antitrust Laws* provides a "Merger Review Process". According to this, the application of Section 7 of the Clayton Act generally requires the determination of the product and geographic dimensions of the relevant market. A product market consists of all goods or services that buyers view as close substitutes, while a geographic market is the area where customers would likely turn to buy the goods or services in the product market. After the determination of the relevant market the Agencies examine the competitive effects that may rise due to the acquisition and whether the acquisition will create or enhance market power.

[4] FTC & DOJ, Antitrust Guidelines for Collaborations among Competitors (2000).

1.2.2. European Union

In Europe, the Treaty of Paris, signed in 1951, gave birth to the EU competition policy. The Paris Treaty establishing the European Coal and Steel Community (1952) contained provisions regarding cartels, concentrations (mergers), and abuse of dominant position by firms. The next step, which laid the foundations of European Community competition was the signing of the Treaty of Rome in 1957. The Treaty of Rome aimed at ensuring that competition in the internal market was not obstructed by anticompetitive behavior of firms or national authorities and it contained provisions on anticompetitive agreements (Article 85) and abuse of dominant position (Article 86).[5] Due to their broad nature, the provisions were left to interpretation by the European Commission, under supervision of the European Court of Justice. Articles 85 and 86 of the EEC Treaty have since been renumbered Articles 81 and 82 of the EC Treaty by virtue of the Maastricht Treaty (or Treaty on European Union), with effect from 01.11.1993, and Articles 101 and 102 of the TFEU (Treaty on the Functioning of the European Union) by virtue of the Treaty of Lisbon signed on 13.12.2007 and entered into force on 01.12.2009. Control of mergers was introduced into European Community law only in 1989 with the Merger Regulation (revised in 2004).

These prohibition rules are applied, as already mentioned, by the European Commission who, also, enjoys a number of investigative powers and can impose fines on undertakings that violate EU antitrust rules. The commission in order to set out the enforcement priorities that will guide its actions in applying Articles 101 and 102 TFEU, publishes Guidelines to provide greater clarity and predictability and to help undertakings better assess whether certain behavior is likely to result in intervention. Article 101, as mentioned above, prohibits agreements and concerted practices aimed at lessening competition within the common market. In particular, it prohibits price fixing, market allocation, output restrictions and tie-in sales. Such agreements and decisions are automatically void, under Article 101(2), when the pro-competitive effects do not outweigh the restriction of competition. Paragraph 3 defines the situations in which agreements,

[5] Erbach, Gregor (2014).

decisions and concerted practices can be accepted: a) if they improve the production or distribution of a good or promote technical or economic progress; b) if consumers receive a share of the resulting benefits; c) if the restrictions imposed are indispensable to the attainment of these objectives; d) if the firms concerned do not have sufficient market power to restrict competition in the product market. The degree of market power required for the finding of an infringement under Article 101(1) in the case of agreements that are anti-competitive is less than the degree of market power required for a finding of dominance under Article 102, where a substantial degree of market power is required.[6]

Article 102 applies to undertakings which hold a dominant position on one or more relevant markets. Therefore, the first problem in such cases is the assessment of whether an undertaking is in a dominant position and of the degree of its market power. The existence of a dominant position is evaluated on the basis of several structural variables, such as the firms' market shares, the nature of entry and exit barriers, etc. According to the 2009 Commission's Guidelines, market shares provide a useful first indication of the market structure and of the relative importance of the various undertakings active on the market. The Commission's view is that the higher the market share, and the longer the period of time over which it is held, the more likely it is to be a preliminary indication of dominance.[7] Low market shares, on the other hand, can generally be considered as a good proxy for the absence of substantial market power. The Commission's experience suggests that dominance is not likely if the undertaking's market share is below 40% in the relevant market.[8] However, since being in a dominant position is not in itself illegal, the next step, in cases that fall under Article 102, is to determine whether the dominant firm abuses its position. Abuses are commonly divided into exclusionary abuses, which scope is to exclude competitors from the market, and exploitative abuses, where the dominant firm exploits its market power by, for example, charging excessive prices. For price based conducts, to be considered abusive, a conduct should risk the exclusion of an equally efficient competitor.

[6] Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2010).
[7] Competition: Antitrust procedures in abuse of dominance, EC factsheet (2013).
[8] Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings (2009).

Finally, the main legislative texts for merger decisions are the EC Merger Regulation and the Implementing Regulation. The Merger Regulation contains the main rules for the assessment of concentrations, whereas the Implementing Regulation concerns procedural issues (notification, deadlines, right to be heard, etc.). While undertakings combining forces can expand markets and bring benefits to the economy, some combinations may reduce competition. Mergers, especially when they are horizontal in structure, may reduce competition in a market, usually by creating or strengthening a dominant player. This is likely to harm consumers through higher prices, reduced choice or less innovation. All proposed mergers notified to the Commission are examined to see if they would significantly impede effective competition in the EU. More specifically, if the merging firms are not operating in the same or related markets, or if they have only very small market shares not reaching specified market share thresholds the merger will typically not give rise to significant competition problems. The merger review is therefore done by a simplified procedure, involving a routine check. Above those market share thresholds, the Commission carries out a full investigation.[9]

Although both of the above legal frameworks (US and EU) share similar aims, however, there are a number of significant differences. First and foremost, the EU has an administrative system for antitrust enforcement, in which companies are penalized with fines, while, in contrast, US antitrust enforcement is based on criminal law, with financial and custodial penalties against individuals. Furthermore private enforcement plays a greater role in the US system. Other differences can be viewed when we examine more thoroughly the exact methodologies of setting fines by the major competition authorities in the United States and European Union. Bellow we present in detail those fining policies for each of the above competition authorities.

[9] Competition: Merger control procedures, EC factsheet (2013).

1.3. Fining Policy

1.3.1. United States

The primary antitrust statute that carries criminal sanctions in the US antitrust legislation is the Sherman Act, while the consulting tool for the determination of the appropriate form and severity of punishment for offenders is the US Sentencing Guidelines (USSG) published by the US Sentencing Commission (USSC). According to these guidelines, both pecuniary and non-pecuniary penalties may be imposed to the offenders: fines on firms and individuals, as well as imprisonment of individuals. The Guidelines address only horizontal agreements and do not provide recommendations on sentencing for other types of antitrust offenses.

With regard to fines on firms, the process of their assessment begins with the calculation of a base fine. To determine the base fine, a percentage of the volume of affected commerce, i.e. of total sales from the relevant market, is taken into account. The USSG suggests that 20% of the volume of affected commerce can be used as a good proxy. This percentage is considered to reflect the losses from the infringement, as the average gain from price-fixing is estimated to be around 10% of the selling price. The USSC doubled the 10% estimate to account for the harm to consumers that are unable or for other reasons do not buy the product at the higher price.[10] This calculation mechanism of the base fine saves resources by courts which do not need to determine the exact benefit or the exact loss. Once the amount of the base fine has been calculated, aggravating and mitigating elements are taken into consideration. For this purpose, a culpability score is calculated based on the number of employees, involvement of high-level officials, prior history of violations, any obstruction of justice, cooperation and acceptance of responsibility, etc. This culpability score is used to determine minimum and maximum multipliers which are applied on the base fine to determine the fine sentencing range.[11] According to the Guidelines neither the minimum nor maximum multiplier shall be less than 0.75. The final

[10] Connor, John M. and Lande, Robert H. (2006).
[11] United States Sentencing Commission Guidelines Manual (2014).

fine for undertakings must not exceed a maximum statutory limit which is the greatest of 100 million US$ or twice the gross pecuniary gains the violators derived from the cartel or twice the gross pecuniary loss caused to the victims. When referring to caps on fines in international cartels, the USSG will use the volume of US affected commerce, unless the undertaking's involvement in the infringement is substantially serious. In this case, worldwide turnover will be considered.

On an individual level, the maximum level of fines is the greatest of 1 million US$ or twice the gross pecuniary gains or twice the gross pecuniary loss caused to the victims. As well as non-pecuniary penalties are concerned, according to the Guidelines the proposed prison sentence for an individual with clean criminal record ranges from 10 to 16 months to 10 years depending on the gravity of the infringement. In cases where the offense is considered mild and the imprisonment sanction is at the lower level (10 to 16 months) the offender is usually given the choice to serve his sentence under house arrest.

Leniency Program

The Antitrust Division's Corporate Leniency Program was introduced in the United States in 1978 and was subsequently amended in 1993. Under this Program firms which cooperate with the antitrust authorities by revealing information about the existence of a cartel, or by providing additional information that can help to speed up the investigation, are exempted from fines, or enjoy significant reductions. Therefore, leniency programs give incentives to any firm engaging in anti-competitive actions to assist the Commission in detecting, investigating and banning the offense. According to the Corporate Leniency Program full immunity is granted only to the first firm to report an antitrust violation. This means that a firm that intends to make a leniency application is in a race with its co-conspirators and possibly its own employees who may also be preparing to apply for individual leniency. For this reason the Antitrust Division of the DOJ has established a marker system. According to this system the Division gives a "marker" to the first applicant in order to hold its place at the front of the line for leniency while it gathers more

information to support its application.[12] However, even if a firm loses the race for leniency, it may still obtain lesser sentencing recommendations by pleading guilty to criminal charges, i.e. by entering into plea agreements. Plea bargaining is an arrangement under which a party that pleads guilty and cooperates with the agency can receive a reduced sentence. In contrast to EU settlements, plea bargaining in the US can take place at any time in a procedure.[13]

Corporate leniency is, in general, available both before and after an investigation has begun. Two types of leniency can be distinguished in the US program. Type A leniency which is available only before the investigation has begun and Type B leniency which is available even after the Division has received information about the activity.

Type A leniency - Leniency Before an Investigation Has Begun

Leniency will be granted to a corporation reporting illegal activity before an investigation has begun, if the following six conditions are met:

1. At the time the corporation comes forward to report the illegal activity, the Division has not received information about the illegal activity being reported from any other source.
2. The corporation, upon its discovery of the illegal activity being reported, took prompt and effective action to terminate its part in the activity.
3. The corporation reports the wrongdoing with candor and completeness and provides full, continuing and complete cooperation to the Division throughout the investigation.
4. The confession of wrongdoing is truly a corporate act, as opposed to isolated confessions of individual executives or officials.
5. Where possible, the corporation makes restitution to injured parties.
6. The corporation did not coerce another party to participate in the illegal activity and clearly was not the leader in, or originator of, the activity.

[12] Hammond, Scott D. And Barnett, Belinda A. (2008).
[13] Ibid 5.

Type B leniency - Alternative Requirements for Leniency

If a corporation comes forward to report illegal antitrust activity and does not meet all six of the Type A Leniency conditions, the corporation, whether it comes forward before or after an investigation has begun, will be granted leniency if the following seven conditions are met:

1. The corporation is the first one to come forward and qualify for leniency with respect to the illegal activity being reported.
2. The Division, at the time the corporation comes in, does not yet have evidence against the company that is likely to result in a sustainable conviction.
3. The corporation, upon its discovery of the illegal activity being reported, took prompt and effective action to terminate its part in the activity.
4. The corporation reports the wrongdoing with candor and completeness and provides full, continuing and complete cooperation that advances the Division in its investigation.
5. The confession of wrongdoing is truly a corporate act, as opposed to isolated confessions of individual executives or officials.
6. Where possible, the corporation makes restitution to injured parties.
7. The Division determines that granting leniency would not be unfair to others, considering the nature of the illegal activity, the confessing corporation's role in it, and when the corporation comes forward.[14]

1.3.2. European Union

The European Commission in order to set out publicly the methodology it will apply in its future decisions imposing fines and to enhance transparency, it introduces guidelines. By doing so, the Commission simultaneously ensures the consistency of its

[14] Ibid 12.

fining policy and provides undertakings with some degree of legal certainty. Such guidelines were issued by the Commission in 1998 and were updated in 2006.

Guidelines 1998

The 1998 Guidelines on setting fines adopted by the European Commission provided, until 2006, along with the leniency notices of 1996, 2002 and 2006, the basis for the calculation of fines imposed on undertakings which infringe Articles 101 and/or 102 TFEU.

The 1998 Guidelines set out a four step process for the determination of the fine:

- *Step 1 - Base Fine:* The base fine is calculated on the basis of three elements. The gravity of the offense, an additional amount for efficient deterrence purposes and the duration of the infringement.

  According to the Guidelines the above can be defined as:

  - *Seriousness of the offense:* Here we distinguish three types of infringements for each of which a corresponding initial fine is set. These types of offenses are: minor infringements with a fine of between 1.000€ and 1 mil. €, serious infringements with a fine of between 1 mil. € and 20 mil. €, and very serious infringements, such as hard-core cartels, with a fine of over 20 mil. €. According to the Guidelines the assessment of the gravity of an offense is based on the nature of the infringement, its effects on the market and the size of the relevant geographic market.
  - *Additional amount for efficient deterrence:* The base fine may be increased so as to ensure the sufficient deterrent of firms from engaging in anti-competitive conduct.
  - *Duration*: The base fine may finally be increased taking into account the duration of the offense. For short-term infringements (less than one year) the base fine is not increased, for medium-term infringements (one to five years),

the fine can be increased by up to 50%, and for long-term infringements the base fine can be increased by up to 10% for each year of the offense. [15]

- *Step 2 - Aggravating and Mitigating Circumstances:* After the calculation of the base fine, the Commission will either increase or decrease the fine according to whether there are any aggravating or mitigating circumstances.

Main Aggravating Circumstances

Leading role: The most prevalent aggravating factor found in the decisions is when the company is a leader or instigator of the infringement.

Coercion and/or retaliatory measures against other undertakings: This factor is seen as one of the most serious aggravating factors by the Commission. Any steps taken to coerce other undertakings to participate in the infringement and/or any retaliatory measures taken against other undertakings with a view to enforcing the practices constituting the infringement are common aggravating factors taken into consideration.

Recidivism: If the undertaking continues or repeats the same or a similar infringement the basic amount of the fine can be significantly increased, even to up to 100%. The reason being that recidivism constitutes proof that the sanction previously imposed was not sufficiently deterrent.

Refusal to co-operate: If the undertaking refuses to cooperate with or attempts to obstruct the Commission in carrying out its investigation is also considered as a particularly serious aggravating factor.

[15] Veljanovski, Cento (2007).

Main Mitigating Circumstances

Termination of the infringement as soon as the Commission intervened: The basic amount of the fine will be reduced if the undertaking concerned provides evidence that it terminated the infringement immediately after the Commission intervened.

Existence of reasonable doubt: This factor is taken into account when the undertaking provides evidence that the infringement was committed negligently. In other words if there exists reasonable doubt on the part of the undertaking as to whether the restrictive conduct does indeed constitute an infringement.

Passive role: The Commission will, also, reduce the fine in circumstances where an undertaking provides evidence that its participation in the infringement is substantially limited and it plays a merely passive role.

Effective co-operation: Undertakings are rewarded for any co-operation given to the Commission outside the scope of the Leniency Notice and beyond their legal obligation to co-operate.[16]

- *Step 3 - Specific increase for deterrence:* The Commission shall ensure that the amount of the fine has a sufficiently deterrent effect. For this purpose, it may increase the fine in cases where the firm has exceptionally high turnover compared to the relevant turnover.

- *Step 4 – Legal Maximum (Cap):* For each undertaking or association of undertakings participating in the infringement, the final amount of the fine should not exceed the statutory ceiling of 10% of the firm's worldwide turnover in the preceding business year.

  In addition, to determine the final fine, the Commission will consider any discounts provided by the leniency program.

[16] Geradin, Damien and Henry, David (2005).

Guidelines 2006

In September 2006 the European Commission adopted new Guidelines for calculating fines. The main difference compared to the 1998 Guidelines is that there is a tendency to depart from the arbitrary methodology for calculating fines based on the gravity of the infringement. Under the 2006 Penalty Guidelines, fines are calculated based on sales and duration.

According to the new guidelines the base fine is now calculated as a percentage of the sales of the offender and the duration of the infringement. More specifically, it and can be up to 30% of the sales made by the undertaking during the last full business year of the offense and this amount will be multiplied by the number of years of participation in the infringement. Also, in cartel cases, the fine is increased by a onetime amount equivalent to 15-25% of the value of one year's sales as additional deterrence.[17] Therefore, the base fine (*B*) will be equal to a percentage (*a*) of the value of sales (*S*) multiplied by the number of years that the infringement lasted (*T*), plus an additional amount for deterrence (*b*):

$$B = aST + bS = (aT + b)\, S$$

As was the case in 1998 Guidelines, again, the base fine may be increased or decreased if aggravating or attenuating circumstances exist. The definition of those circumstances remains the same as before. In any case, when it is possible to accurately calculate the profit the firm gains as a result of the infringement, the final fine should exceed any gains to the offender. Finally, similar to the 1998 Guidelines, the final fine may not exceed 10% of the firm's gross worldwide turnover the last year of the infringement. We should note here that any reduction granted on the basis of the Leniency Notice will be applied after the 10% ceiling.[18]

Leniency Program

Leniency programs have been recently introduced in the European antitrust legislation and since then they play a significant role in the effective enforcement of

[17] Competition: Antitrust procedures in anticompetitive agreements, EC factsheet (2013).
[18] Ibid 4.

competition law. Their implementation started with the 1996 Notice which was then updated in 2002, while the latter Notice was published in 2006.

1996 Leniency Notice

The 1996 Notice provided for three categories of leniency. Firstly, the non-imposition of a fine or a very substantial reduction in the fine. Very substantial was deemed to be at least 75%. Secondly, a substantial reduction in the fine, deemed to be between 50 and 75%. Thirdly, a significant reduction in the fine that could be imposed, between 10 and 50%. More specifically:

Non-Imposition of a Fine or a Very Substantial Reduction in its Amount: A firm which:

a) informs the Commission about a secret cartel before the Commission has undertaken an investigation, ordered by decision, of the firms involved, provided that it does not already have sufficient information to establish the existence of the alleged cartel;
b) is the first to adduce decisive evidence of the cartel's existence;
c) puts an end to its involvement in the illegal activity no later than the time at which it discloses the cartel;
d) provides the Commission with all the relevant information and all the documents and evidence available to it regarding the cartel, and maintains continuous and complete co-operation throughout the investigation;
e) has not compelled another firm to take part in the cartel and has not acted as an instigator or played a determining role in the illegal activity, will benefit from a reduction of at least 75% of the fine, or even from total exemption from the fine that would have been imposed if it had not co-operated.

Substantial Reduction in a Fine: Firms which both satisfy the conditions set out above, points *(b)* to *(e)* and disclose the secret cartel after the Commission has undertaken an investigation, will benefit from a reduction of 50 to 75% of the fine.

Significant Reduction in a Fine: When a firm co-operates without having met all the conditions set out above, it can benefit from a reduction of 10 to 50% of the fine that would have been imposed if it had not co-operated.[19]

2002 Leniency notice

After five years of implementation the Commission considered it necessary to amend the 1996 Leniency Notice in order to increase the transparency and certainty of the conditions on which reduction of fines would be granted. The most significant change brought by the 2002 Notice was the abolishment of the existing categorization and the distinction between fine immunity and reduction.

Full immunity now does not lie in the discretion of the Commission, but in order to be granted, the undertaking should meet specific conditions. It should be the first firm to provide evidence, which allowed the investigation or detection of an infringement of Article 81 of the Treaty (now 101 TFEU). It should collaborate fully with the authorities and provide all the information in its possession. It should end its involvement in the suspected infringement no later than the time at which it submits the evidence and it should not have a leading role or have been the instigator of the infringement.

A firm that did not meet the above conditions could be eligible to benefit from a reduction of any fine that would otherwise have been imposed. In order to qualify it should have immediately ended its involvement in the cartel and given evidence which represented "significant added value"[20] in addition to the evidence already in the Commission's possession. Priority in this case is given to written evidence (hard evidence). The first firm that provided the Commission with evidence of the suspected infringement that represented "significant added value" received a 30-50% reduction. The second undertaking received a 20-30% reduction, and subsequent undertakings received reductions up to 20%.[21]

[19] 1996 Leniency Notice.
[20] The concept of "added value" refers to the extent to which the evidence provided strengthens, by its very nature and/or its level of detail, the Commission's ability to prove the facts in question.
[21] 2002 Leniency Notice.

Leniency Policy has been considerably improved with the introduction of the 2002 Leniency Notice. In the five years after the Leniency Notice of February 2002, more than 100 applications for immunity were filed to the EC, indicating that this is an essential instrument for uncovering cartels.[22]

2006 Leniency Notice

On the 8th of December 2006 the Commission launched a revised Leniency Notice. The primary aim of the 2006 Leniency Notice is to clarify further what information an applicant has to present to the Commission in order to benefit from immunity. More specifically, a detailed description of the alleged cartel including its aims, activities, functioning and duration should be provided, along with a clear identification of the products or services concerned, the geographic scope, and the estimated market volumes affected by the alleged cartel. Moreover, specific dates, locations, names and addresses of the participants of the cartel, including involved individuals shall be specified. Furthermore, the revised Leniency Notice introduces a new "marker system" for immunity applicants similar to that applied under the US Corporate Leniency Program, mentioned above.

We focused on US and EU jurisdictions as most OECD countries follow their lead. For example, in the UK the starting point for calculating antitrust fines is a fraction of the relevant turnover, i.e. affected commerce and the cap on fines is set at 10% of the undertaking's global turnover, exactly as is the case in the EU.

[22] Ascione, Aurora and Motta, Massimo (2008).

1.4. Current Approaches on Competition Law Enforcement and Optimal Fines

As mentioned above, in recent years, the procedure for calculating fines and whether this leads to the setting of "optimal" fines has become the subject of intense controversy. In a number of recent papers alternative approaches of calculating fines have been used and multiple variations of the calculation process have been proposed. For instance, Motta and Polo (2003), Rey (2003) and Spagnolo (2004) considering the effects of leniency programs on the incentives to collude assume that both the probability of detection and penalties are fixed. On the other hand, Houba et al. (2010), following Harrington (2005), when analyzing the effectiveness of antitrust regulation in a repeated oligopoly model in which fines and detection probabilities depend on the cartel price, assume that fines are directly proportional to illegal profits. More recently, Katsoulacos and Ulph (2013), in order to question the empirical results of a series of articles mainly by Connor and Bolotova (2006) and to examine the effect of the toughness of the penalty regime on the cartel overcharge, apply a two-fold framework considering the calculation of fines both as a fraction of the firm's revenue as well as a fraction of its profit. Finally, one of the most recent approaches is that of Katsoulacos et al. (2015) where an alternative fining policy design is proposed. Specifically, they suggest that CAs should switch the base on which penalties for cartels are set away from the conventional bases of revenue or profits and instead to base the penalty on the cartel overcharge. To justify their suggestion they compare three penalty regimes - those based on profits, those based on revenue, and those based on the cartel overcharge and they show that: (i) fines based on overcharges are more successful in terms of their effect on price when compared to fines based on revenues or profits, (ii) an overcharge-based regime welfare dominates a profits-based regime which in turn welfare dominates a revenue-based regime.

Chapter 2

The Distortive Effects of Antitrust Fines Based on Revenue

2.1. Introduction

How Competition Authorities (CAs) should set fines and how they actually do so in practice is a highly debated issue among antitrust practitioners. In Europe, where fines are often set directly by the CAs, appeal courts have often slashed CAs' decisions precisely on the grounds of how they set the fines. An illuminating example is the UK Competition Appeal Tribunal (CAT) decision in 2011 to substantially cut the fines set by the Office of Fair Trading (OFT) for members of the construction recruitment cartel substantially, on the grounds that the "wrong" measure of affected commerce was used.

One reason behind these debates is that antitrust regulating CAs but also courts, where in charge, use rules of thumb to set the fines that - although well established in the legal tradition and in sentencing guidelines and possibly easy to apply - are very hard to justify and interpret in logical economic terms.

In contrast to what the voluminous literature on optimal fines suggests, starting with Becker's seminal paper (1968), as mentioned in Chapter 1, antitrust rules or the practice of CAs in most jurisdictions *base fines on affected commerce* rather than on unlawful profits (or on the loss of consumer surplus (*CS*)). As it is hard to find a logical foundation for choosing affected commerce as the benchmark for setting fines, it is no wonder we get surreal conflicts like the one between the CAT and OFT mentioned above. In addition, several jurisdictions impose *caps to maximum fines*, sometimes linked to firms' total yearly turnover, at other times just "falling from heaven".

In this chapter, we highlight a number of "distortions" that arise as a result of these policies towards antitrust violations, concentrating on the case of cartels.

A first and obvious distortive effect of fine caps (or fines) linked to total (worldwide) firm revenue is that *specialized firms active mostly in their core market expect lower fines (when caps bind) than more diversified firms active in several other markets* than the relevant one.

As the many (other) distortive effects generated by fine caps have been widely discussed elsewhere, we will consider this distortion only briefly and focus on two other, somewhat less obvious, distortions that occur when the volume of affected commerce is used as a base to calculate antitrust fines:

(i) If expected fines are not sufficient to deter the cartel, which seems to be the norm given the number of cartels that CAs continue to discover, *fines based on revenue rather than on collusive profits push firms to increase cartel prices above the monopoly level* to reduce the penalty, thus exacerbating the anticompetitive harm caused by the cartel.

(ii) Firms with low profit/revenue ratios, for example firms at the end of a vertical production chain, *expect larger fines* relative to the same collusive profits *than firms that have larger profit/revenue ratios*, e.g. due to their position at the beginning of the production chain.

In this chapter, we propose simple models of cartel pricing and antitrust enforcement to characterize these distortions and their comparative static properties; we quantify their likely impact empirically, using simple simulations based on market data; and we discuss the obvious need to take action against them. Section 2.2 briefly discusses how fines should be set in antitrust, in contrast to current antitrust regulation and sentencing guidelines. Section 2.3 briefly discusses the first distortion, mainly linked to price caps. Sections 2.4 and 2.5, the core of the chapter, analyze the other two distortions within a simple theoretical model and estimate their likely empirical relevance. Section 6 concludes by discussing how to amend this unsatisfactory situation.

2.2. Background

2.2.1. Optimal Monetary Fines in Antitrust

As already discussed in Chapter 1, one of the fundamental principles of the modern economic analysis of the public enforcement of law, based on the seminal paper by Becker (1968),[23] is that penalties should be set to deter inefficient offences, that is, offences that create greater social welfare harm as compared to the gain for the offender(s). [24] When the crime always produces greater harm than benefit, as is the case for cartels (assuming they don't produce efficiencies), then maximizing deterrence net of enforcement cost becomes optimal. Risk aversion may reduce optimal fines but risk neutrality seems a natural assumption in the case of managers and firms and given this, enforcement errors by diluting deterrence imply higher optimal fines than in their absence.[25]

In the case of cartels, the benefits are the discounted expected profits from collusion and harm is equal to the *CS* loss. Because harm and benefits are very correlated, they are both good proxies of what drives firm managers' decisions – therefore, fines meant to achieve efficient deterrence could be based on either one. As the loss of *CS* is a bit harder to estimate, basing fines on an estimate of collusive profits may be an optimal way to go.

This very simple logic is contradicted by the current fining policy adopted by most jurisdictions, which typically base fines on *affected commerce*, i.e. on *revenue* in the relevant market, rather than on collusive profits; they also often impose caps to maximum applicable fines in terms of percentage of overall firm turnover.[26]

[23] Another early contribution is Stigler (1970). For a very good, relatively recent, extensive review see Polinsky and Shavell (2000).
[24] This is the net social harm to "others". See, for example, Landes (2003), p. 656.
[25] See, for example, Polinsky and Shavel (2000), p. 60-61. This analysis also suggests that we should not use costly imprisonment before having set fines maximal, in order to save on imprisonment costs – see, for example, Buccirossi and Spagnolo (2007), p. 10.
[26] One reason why most public enforcers have maximum statutory limits is that they are interested in not jeopardizing the viability of the convicted firm in the future. See Buccirossi and Spagnolo 2007 for a list of reasons why this policy is flawed.

2.3. Distortion 1: Fine Caps Linked to Total Revenue

Our main objective in this chapter is to examine some of the potential implications for social welfare and also for the incidence of fines in different industries (we will call them all, for short, "distortions") that result from the current fining policies in the EU, US and most other jurisdictions that follow their lead. The first "distortion" is linked to fine caps rather than fines themselves, and will only be discussed briefly.

Distortion 1: If total firm turnover is used (either as a base for the fine or for a cap of fines that is binding for at least some firms), those firms that are more diversified, acting in many markets other than the relevant one where the infringement occurs, expect higher fines than firms that have a narrow focus on their core business, i.e. for whom affected revenue in the relevant market is not very different from total revenue.

This somewhat obvious distortion – why should diversified firms active in many markets face higher fines than more narrowly focused firms? – could, in principle, induce firms that are at risk of antitrust legal action, like technology-leading dominant firms, to inefficiently under-diversify inefficiently to reduce their legal liability.[27]

This distortion reminds us of how firms react, inefficiently increasing leverage, when courts take into account their financial situation when establishing fines, the so-called "judgment proof" problem; see e.g. Shavell, 1986; Che and Spier, 2008 and with reference to Antitrust, Buccirossi and Spagnolo, 2007, 2008.

We do not believe this is commonly happening; we do hope that antitrust liability concerns are still of secondary importance for the strategic decision of which markets to enter. Still, it is not clear that risking this distortion is necessary for an effective enforcement of competition policy.[28]

Moreover, the notion of imposing pre-established caps on fines is by itself problematic (Bos and Schinkel, 2006, pp. 673–82). It is apparently justified by the need to

[27] This distortion could in principle be prevented by adjusting probabilities of detection, increasing auditing efforts for industries where firms are less diversified. However, this would not be a solution as long as even firms within the same industry have different degrees of diversification.

[28] There are many additional reasons why such caps are not a sound rule of thumb, some of which are discussed in Buccirossi and Spagnolo (2006, 2007, 2008).

not drive infringing firms bankrupt. High fines may lead to bankruptcy, the argument goes, which may be associated with a reduction of the number of active competitors in a market which, *ceteris paribus*, may be an undesirable outcome for competition (not if it increases asymmetry). However, as Buccirossi and Spagnolo (2007, pp. 10-12) stress, this argument is suspect for a number of reasons:

First, in assessing the actual effect that bankruptcy due to high fines has on competition in an industry, one needs to take into account the impact of the level of fines on so-called general deterrence, that is, its impact, through the *ex ante* deterrence of cartels in many other industries, on competition in these other industries, in addition to the one examined.

Second, if bankruptcy procedures are efficient, they could, in a relatively short period of time, lead to the replacement of a "bankrupt" colluding firm, say firm A, by a "new" firm – firm A under new ownership – which then gets a "fresh start" and may well be less likely to engage in collusive practices, having less "established connections" with other firms.

Third, designing fining policy so as to avoid bankruptcies may well distort firms' decisions regarding their financial (debt-equity) structure. Specifically, it may induce cartel members to issue more debt, reducing their ability to pay antitrust fines, thus adding a further distortion to the other social costs of collusion.

Allowing for the possibility of decision errors in enforcement provides the basis for another reason against the imposition of high fines. In the presence of decision errors, the assumption that fines are socially costless may be inappropriate to the extent that fines may deter firms from undertaking actions that are socially benign. For example, Katsoulacos and Ulph (2012) show that if a CA makes mistakes[29] and firms face legal uncertainty in that they do not know the true nature of their actions (harmful or benign), nor the estimate of harm that the authority will reach if their actions come under investigation, then in certain cases the optimal fine should be low – indeed, it should be zero. However, it is hard

[29] Though it can discriminate, which means that it condemns a "harmful" action with higher probability than a "benign" action.

to think that this result could be relevant to the case of "hardcore" cartels (continuing to assume that these cartels do not generate efficiencies).

Removing caps on fines would eliminate the above mentioned distortion and possibly increase deterrence. However, if removing fine caps is not politically viable, then the cap should not be related to total firm turnover, as in the EU but to firms' collusive profits or to the CS loss they induce, as in the US.

2.4. Analysis of Distortion 2: Fines, Revenue and Cartel Pricing

The second distortion we want to discuss is not linked to caps but to sentencing guidelines or analogous regulations suggesting that fines should be linked to affected commerce – i.e. total sales/revenue from the relevant market the year before the conviction. In summary:

Distortion 2: A fining rule proportional to affected commerce – i.e. to total revenue in the relevant market - distorts the price-setting incentives of the cartels that it does not deter, inducing them to optimally increase the cartel's price above the monopoly level.

This effect tends to reduce social welfare relative to a monopolized situation with similar fines related to profits, and potentially even relative to a situation with no fines, due to the distortive effects of the higher price and, in the case where the comparison is to a situation with no fines, the presence of antitrust enforcement costs.

Of course, it could be argued that the practical significance of this distortion is likely to be small because it requires managers of firms involved in cartels to be well-informed and forward-looking, and to formulate strategic decisions at a level that may not be easily met in reality.

However: the escalation of fines as a percentage of revenues in recent years on both sides of the Atlantic, as well as the much stronger public emphasis on effective detection and enforcement of antitrust law by CAs (often backed by additional resources), makes it

more likely that managers will be anticipating and incorporating into their decisions the potential impact of being investigated and found to be in breach of antitrust law; as we will show below, if managers do adjust their behavior, taking into account the likelihood that they may face a penalty for acting illegally, the "cost" of this in terms of the loss in consumers' welfare may well be substantial.

2.4.1. Formal Investigation of Distortion 2

Assume a homogeneous product industry with constant marginal cost *c* and that the lifetime of a cartel, if it is formed, is normalized to unity. In obvious notation, expected cartel profits are given by:

$$\Pi(Q) = (1-\beta)[R(Q) - cQ] + \beta\delta[R(Q) - cQ] - \beta\delta[\varphi R(Q)] \qquad (2.1)$$

where β is the probability of successful enforcement (that is, the probability of detection multiplied by the probability that the CA's investigation leads to a ban and a fine is imposed), φ is the fraction of revenue fined (the CA sets φ exogenously) and δ, $0 < \delta \leq 1$, is the duration of the cartel, i.e. the fraction of time since the cartel was formed that it takes the authority to detect it, investigate it and ban it by imposing a fine. In the economics of crime, it is typically assumed - and this is indeed the natural assumption to make - that $\delta = 1$; i.e. that crimes are detected after they have been committed, so that the criminal gains from it before it is detected, investigated and sanctioned. While there is a strand in the literature that treats economic actions as criminal actions, in the sense of assuming that when these actions are harmful to society, they are detected and banned after their natural lifetime is over and the entire benefit has accrued to those taking the actions, this certainly need not be the case. An economic action has an ongoing dimension to it, so it can be detected, subsequently investigated and a fine can be imposed before its natural life is reached. So, according to (2.1), the cartel expects to get the entire cartel profit for as long as it is not detected and this has a probability of $(1 - \beta)$ and it expects to get a fraction δ of the cartel profit minus the fine (φR) if it is detected and banned with a probability of β.[30]

[30] For a more extensive discussion on these issues, see also Katsoulacos and Ulph (2013).

Let us here begin with the assumption that $\delta = 1$ (which is then relaxed) and thus re-write expected profits as:

$$\Pi(Q) = R(Q) - cQ - \beta[\varphi R(Q)]$$

The first order condition (f.o.c.) for maximum profit is as follows:

$$\pi_Q = (1 - \beta\varphi)R'(Q) - c = 0 \tag{2.2}$$

or

$$R'(Q_d^*) - \frac{c}{1-\theta} = 0 \tag{2.3}$$

where $\theta = \beta\phi$

Thus, assuming $R''(Q) < 0$ – so there is declining marginal revenue – the second order condition for profit maximization is satisfied.

Note now that if the fine was on profits, if firms ignored fines or if there were no fines, then the f.o.c. for profit maximization would be:

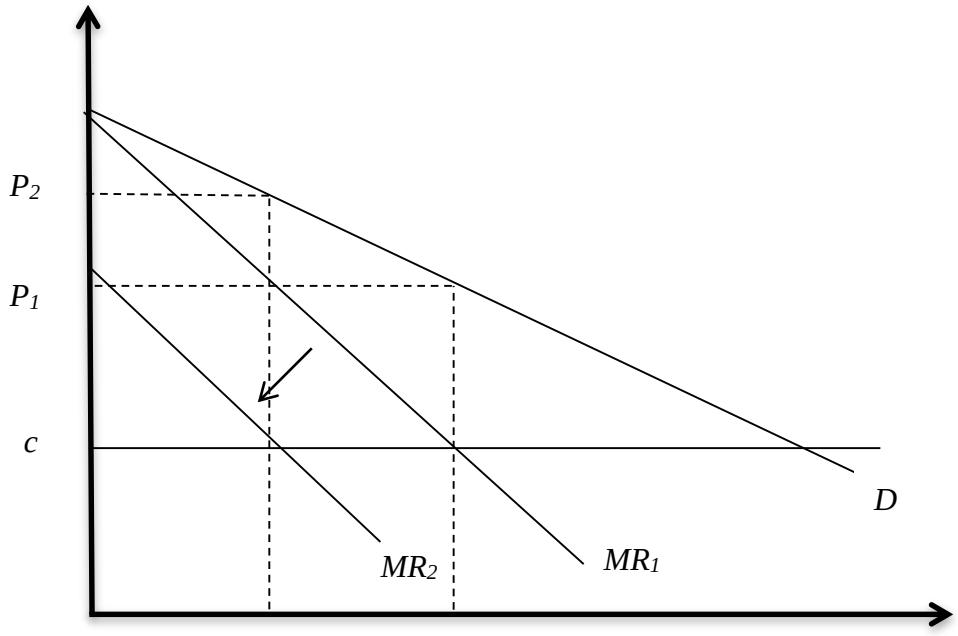
$$R'(Q_u^*) - c = 0 \tag{2.4}$$

So, given declining marginal revenue, comparing (2.3) to (2.4), we have the following:

Result 1: $Q_d^* < Q_u^*$**,** *The fine based on revenues distorts output to a lower, more distorted level, relative to the already distorted monopoly output that would emerge if the fine was on profits, or if firms ignored fines, or if there were no fines.*

The result is also shown in Diagram 2.1, in which we illustrate the effect of the imposition of the fine, which shifts the marginal revenue curve downwards and leads to an increase in price from p_1 to p_2.

Diagram. 2.1: Effect on Cartel Price of Fine based on Revenues



Furthermore, from (2.3), we observe the following:

Result 2: *The distortion on output generated by fines on revenue is increasing in the marginal cost (c), in the probability of successful enforcement (β) and in the percentage of revenue fined (φ).*

This result can be better shown using the implicit function theorem applied to (2.2), which gives the following:

$$\frac{dQ}{dc} = -\left(\frac{d\pi_Q}{dQ}\right)^{-1}\frac{d\pi_Q}{dc} = \frac{1}{(1-\beta\phi)R''(Q)} < 0$$

$$\frac{dQ}{d\beta} = -\left(\frac{d\pi_Q}{dQ}\right)^{-1}\frac{d\pi_Q}{d\beta} = \frac{\phi R'(Q)}{(1-\beta\phi)R''(Q)} < 0$$

and

$$\frac{dQ}{d\phi} = -\left(\frac{d\pi_Q}{dQ}\right)^{-1}\frac{d\pi_Q}{d\phi} = \frac{\beta R'(Q)}{(1-\beta\phi)R''(Q)} < 0$$

The comparative static results assume that the representative cartel remains in place while parameters change. However, as higher c, β and φ imply higher expected fines relative to expected collusive profits, the deterrence effect of the policy is also typically increasing in these parameters. Thus, the cartel will be probably deterred and in this case there will neither be expected fine nor distortions.

We therefore have the following:

Result 3: *For a representative cartel, the largest welfare loss linked to distortion is present at intermediate levels of c, β and φ, where the cartel is not yet deterred but the expected fine is a substantial fraction of revenues.*

As the distortion is only present for cartels that are not deterred, our distortion can be thought of as being - at least partly - self-correcting. An increase in the expected fine will have ambiguous effects in general, as on one hand it increases the size of the per-cartel distortion, while on the other hand it reduces the number of operating cartels, i.e. of firms subject to the distortion.

The welfare effect is clear at the corners of course. Where enforcement is very poor, because the expected fine is very low, an increase in the expected fine will increase the distortion considerably while having little effect on deterrence. Where enforcement is almost perfect, an increase in the expected fine could lead to full deterrence and the distortion will disappear with cartels.

At intermediate levels of enforcement instead, the effect on welfare caused by an increase in the expected fine will depend on whether the increase in deterrence or the increase in per-cartel distortion will dominate.[31]

[31] Of course, an increase in welfare does not preclude that the average price overcharge will not increase as fines increase, because higher fines first deter cartels with lower price overcharges, as shown by Katsoulacos and Ulph (2013).

It is also illuminating to rewrite (2.3) in terms of prices, as:

$$p_d^*(1-\varepsilon) - \frac{c}{1-\theta} = 0 \tag{2.5}$$

where ε is the inverse own-price elasticity of demand. It follows from (2.5) that:

$$\frac{p_d^*}{c} = \frac{1}{(1-\varepsilon)(1-\theta)} \tag{2.6}$$

While, from (2.4):

$$\frac{p_u^*}{c} = \frac{1}{(1-\varepsilon)} \tag{2.7}$$

Thus, we get the following:

Result 4: *Comparing (2.6) and (2.7), the cartel price overcharge with fines on revenues is higher than the normal monopoly overcharge that would emerge if the fine was on profits or firms ignored fines or if there were no fines.*

From (2.6), the cartel price overcharge with fines on revenue is decreasing in the elasticity of demand (ε) and increasing in the probability of successful enforcement (β) and in the percentage of revenue fined (φ). On the other hand, from (2.6) and (2.7), the magnitude of the price distortion (the ratio of with-fines prices to monopoly prices without fines) due to fines on revenue is independent of ε and is increasing in β and φ.

Given (2.6), we note that demand elasticities will differ across sectors as well as across jurisdictions. So even assuming the same β across sectors and jurisdictions (which is unrealistic), it is not easy to test empirically whether the price overcharge is being affected by fining policies that involve fines on revenues.

We move on to the general form of (2.1) and assume now that $0 < \delta < 1$. This means that the cartel is detected, an investigation is undertaken and a fine is imposed in a period while the cartel is still active.

So, from (2.1), now setting

$$\eta = \frac{\beta\varphi\delta}{1-\beta(1-\delta)}$$

the f.o.c. for profit maximization becomes as follows:

$$R'(Q_d^*) - \frac{c}{1-\eta} = 0 \tag{2.8}$$

Thus we get from (2.8):

Result 5: *The larger the duration δ of the cartel (the time that lapses between cartel formation and when the cartel is banned), the larger the distortion generated by a policy of fines based on revenue.*

Note here that while the expected fine is

$$F^e = (\beta\varphi\delta)R(Q_d^*) \tag{2.9}$$

the loss in CS while the cartel lasts is given by the equation:

$$CS^{Loss} = [(1-\beta) + \beta\delta][CS(Q_d^*) - CS(Q_u^*)] \tag{2.10}$$

so we have the following (see also Table 2.2):

Result 6: *Even if expected fines are falling relative to the incidence on consumers due to this fining policy (measured by consumers' surplus loss), the consumer loss ratio can be substantially increasing.*[32]

A question then naturally emerges: how significant is this second distortion?

[32] We are grateful to David Ulph for pointing out and discussing with us this point.

2.4.2. Simple Empirically-driven Simulations

Below we assume a linear inverse demand function, $p(Q) = a - Q$, with $a = 100$ and examine the magnitude of the CS loss for various values of the parameters β, φ and δ (Table 2.1) as well as the magnitude of the fine to CS loss ratio for a small value of φ, $\varphi = 0.1$, allowing the duration of the cartel to vary (Table 2.2). As Table 2.1 indicates, the CS loss due to the distortion can be quite sizable. At the benchmark value of $\varphi = 0.3$, the loss is 7.78% with $\beta = 0.4$ and $\delta = 0.7$. The loss with the same φ and β values rises to 11.35% when there is a large delay in getting the cartel banned, i.e. $\delta = 1$. As Table 2.2 indicates, while the fine to CS loss ratio is falling (even if slightly) as δ is increasing the CS ratio is increasing very substantially in percentage terms.

Table 2.1: Consumer Surplus Loss

Consumer Surplus Loss									
$\mathbf{CS^{Loss}/CS_u}$	-1.83%	-3.73%	-5.71%	-7.78%	-9.96%	-12.26%	-14.72%		
$\boldsymbol{\beta}$*	0.1	0.2	0.3	0.4	0.5	0.6	0.7		
$\mathbf{CS^{Loss}/CS_u}$	-2.46%	-5.05%	-7.78%	-10.66%	-13.69%				
$\boldsymbol{\varphi}^{\dagger}$	0.1	0.2	0.3	0.4	0.5				
$\mathbf{CS^{Loss}/CS_u}$	-1.04%	-2.12%	-3.21%	-4.33%	-5.46%	-6.61%	-7.78%	-10.15%	-11.35%
$\boldsymbol{\delta}^{\ddagger}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1

Note: *$\alpha = 100$, $c = 30$, $\varphi = 0.3$, $\delta = 0.7$. $^{\dagger}\alpha = 100$, $c = 30$, $\beta = 0.4$, $\delta = 0.7$. $^{\ddagger}\alpha = 100$, $c = 30$, $\beta = 0.4$, $\varphi = 0.3$.

Table 2.2: Fine and Consumer Surplus Loss

Consumer Surplus Loss									
$\mathbf{CS^{Loss}/CS_u}$	-0.34%	-0.69%	-1.04%	-1.39%	-1.75%	-2.10%	-2.46%	-3.18%	-3.54%
$\mathbf{F/\ CS^{Loss}}$	-4.31	-4.28	-4.26	-4.24	-4.23	-4.21	-4.20	-4.17	-4.16
$\boldsymbol{\delta}^{*}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1

Note: *$\alpha = 100$, $c = 30$, $\beta = 0.4$, $\varphi = 0.1$.

2.5. Analysis of Distortion 3: Revenue and Profit Across Industries

The third distortion we mentioned is linked to the very different ratio between profits or value added and revenue/turnover in different industries and for different firms when they are active in several industries. We can summarize it as follows:

Distortion 3: Firms forming cartels at the end of a long value chain, with a low profit/revenue ratio, expect, *ceteris paribus*, larger fines relative to collusive profits than firms that are either at the beginning of the value chain or are vertically integrated that have a larger profit/revenues ratio.

The importance of this distortion depends on differences across markets and different levels of the production chain. Following a simple formal analysis of this problem we try to quantify the difference in the fines/profit ratio that fine caps can generate in terms of revenues, using real-world data on revenues and profits for different firms in different sectors.

2.5.1. Analysis of Distortion 3

Consider two industries, *A* and *B*, that differ in terms of their collusive profit to revenue ratios, $(\Pi_i/R_i), i = A, B$. Specifically, assume that:

$$(\Pi_i/R_i),$$

$$(\Pi_A/R_A) < (\Pi_B/R_B) \tag{2.11}$$

So, *A* is the industry with the low profit to revenue ratio. Note that as $\Pi_i = R_i - C_i$, $i = A, B$, where *C* is total cost, inequality (2.11) immediately implies that:

$$(C_A/R_A) > (C_B/R_B) \tag{2.12}$$

that is, *A* is the industry with the high cost to revenue ratio.

With a policy of fines on revenue, the expected fine in the two industries, if the percentage of revenue fined is the same in both and equal to φ, is as follows:

$$F_i = \varphi R_i, \qquad i = A, B \tag{2.13}$$

Substituting from (2.13) onto (2.11) and rearranging yields:

$$(F_A/\Pi_A) > (F_B/\Pi_B) \tag{2.14}$$

That is,

Result 7: *Larger fines relative to collusive profits are imposed on industries with lower profit/revenue ratio (2.11) or on industries with higher cost/revenue ratio (2.12).*

On the other hand, Beckerian fines or fines as a fraction of profits, which do not distort price decisions, would lead to a fine/profit ratio that is equal for both industries.

This distortion implies that, for example, industries with high R&D (fixed) costs will, *ceteris paribus*, pay higher fines as a fraction of their profit than industries with low R&D costs! Also, industries with large human capital rents that are paid as bonuses out of profits, as e.g. in consultancy, where these payments are not included in costs, pay, *ceteris paribus*, lower fines as a fraction of their profit.

2.5.2. Simple Empirically-driven Simulations

We collected some data on the profit/revenue ratio in different industries where a cartel has been discovered in recent decades to get an idea of how large this third distortion could be. This exercise revealed that the total revenue/profit can range:

(i) from the 5.8 of Nippon Electric Glass (convicted by the EU Commission for the cartel of cathode ray tube glass used in television);

(ii) to the 12 of Exxon Mobile (convicted by the EU Commission for the cartel on paraffin waxes and slack wax);

(iii) to the 91.7 of Unipetrol (convicted by the EU Commission for the cartel on synthetic rubber); and

(iv) to the 117.4 of Panasonic (convicted by the EU Commission on household and commercial refrigeration compressors).

This simple exercise suggests that for the very same infringement and the same collusive profits obtained from it (benefits from the cartel), firms in one industry may face, *ceteris paribus*, 20 times larger fines than counterparts in another industry for no logical reason, just because they happen to be at the end of the value chain.

2.6. Concluding Remarks

Enforcement costs often justify the use of simple rules of thumb that are easier to implement, although they are not optimal. However, as we have seen, basing fines on a firm's affected commerce rather than on collusive profits, and basing fine caps on the firm's total revenue rather than on that from the relevant market, is likely to create large distortions.

Fine caps based on total revenue, as set by the EU Commission, when binding tend to generate much higher fines for more diversified firms, potentially inducing inefficient under-diversification as a means to reduce legal exposure.

Fines based on affected commerce, as required by the USSC and the EU Commission induce undeterred cartels to price higher than they would if fines were based on profits or in the absence of antitrust enforcement.

Moreover, fines based on affected commerce tend to generate much larger fines for firms that are at the end of the value chain, than for firms at the beginning of the value chain or firms that are vertically integrated.

Our empirically based simulations suggest that the deadweight losses produced by these distortions can be very large, and that they may generate fines differing by over a factor of over 20 for firms that should instead have the same fine.

It is worth noting that, in the US case, this rule of thumb does not produce any saving in enforcement costs, because the cap on fines prescribed by the USSG requires courts to calculate firms' collusive profits anyway.

It is also worth noting that the distortions we identified are not substitutes, so that either one or the other is present. Instead, they are all present simultaneously and add to one another in terms of poor enforcement.

Developments in economics and econometrics make it possible to estimate illegal profits from an antitrust infringement with reasonable precision or confidence, as regularly done to assess damages. It is time to change these distortive rules of thumb that make revenue so central for calculating fines, if the only thing the distortions buy for us is saving the costs of data collection and illegal profit estimation.

Chapter 3

A Simple Quantitative Methodology for the Setting of "Optimal Fines" by Antitrust and Regulatory Authorities

3.1. Introduction

The theoretical literature on optimal fines has developed enormously over the last thirty or so years and we now understand better than ever all the main factors that affect the size of optimal fines. Further, these developments have had a significant impact on the approach that Competition and Regulatory Authorities use when involved in fine-setting in recent years.

However, there is still a gap in linking theoretical developments to practical fine-setting in the sense that there is no quantitative methodology to guide Authorities about how the various factors that economic theory recognizes as important and other issues related to mainly legal considerations can be brought together and quantified within a coherent methodological framework that would allow them to generate fine estimates under a variety of different circumstances.

The main rationale of this chapter is to try to fill this gap by developing such a practical quantitative methodological framework that is based mainly on economic theory but also takes into account a multitude of diversely motivated considerations that all major CAs and RAs take into account when setting fines. In relation to the latter, we mainly rely

on the practices followed by the US[33] and EU[34] (DG Comp) authorities and those of the OFT[35] as reviewed in Chapter 1.

As discussed extensively in Chapter 1, economic theory on optimal fines descents directly from Becker's (1968) seminal paper and the papers that applied his analysis to antitrust.[36] According to this approach, fines should be set so as to deter actions that lower total welfare. This implies that the optimal fine should be set at a level that just deters those actions the harm to others of which is just higher than the benefit generated to the wrongdoer. However, it is often suggested that the appropriate standard on the basis of which CAs and RAs should assess anticompetitive actions should be consumer surplus.[37] This implies that the authorities adopt stricter deterrence objectives in fine-setting than suggested by a standard of total welfare, which require relating the penalties that they set to the benefit that firms have derived from taking the actions. Thus, when, as is the case in the EU and the US, the authorities use a consumer surplus standard, then the optimal fine should be one that deters all actions that lower consumer surplus irrespective of the benefits generated to the wrongdoers. As a result, with this standard, more actions will be deterred than if the standard was one of total welfare.

Note that, while in both of the cases just described the objective of the fines is to deter firms from taking actions that are harmful to others, in the literature the term "dissuasive" is often used to describe fines set to deter all actions that lower consumer surplus and the term "restitutive" is used to describe fines set to deter only actions that lower total welfare.[38] We use the same terminology in this chapter. An important question is whether economic theory has influenced practical fine-setting.

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[33] U.S. Sentencing Guidelines, 2012.
[34] EU Guidelines, 2006.
[35] OFT's Guidance as to the Appropriate Amount of a Penalty, 2012
[36] References here include (though the list is far for complete): Stigler, G. J. (1970), Landes, W. M. (1983), Polinsky, M., and S. Shavell (2000), Garoupa, N. (2001), Harrington, J. (2005), Connor, J. M. and R. H. Lande (2006), Motchenkova, E. & P. Kort (2006), Buccirossi, P. & G. Spagnolo (2006, 2007), Motchenkova, E. (2008), Ginsburg, D. H. and Wright, J. D. (2010), Harrington, J. (2010), Houba H. et al. (2010, 2012, 2013), Bageri V., Y. Katsoulacos & G. Spagnolo (2013), Katsoulacos, Y. and Ulph, D. (2013).
[37] See, eg SC Salop, "Question: What is the Real and Proper Antitrust Welfare Standard? Answer: The True Consumer Welfare Standard" (2010) 22(3) Loyola Consumer Law Review 336.
[38] See, eg Katsoulacos and Ulph, supra n 36.

In fine-setting guidelines, CAs recognize that there should be a restitutive element in their fines - in the sense of penalizing firms for the harm that their actions have caused to others[39] - and they also distinctly stress the dissuasive (or deterrence) element that should characterize their fines. We take it that, by articulating their approach to practical fine-setting in a way that allows them to incorporate restitutive and dissuasive elements in an additive fashion, CAs wish to signal that purely restitutive fines are not enough and that they have stricter deterrence objectives, consistent with a consumer surplus standard.

In this Chapter we introduce a methodology that takes into account both of the above basic elements in fine-setting, allowing CAs to combine efficiency *and* consumer welfare considerations in their calculation, by using appropriate weight parameters that are dependent on the exact objectives of their enforcement decisions. The methodology is used to derive simple formulas on the basis of which an authority can derive optimal fines, or an indicative likely range of such fines in any given situation, using information on the price overcharge caused by an action, the intensity of competition in the "but-for" situation, the size of cost efficiencies and the possibility that when an action is investigated its effects have not yet materialized[40]. Furthermore, in the proposed methodological framework we incorporate a series of other (including legal) considerations that should be used in the calculation of optimal fines. Such considerations include: the detection rate, possible decision errors, investigating an infringement before it has reached its "natural life" (referred to in the literature as desistance), and various other more *ad hoc* aggravating and mitigating factors that are taken into account in practice by the authorities. In order to bring together all of the above in a single framework, we introduce several parameters in a basic model that allows us to capture their effect on the assessment of the optimal fine.

In Section 3.2 we present the above-mentioned methodology for calculating the optimal *base* fine, while in Section 3.3 we discuss the necessary adjustments to the base fine required to obtain the optimal *final* fine. Section 3.4 concludes by summarizing the

[39] For a review of the main characteristics of fine-setting by DGCMP, OFT and US Authorities, see Section 2 of Bageri et al, supra n 36.

[40] As when an anti-competitive action of a dominant firm the objective of which is to exclude a rival has not run its course when the authority investigates the action.

methodology and making a distinction between three broad potential categories of offenses to which the methodology can be applied.

3.2. Calculation of the Optimal Base Fine

In practice, the methodology that the CAs or other sectoral regulatory authorities use to calculate the fine imposed on a firm or organization which takes an action that violates competition law or sectoral regulatory law is to start by calculating a *basic fine* that is imposed, which is then adjusted (upwards and downwards) taking into account various factors in order to calculate the final optimal fine.

The starting point for calculating the basic fine is, generally, the revenue that the firm made in the last year in which the action took place in the relevant market[41]. This could either be the last year of the natural life of the action if the authority intervenes only after the action has come to an end, or it could be the last year of an on-going action that the authority has ordered the firm to cease before it has to come to a natural end. There is then an adjustment made to take account of the duration of the action – which typically takes the form of multiplying the revenue by the number of years over which the action took place[42]. The basic fine that is set is calculated as a percentage of the last year's revenue adjusted for the duration. The question is: *what factor of proportionality should Authority use to set its penalty?*

In general we can assume that an anti-competitive action imposes harm on others which is not corrected through a successful claim for private damage, and so constitutes a genuine externality[43]. The concept of harm on others generally refers to the harm that the

[41] Relevant product market and relevant geographic market. See for example the recent guidelines for the calculation of the fine issued by the Competition Authority in the United Kingdom (Office of Fair Trading, OFT), pp. 9.

[42] If the infringement lasts for less than a year, then in some cases (e.g. Office of Fair Trading) for the calculation of the fine the whole year is used, while in others (e.g. Greek Competition Commission) a percentage of the duration of the infringement is used.

[43] The individuals affected by the offence have not initiated proceedings to be compensated which have been satisfied by the firm that has made the infringement.

action causes to consumers; however, it can also refer to the harm to other groups, such as other firms, or the state.

We will start by assuming that:

1. The anti-competitive action lasts for just a single period, at the end of which the firm taking the action faces a probability $\chi, 0 < \chi \leq 1$, of having its action investigated by a CA. We refer to χ as the coverage or detection rate.
2. If an action is detected and investigated, the CA will be able to determine definitely that it is harmful in terms of its standard and impose a penalty.

We first consider the implications of the restitutive and dissuasive elements in fine-setting[44].

3.2.1. Restitutive Penalties

According to economic theory, if the authority's standard was that of *Total Welfare* (*W*), it should base its calculation of optimal fines on the effect of anticompetitive actions on others (i.e. on other firms, on consumers etc.). As already mentioned, we will refer to penalties in this case as restitutive penalties. The change in welfare due to anticompetitive behavior can be expressed as $\Delta W = \Delta\pi + \Delta WO$, where $\Delta\pi > 0$ measures the benefit or the additional profit for the firm and ΔWO measures the change in the welfare of others, where $\Delta WO = \Delta CS + \Delta SO$, with *CS* the change in Consumer Surplus and *SO* the change in the surplus of others except consumers. We assume throughout that $\Delta WO < 0$, which means that the overall effect on the "others" is negative. The CA will consider a behavior as illegal and take action against it if it negatively affects the total welfare, i.e. if:

$$\Delta W = \Delta\pi + \Delta WO \leq 0 \qquad (3.1)$$

or otherwise it will allow it. Obviously in order for (3.1) to hold we must have $\Delta WO < 0$, and ΔWO must be larger than $\Delta\pi > 0$ in absolute value.

[44] The discussion in subsections 3.2.1 and 3.2.2 below relies on Katsoulacos and Ulph (2013).

If a firm obtains a benefit $\Delta\pi > 0$ and faces the possibility of paying a fine $F > 0$ with probability $\chi, 0 < \chi \leq 1$, then it will take the action as long as the net benefit is positive, i.e. it will take/not take the action according to whether:

$$\Delta\pi - \chi F > 0 \text{ or } \Delta\pi - \chi F < 0 \tag{3.2}$$

This implies that in order to maximize social welfare, the CA will set a fine equal to:

$$\chi F = -\Delta WO \tag{3.3}$$

Obviously, given (3.3), firms will undertake all actions for which $\Delta\pi + \Delta WO > 0$, thus increasing total welfare and will not take the actions for which $\Delta\pi + \Delta WO \leq 0$, which reduce total welfare.

Therefore, expressed as a fraction (φ) of the adjusted for the duration of the infringement revenue (R)[45] earned by taking the action, the optimal penalty rate under a total welfare objective is:

$$F^{TW} = \varphi^{TW} R$$

where

$$\varphi^{TW} = \frac{F^{TW}}{R} = \frac{(-\Delta WO)/R}{\chi} \tag{3.4}$$

3.2.2. Dissuasive Penalties

Most CAs (especially in EU and US) disallow anticompetitive actions if they reduce consumer welfare – that is, they use a consumer surplus (*CS*) substantive standard.[46] The objective of maximizing consumer welfare translates into one of setting fines that

[45] Practically if the offense last for a period of T years, and R_t is the revenue in the relevant market at a certain point in time t, $R = \sum_{t=1}^{T} R_t$

[46] For discussion concerning the use of Consumer Surplus and Total Welfare standards on the enforcement of Competition Law see Salop (2010) supra n 36, Farell and Katz (2006), Pittman (2007), Carlton (2007), Kaplow (2011), Y Katsoulacos and D Ulph (2011).

would *deter* all anti-competitive actions that lower *CS*[47]. The fines that would be set in this case are referred to in the literature as dissuasive penalties: the CA sets penalties so that no action can have a positive expected benefit for the firms. Therefore the optimal fine in this case will be:

$$\chi F^{CS} = \Delta\pi \tag{3.5}$$

or

$$\varphi^{CS} = \frac{F^{CS}}{R} = \frac{(\Delta\pi)/R}{\chi} \tag{3.6}$$

3.2.3. A Simple Quantitative Methodology for the Calculation of the Optimal Base Fine

As mentioned above, in practice CAs recognize a dissuasive or deterrence element in their fines but also incorporate an element that has restitutive character - in the sense of penalizing firms for the harm that their actions have caused to others. Below we propose a quantitative, yet simple and practical, methodology for calculating the optimal base fine taking into account both of the above considerations.

Specifically, we define the optimal base fine as follows:

$$F^{*} = aF^{TW} + (1-a)F^{CS} \tag{3.7}$$

So:

$$F^{*} = a\frac{(-\Delta WO)}{\chi} + (1-\alpha)\frac{\Delta\pi}{\chi} \tag{3.8}$$

Therefore:

$$\varphi^{*} = \frac{F^{*}}{R} = \frac{\Delta\pi - a(\Delta WO + \Delta\pi)}{\chi R} \tag{3.9}$$

[47] Subject to certain constraints, such that fines should not put at risk the survival of firms, if it is expected that if firms shut down competition will be reduced, and other "legal" constraints – these are discussed in Bageri et al. (2013) and in greater detail in Houba et al. (2013).

That is, the CA, in order to calculate the optimal base fine, weights the effect of the anticompetitive action on the welfare of others with α and the effect on the firm's profit with 1-α, where $0 \leq \alpha \leq 1$ - so **parameter α is a parameter of regulatory policy**. According to (3.9), with $a > 0$, the CA sets a fine that is *greater than* the benefit ($\Delta\pi$) that the firm obtains by the offense,[48] weighted by the inverse of the probability to detect the infringement, for as long as

$$\Delta WO + \Delta\pi < 0 \rightarrow \Delta W < 0$$

i.e. for as long as the action reduces total social welfare. More specifically:

- if $a = 1$:

  $$F^*(1) = F^{TW} = \frac{-\Delta WO}{\chi}$$

  i.e. the fine is "purely restitutive";
- if $a = 0$:

  $$F^*(0) = F^{CS} = \frac{\Delta\pi}{\chi}$$

  i.e. the fine is "purely dissuasive" and
- If $0 < \alpha < 1$:

  $$F^*(1) = \frac{-\Delta WO}{\chi} < F^*(a) < F^*(0) = \frac{\Delta\pi}{\chi} \text{ if } \Delta WO + \Delta\pi > 0$$

  $$F^*(1) = \frac{-\Delta WO}{\chi} > F^*(a) > F^*(0) = \frac{\Delta\pi}{\chi} \text{ if } \Delta WO + \Delta\pi < 0$$

Thus, when $0 < \alpha < 1$, not all anticompetitive actions that are expected to create extra profit $\Delta\pi$ are deterred when $\Delta W = \Delta WO + \Delta\pi > 0$, while in the opposite case all these actions are deterred. The optimal fine is greater than the fine that would maximize total welfare if the change in total welfare caused by the action were positive ($\Delta W = \Delta WO + \Delta\pi > 0$), and it is smaller than the fine that would maximize total welfare if the change in total welfare caused by the action is negative ($\Delta W = \Delta WO + \Delta\pi < 0$).

Concerning parameter α we suggest that:

[48] The OFT states explicitly that it adjusts the fine to be at least equal to $\Delta\pi$, given the size of the latter is known.

- For reasons of legal certainty, the value of parameter α, i.e. of the parameter used by the CA to weight its dissuasive and restitutive objectives, should be known and constant for any given type of offence.
- The authority uses $\alpha = 1$ in such cases as administrative offences, e.g. cases of network administrators' infringements in a regulated network industry, cases in which infringements are unlikely to be motivated by, and do not increase, profit. More generally, however, if the $\Delta\pi$ realized is very small then, for the calculation of the basic fine, we must take into consideration the possibility that the *anticompetitive behavior aims at excluding competitors* and that the effect of this behavior has not yet materialized – on this see also *infra* Section 3.3.6.
- Generally, when CAs wish to focus mainly on the deterrent effect of fines, they should set the weight $\alpha \leq 0.5$.

As shown in Annex A, the terms of equation (3.9) can be defined alternatively on the basis of a linear market model of oligopolistic competition, as follows:

$$\frac{\Delta\pi}{R} = \frac{\theta}{1+\theta}\left[1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right] \tag{3.10}$$

where

$$\theta = \frac{\Delta p}{p_0} = \frac{p_1 - p_0}{p_0} > 0, \text{ and } \psi = \frac{c_0}{p_0}, \gamma = \frac{c_1}{c_0} \tag{3.11}$$

Thus, variable θ measures the price overcharge, while parameters ψ, $0 < \psi \leq 1$ and γ, $0 < \gamma \leq 1$ measure, respectively, the intensity of competition before the anticompetitive behavior (the larger the ψ, the more intense the competition in the "but-for" situation) and the efficiency effect of the action - how much it reduces the cost (the smaller the γ, the higher the reduction of the firm's cost, because of the offensive behavior[49]). The variables p_0, p_1 are the prices before and after the infringement respectively, and similarly for the costs c_0, c_1.[50]

[49] The economic theory recognizes the possibility of efficiency effects from actions which aim at reducing competition. See, for example, M. Motta (2004), M. Whinston (2006), and O'Donoghue and Padilla (2006).
[50] The definitions of all variables and parameters are shown in Annex D.

According to the empirical literature on horizontal agreements (cartels), for example, a reasonable assumption for the increase in prices caused by the cartels, θ, is that it is between 10 to 40 per cent[51]. Assuming that $\theta = 0.2$ (the most recent and probably most accurate empirical study sets it to 0.17)[52], and that $\gamma = 0.8 = \psi$ (the cost reduction is large, at 20%, and the intensity of competition in the absence of the anticompetitive behavior is relatively low), then $(\Delta\pi/R) = 0.233$. This means that if the objective is purely the deterrence of anticompetitive practices (so $\alpha = 0$), then the optimal base fine (as a percentage of the revenue), if $\chi = 1$, is

$$\varphi^* = \frac{\Delta\pi}{\chi R} = 23\%.$$

If the intensity of competition in the counterfactual was very strong, so $\psi = 1$, then $\varphi^* = 33.3\%$.

Also, if $\Delta CS = CS_1 - CS_0 < 0$ where "1" and "0" refer respectively to the period before and after the offense, then as also shown in Annex A:

$$-\Delta CS/R = \theta \qquad (3.12)$$

So, replacing (3.10) and (3.12) in (3.9) we have:

$$\varphi^* = \frac{F^*}{R} = \frac{(1-a)\Delta\pi - a\Delta CS - a\Delta SO}{\chi R} \qquad (3.13)$$

or

$$\varphi^* = \frac{(1-a)\Delta\pi}{\chi R} + \frac{a\theta}{\chi} + \frac{\alpha\Delta SO}{\chi R} \qquad (3.13')$$

or

$$\varphi^* = \frac{F^*}{R} = \frac{\theta}{\chi R}\left[a + \frac{(1-a)}{(1-\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - a\frac{\Delta SO}{\chi R} \qquad (3.14)$$

where if the offense harms others, apart from consumers, then $\Delta SO < 0$.

[51] See Katsoulacos and Ulph (2013), Boyer and Kotchoni (2011), Allain, Boyer, Kotchoni and Ponssard (2011). Issues related to the detection and duration of cartels and the implications of antitrust enforcement on cartel pricing are examined in Harrington J. (2004) and Connor J. M. (2011).
[52] Allain et al, ibid.

Equations (3.13) or (3.13′) and (3.14) are the basic equations for calculating the optimal base fine[53]. On the basis of (3.13′) or (3.14), an authority can derive optimal fines, or an indicative likely range of such fines in any given situation, using information on the price overcharge caused by an action, the intensity of competition in the "but-for" situation, the size of cost efficiencies, the detection rate and any harm caused to "others" (except consumers).

Continuing with the above example, if we assume that $\chi = 0.8$ (which is a reasonable or even minimum value at least for sectoral regulatory offenses), $\alpha = 0$, i.e. purely dissuasive fines, $\Delta SO = 0$ and $\gamma = 0.8 = \psi$, then $\varphi^* = 29\%$ while with $\psi = 1$, $\varphi^* = 41.6\%$. On the other hand, with $\alpha = 0.5$, these become, respectively, $\varphi^* = 27\%$ and 33.3%, *which tells us that the major competition authorities[54] in the U.S. and EU have not been unreasonable in recently setting the highest φ^* between 30 and 40 percent.* In Table 3.1 we calculate φ^* for various parameter values assuming that the CA puts equal weight to restitution and dissuasion in fine setting, i.e. that $\alpha = 0.5$. In Annex B we provide additional examples for alternative parameter values.

Table 3.1

Alternative Scenarios	J^*
α= 0.5, χ= 0.8, θ=0.2, γ= 1, ψ=1	23%
α= 0.5, χ= 0.8, θ=0.2, γ= 0.9, ψ=1	28%
α= 0.5, χ= 0.8, θ=0.2, γ= 0.8, ψ=1	33%
α= 0.5, χ= 0.8, θ=0.2, γ= 1, ψ=0.9	21%
α= 0.5, χ= 0.8, θ=0.2, γ= 1, ψ=0.8	19%
α= 0.5, χ= 0.8, θ=0.2, γ= 0.9, ψ=0.9	26%
α= 0.5, χ= 0.8, θ=0.2, γ= 0.8, ψ=0.8	27%

[53] For the calculation of $\Delta\pi$ in practice see further comments in Section 3.3.6 infra.
[54] Which do not take into account ΔSO.

3.3. Adjustments to the Optimal Base Fine and Assessment of the Optimal Final Fine

The above framework can incorporate all the necessary adjustments needed for the assessment of the optimal final fine. Below we introduce necessary parameters in order to capture the effect of errors, desistance and other important factors in the calculation of the optimal final fine.

3.3.1. Accounting for Errors

Above we have essentially assumed that, if the CA detects an action, then it will allow it if it is benign in terms of its standard whereas, if it is harmful, it will recognize this and condemn it, in both cases with probability of unity. Firms are aware of this and are assumed to know whether their action is harmful or benign. Therefore, the only uncertainty they face is whether their behavior will be detected or not. However, at least in some cases, the CAs will make both Type I and Type II errors, and/or the firms will not know exactly on what criteria their behavior will be assessed.[55] Assume that $\bar{\rho}$, $0 < \bar{\rho} < 1$, is the probability that the CA will decide, after detecting an action, that the action is offensive and should be fined when the action is indeed harmful.[56] Assume also that the authority's assessment procedure has some (minimum) discriminating value in the sense that the probability that it will decide that the action is offensive when it is actually benign is lower than $\bar{\rho}$.[57] If firms know the type of their action and also know the probability that their action will be condemned depending on whether it is harmful or benign, then the calculation of the optimal fine given by equations (3.13) and (3.14) above must be adjusted as follows:

[55] Even though they may know the type of their action.
[56] To put it otherwise, {rho overbar} is the contingent probability that an action is found to be harmful given that it is harmful.
[57] For a welfare analysis of alternative enforcement procedures (object-based or per se and effects-based or rule-of-reason) see Y. Katsoulacos and D. Ulph (2009), Katsoulacos and Ulph, supra n 46. The latter type of procedure is also termed "discriminating".

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{(1-a)\Delta\pi - \alpha\Delta CS - a\Delta\mathrm{SO}}{\chi\bar{\rho}R} \qquad (3.15)$$

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{\theta}{\chi\bar{\rho}R}\left[\alpha + \frac{(1-\alpha)}{(1+\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - a\frac{\Delta\mathrm{SO}}{\chi\bar{\rho}R} \qquad (3.15')$$

By setting a fine based on $\bar{\rho}$, the authority aims to deter firms from undertaking harmful actions and not to deter any firms from taking benign actions.[58]

If firms do not know the type of their actions, then they can only expect that their actions will be condemned with a probability equal to the average probability with which actions are condemned by the authority, given that it makes both Type I and Type II errors.[59] This average probability is lower than the probability with which harmful actions are condemned and higher than the probability with which benign action are condemned. In practice, $\bar{\rho}$ may be approximated to this average probability. Then, in cases such as those dealt with by sectoral RAs, the parameter $\bar{\rho}$ will be high (close to 1 - the recommended values for $\bar{\rho}$ are then between 0.8 and 1; for example, they are 1 for administrative offenses). More generally, an approximation of parameter $\bar{\rho}$ can be made for any given category of actions, as the rate of cases in this category examined by the CA in the past and concluded that they were offensive.

3.3.2. Desistance and Detection of Infringements before they have reached their Natural Life

Above we have assumed that the offensive behavior lasts for a particular period of time at the end of which the CA intervenes and stops it, i.e. when the firm has already gained the expected benefit $\Delta\pi$. Generally, however, we know that offensive behaviors not only last for many years, but also that the CA can detect them and stop them *before* the firms would do so (referred to in the literature as desistance[60]) or it may not detect them

[58] Given that these latter firms face a lower probability of being condemned, a higher fine than that given by equation (3.15′) is needed to deter them. Y Katsoulacos and D Ulph, "Legal Uncertainty and Competition Law Enforcement Procedures" mimeo, available from www.cresse.info (publications), examine in detail optimal fines under alternative types of uncertainty—here we assume what they call partial legal uncertainty.
[59] This is the situation referred to as complete legal uncertainty in Katsoulacos and Ulph, ibid.
[60] In the legal literature, desistance refers to the "cessation of an offending of antisocial behavior".

for many years after they end.[61] Assuming that the firms know that their offenses can be investigated by the CA before or after the end of their "natural life", Katsoulacos & Ulph (2013) show, using empirical evidence from cases that have been examined by European competition authorities, how this affects the calculation of the optimal fine. Assume that firms are investigated at or before the end of their natural lifetime, ignoring cases where this is not valid.[62] Then the calculation of φ^* and F^* from equation (3.13) above is different, as is shown in Annex C. Let us assume that the natural life of the violation is normalized to unity. Given that, suppose that the duration of the violation is d, $0 < d \leq 1$. The duration is the period from the beginning of the infringement until it is detected and investigated by the CA, so if, for example $d = 0.5$, the infringement is detected in the middle of its natural life.

In this case, F^* and φ^* are given (as $\hat{F}^*$ and $\hat{\varphi}^*$) from equations (3.16) and (3.17) below – equations (3.A28) and (3.A29) in Annex C.

$$\hat{F}^* = a\hat{F}^{TW} + (1-a)\hat{F}^{CS} = \delta[aF^{TW} + (1-a)F^{CS}] = \delta F^* \qquad (3.16)$$

$$\hat{\varphi}^* = \frac{\tilde{F}^*}{dR} = a\hat{\varphi}^{TW} + (1-\alpha)\hat{\varphi}^{CS} = \frac{\delta}{d}\varphi^* \qquad (3.17)$$

More specifically, F^* must be adjusted by multiplying by $\delta = [1 - \chi(1-d)]$. If, for example, $\chi = 0.8$, then, for $d = 1$, 0.75, 0.5, 0.25 and 0.1, F^* must be multiplied by $\delta = 1$, 0.8, 0.6, 0.4 and 0.3, respectively.

3.3.3. Other (Aggravating) Factors that Increase the Base Fine[63]

The objective of this and the next subsection is to take into account and incorporate in the framework above a number of other factors that CAs recognize in practice as important, even though they are difficult to justify on the basis of formal economic analysis. This is consistent with our overall objective of providing a coherent quantitative

[61] I.e. after their "natural life".
[62] Certainly, the vast majority of offenses by firms in regulated markets, such as the energy or telecom markets, are detected and investigated by the RA before the end of their "natural life".
[63] For these factors and those that reduce the base fine see for example the recent OFT guidelines.

methodology for fine setting that can also account for these other factors in order to have practical applicability. Such admittedly more ad hoc considerations, which are, however, routinely taken into account in practice by CAs, include:

- repeated infringements by the same undertaking or other undertakings in the same group;
- continuing the infringement after the start of the investigation;
- role of the undertaking as a leader in, or an instigator of, the infringement;
- involvement of directors or senior management;
- persistent and repeated unreasonable behavior that delays the CA's enforcement action; and
- infringements which are committed intentionally rather than negligently.

We propose that the optimal base fine is multiplied by parameters σ^{ν}, where $\sigma > 1$, ν is the number of repeated infringements and μ, $\mu \geq 1$, where parameter μ captures all the other aggravating factors above that increase the base fine depending on their seriousness.

3.3.4. Other (Mitigating) Factors that Decrease the Base Fine

Such factors taken into account in practice by CAs include:[64]

- genuine uncertainty on the part of the undertaking as to whether the agreement or conduct constituted an infringement.
- adequate steps having been taken with a view to ensuring compliance with competition law.
- the undertaking is acting under severe duress or pressure.
- termination of the infringement as soon as the CA intervenes.
- cooperation which enables the enforcement process to be concluded more effectively and/or speedily.

[64] The same remarks to those mentioned at the beginning of Section 3.3.3 apply here.

We propose that the optimal base fine be multiplied by parameter λ, $0 \leq \lambda \leq 1$ for all the above factors that decrease the base fine.

Considering the above, we have that the optimal final fine, if R is the total revenue during the offense and $\alpha < 1$, $\Delta\pi > 0$, is:

$$\hat{F} = \delta F^*, \; F^* = \varphi_\tau{}^* R, \; \varphi_\tau{}^* = \sigma^\nu \mu\lambda\varphi^*(\bar{\rho}) \tag{3.18}$$

where

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{(1-\alpha)\Delta\pi - \alpha\Delta CS - \alpha\Delta SO}{\chi\bar{\rho}R} \tag{3.19}$$

or

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{\theta}{\chi\bar{\rho}R}\left[\alpha + \frac{(1-\alpha)}{(1+\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - a\frac{\Delta\mathrm{SO}}{\chi\bar{\rho}R} \tag{3.19′}$$

As already mentioned $\delta = [1-\chi(1-d)]$, where d is the desistance parameter, $0 < d \leq 1$.

In the previous example, where we did not take into account errors, desistance (i.e. δ), and the aggravating and mitigating factors, for parameter values $\chi = 0.8$, $\Delta SO = 0$, $\gamma = 0.8 = \psi$ and $\alpha = 0.5$, we have $\varphi^* = 27\%$. If we take these factors into consideration and with $\nu = 5$, $\sigma = 1.05$, $\mu = 1.1$, $\lambda = 0.8$ and $\rho = 0.9$, we have $\varphi^*(\bar{\rho}) = 0.30$ and $\varphi_\tau^* = 33.7\%$. If $R = 100$ million, then $F^* = 33.7$ million. Also if $d = 0.5$, i.e. the infringement is detected in the middle of its natural life, $\delta = 0.6$ and $\hat{F} = 20.2$ million.

3.3.5. Other Factors Affecting the Calculation of the Final Fine - Administrative Violations

We first note that if the CA considers that the firm should be subject to a fine of not less than $\Delta\pi$, then it evaluates the final fine as:

$$F_\tau = \max[\Delta\pi, \hat{F}] \tag{3.20}$$

where

$$\hat{F} = \delta F^*, \; F^* = \varphi_\tau{}^* R, \; \varphi_\tau{}^* = \sigma^\nu \mu\lambda\varphi^*(\bar{\rho}) \tag{3.21}$$

with $\delta = [1-\chi(1-d)]$, d being the desistance parameter, $0 < d \leq 1$,

and

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{\theta}{\chi\bar{\rho}R}\left[\alpha + \frac{(1-\alpha)}{(1+\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - a\frac{\Delta \mathrm{SO}}{\chi\bar{\rho}R} \quad (3.22)$$

In cases that concern administrative offenses and violations of network administrators, cases for which there can be no relevant and reliable estimates of $\Delta\pi$ and $\Delta WO = \Delta CS + \Delta SO$, or of θ, γ and ψ, the final fine should be set as:

$$F_\tau = TF_R \quad (3.23)$$

where F_R is the maximum administrative regulatory fine (e.g. €1,000 – €10,000) per day for the days that the offense lasted and T is the number of days that it lasted. F_R is calculated taking into account the factors listed in Subsections 3.3.3 and 3.3.4 supra. The authority can also impose caps on maximum applicable fines in terms of percentage of overall firm turnover (e.g. 10%) in all markets (and countries) in which it is active (such as the EU and UK CAs do).[65] Of course, this only matters when the firm's revenue in the relevant market is correctly specified for the calculation of the fine, as described above.

3.3.6. The Calculation of the Optimal Fine when there is Desistance and the Realized Profit ($\Delta\pi$) at the Time of the Investigation is Very Small

In cases where the CA detects and investigates an offensive action before the end of its "natural life" - i.e. in cases where there is desistance - the expected benefit that the firm would gain by its behavior in the course of its "natural life" may differ significantly

[65] The USSG suggest that the final fine for undertakings must not exceed a maximum statutory limit which is the greatest of 100 million USD or twice the gross pecuniary gains the violators derived from the cartel or twice the gross pecuniary loss caused to the victims. The maximum level of fines against individuals is the greatest of 1 million USD or twice the gross pecuniary gains or twice the gross pecuniary loss caused to the victims, while a maximum imprisonment sentence can be up to 10 years.

from the benefit that it had realized when the CA intervened[66]. How can we take this into account in the calculation of the fine?

The anti-competitive behaviors that often concern, for example, the sectoral regulatory authorities are "exclusionary behaviors" (foreclosure practices) by dominant firms. Their aim is to remove or weaken competition from existing competitors, or to establish or strengthen entry barriers, thereby removing or weakening potential competition. In cases with desistance, we then face two serious problems:

(a) While the behavior is intended to exclude competitors, exclusion may not have happened when the CA intervened, but it may happen later (perhaps a little later).

(b) The benefit gained before and after the success of the strategy (the exit or marginalization of the competitor) will generally be very different. In many cases the benefit will be very small before the exclusion, or it may even be negative, e.g. if the strategy was "predatory pricing". On the other hand, the benefit after the exclusion will be very large (especially if there is an exit and if entry barriers are high).

From (b) it is implied that if we use benefit realized (the profit of the offender) in the calculation of the fine, the fine will be very small (or even negative!). Also, we cannot alternatively use the harm to others: although (a) implies that the damage to others can be very important, this will only be evident in the future.

Of course, the CA can assume that with high probability, the firm's aim was to force the competitors to exit, given that, in general, a firm with a dominant position would only sacrifice part of its profit if its purpose was to foreclose in the future a competitor, and this would be expected to happen with very high probability. Assume that this probability is ξ (which will be close to 1, if the CAs investigation has provided evidence that the firm has indeed been acting with exclusionary intent). The extra profit that the dominant firm expects after the exclusion of a competitor can in practice be approximated as a percentage of the total revenue of the competitor (which, it can be assumed, will be earned, after the exit, by the firm with the dominant position). In general, a dominant firm is expected to

[66] In general, the literature assumes that the already gained profits from the infringement are equal to the expected profits.

capture the lion's share of the revenues made by an excluded competitor when product differentiation is not very important. For example, in many liberalized network industries, if exclusionary practices by dominant incumbents lead to the exclusion of new entrants, their revenues are likely to be switched back to these incumbents.[67] In this case, the calculation is:

$\Delta\pi$ = already realized profit + ξ × additional expected profit if the competitor is excluded = already realized profit + ξ × f × total revenue of the competitor, where f (f = 0.15 or 0.2), is the fraction of the revenue of the competitor that is expected to be an additional profit by the dominant firm.

However, since there may be legal restrictions on calculating the fine utilizing the type of data just mentioned, we propose that in cases where:

- the facts show a serious violation with exclusionary practices by dominant firms (which practices have yet to lead to exclusion when the case is under investigation but can, according to the authority's assessment, have serious future consequences on the market) and
- the values of $\Delta\pi$ and ΔWO or θ, which can be calculated when the case is under investigation, are much smaller than those that would occur if or when we have an exclusion,

$\varphi_\tau{}^*$ (above) should be increased by a percentage $\tilde{\varphi}$, the size of which could be taken to vary between 1 and 10 per cent, depending on the seriousness of the violation and the size of the expected benefit by the exclusion (which depends on the market share of the excluded firm). The penalty would then be:

$$\tilde{F} = (\varphi_\tau{}^* + \tilde{\varphi})R \qquad (3.24)$$

[67] This is exactly the situation that seems to have characterized, for example, the Greek energy market in the last 5–6 years.

3.4. Summary of the Methodology – Conclusions

Summarizing the suggested methodology we can make a distinction between three categories of offenses[68] to which our methodology can be applied:

Category 1: In this category we have cases for which $\Delta\pi$ and $\Delta WO = \Delta CS + \Delta SO$, or θ, γ and ψ, *cannot* be reliably estimated *and* there is *no* strong evidence of exclusionary behavior by a dominant firm. In these cases, which can take the form of, for example, administrative offenses and violations of network administrators in regulated network industries, the final fine is:

$$F_\tau = TF_R$$

(see equation 3.23 above). We also note that in this case, as well as in the following cases, the authority can impose caps on maximum applicable fines in terms of percentage of overall firm turnover (e.g. 10%) in all markets (and countries) in which it is active.

Category 2: Here we have offenses for which *it is* possible to determine their effect on the market, and we can assume that this effect on $\Delta\pi$ and ΔWO has been completed or almost completed when the case comes under investigation. Then, for the calculation of the fine, the authority can utilize one of two approaches.

Approach A: The authority can calculate, from its estimates of $\Delta\pi$, ΔCS, ΔSO from the data collected for the case, the optimal base fine as:

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{(1-\alpha)\Delta\pi - \alpha\Delta CS - \alpha\Delta SO}{\chi\bar{\rho}R}$$

and thus[69]:

$$\hat{F} = \delta F^*,\ F^* = \varphi_\tau{}^* R,\ \varphi_\tau{}^* = \sigma^\nu \mu\lambda\varphi^*(\bar{\rho})$$

[68] It is possible of course that in a certain case more than one violation can be investigated and these violations may belong to different categories of offenses as defined below.

[69] Concerning the value of the regulatory parameter α see also the comment supra Subsection 3.2.3.

where δ = [1-χ(1-d)], d being the desistance parameter, $0 < d \leq 1$.

Approach B: The authority, from the data collected for the case - specifically, information on the price overcharge and its estimates of cost reduction (efficiency) effects, of the intensity of competition in the "but-for" situation and of ΔSO - can calculate the optimal base fine as:

$$\varphi^*(\bar{\rho}) = \frac{\mathrm{F}^*(\bar{\rho})}{R} = \frac{\theta}{\chi\bar{\rho}R}\left[\alpha + \frac{(1-\alpha)}{(1+\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - a\frac{\Delta\mathrm{SO}}{\chi\bar{\rho}R}$$

and

$$\hat{F} = \delta F^*,\ F^* = \varphi_\tau{}^* R,\ \varphi_\tau{}^* = \sigma^\nu \mu\lambda\varphi^*(\bar{\rho})$$

where δ = [1-χ(1-d)], d being the desistance parameter, $0 < d \leq 1$.

Irrespective of the approach used, if the authority considers that the firm should be subject to a fine of not less than $\Delta\pi$, then it evaluates the final fine as:

$$F_\tau = \max[\Delta\pi, \hat{F}]$$

<u>*Category 3*</u>: In this category we have offences where the facts show a serious violation with *exclusionary practices by dominant firms* - which practices, however, have yet to lead to exclusion when the case is under investigation but can have serious future consequences in the market. In these cases, the values of $\Delta\pi$ and ΔWO or θ, which can be estimated when the case is under investigation, are much smaller than those that would occur if or when there is exclusion. That is why we suggest that $\varphi_\tau{}^*$ (above) be increased by a percentage $\tilde{\varphi}$, the size of which could be taken to vary between 1 and 10 per cent, depending on the seriousness of the violation and the size of the expected benefit by the exclusion (which depends on the market share of the excluded firm). The penalty should thus be:[70]

$$\tilde{F} = (\varphi_\tau{}^* + \tilde{\varphi})R$$

Again, if the authority considers that the firm should be subject to a fine of not less than $\Delta\pi$, then it evaluates the final fine as:

[70] See also supra Section 3.3.6.

$$F_\tau = \max[\Delta\pi, \hat{F}]]$$

3.5. Annex A: Derivation of Expression (3.14)

In this Annex we set out in detail the model on the basis of which the optimal base fine, i.e. equation (3.14), can be calculated.[71] In common with a lot of the literature, we assume that there is a market for a homogeneous product in which the production technology is characterized by constant unit costs. In the counterfactual situation in which the potentially anticompetitive action had not been taken, we assume that the firm would have had constant unit costs $c_0 > 0$, the equilibrium price would have been $p_0 \geq c_0$ and the equilibrium output $Q_0 > 0$. Note that there is no presumption that the counterfactual situation is that of perfect competition. There may be "natural" forces of competition - barriers to entry, limited number of firms - that would have produced an outcome other than perfect competition.

The firm takes some anticompetitive action which can have two effects: it can raise the price-cost margin and it can also have an efficiency effect of lowering costs (which lowers the price). We assume that the former effect dominates the latter such that, overall, the price increases. So formally, once the action has been taken, the unit costs are $c_1, \quad 0 < c_1 \leq c_0$, the equilibrium price is $p_1 > p_0$ and the equilibrium output is $Q_1, \quad 0 < Q_1 < Q_0$.

We define:

$$\theta = \frac{\Delta p}{p_0} = \frac{p_1 - p_0}{p_0} > 0 \qquad (3.A1)$$

Without loss of generality, we normalize prices by assuming that

$$p_0 = 1 \qquad (3.A2)$$

A firm's revenue is equal to $R_i = p_i Q_i, \ i = 0, 1$, and its profit is $\pi_i = R_i - c_i Q_i = (p_i - c_i) Q_i, i = 0, 1$. We assume that $\Delta\pi = \pi_1 - \pi_0 > 0$ so that, absent intervention by a competition authority, the firm would take the action.

[71] See Katsoulacos Y. and Ulph D. (2013).

We also assume that this action imposes harm on others. The demand is a linear function which, by suitable choice of units, can be written as:

$$p = (1 + \varepsilon) - Q, \varepsilon > 0 \tag{3.A3}$$

Given the normalization in (3.A2), $\varepsilon = Q_0 = -\frac{dp}{dQ}.\frac{Q_0}{p_0}$

$$\varepsilon = Q_0 = -\frac{dp}{dQ}\frac{Q_0}{p_0}$$

i.e. the inverse elasticity of demand and is thus a measure of the underlying competitiveness of the industry in which the action is taking place.

It also follows from (3.A2) and (3.A3) that:

$$Q_1 = \varepsilon - \theta \tag{3.A4}$$

so, to ensure positive output, it must be the case that $\theta < \varepsilon$.

Given this demand function it follows that the consumer surplus is

$$CS_i = \tfrac{1}{2}Q_i^2$$

and so

$$-\Delta CS = CS_0 - CS_1 = \frac{1}{2}(Q_0^2 - Q_1^2) > 0 \tag{3.A5}$$

measures the loss of consumer surplus - the harm - caused by the action.

From (3.A3), (3.A4) and (3.A5):

$$\frac{(-\Delta \mathrm{CS})/R}{\chi} = \varphi^{TW} = \frac{\frac{\theta}{1+\theta}\left(1 + \frac{1}{2}\frac{\theta}{\varepsilon - \theta}\right)}{\chi} \tag{3.A6}$$

Note that if $2(\varepsilon - \theta) \approx 1$ then we have:

$$\tilde{\varphi}^{TW} = \frac{\theta}{\chi} \tag{3.A7}$$

Let us now focus on the three terms of equation (3.9). Firstly:

$$\frac{\Delta\pi}{R} = \frac{\theta}{1+\theta} - \frac{D}{R} + \frac{E}{R} \tag{3.A8}$$

where

$$\frac{D}{R} = \frac{(p_0 - c_0)(Q_0 - Q_1)}{R} \tag{3.A9}$$

and

$$\frac{E}{R} = \frac{(c_0 - c_1)Q_1}{R} \tag{3.A10}$$

In equations (3.A8) – (3.A10), *R* is the revenue during the violation and *c* is the marginal cost. Equation (3.A9), therefore, shows the reduction of the profit to its initial price due to the output (*Q*) reduction caused by the anticompetitive action.

If

$$c_0 = \psi p_0,\ 0 < c \leq 1 \tag{3.A11}$$

we have

$$\frac{D}{R_1} = \frac{(1-\psi)p_0(Q_0 - Q_1)}{p_1 Q_1} = \frac{(1-\psi)p_0(Q_0 - Q_1)}{(1+\theta)Q_1} \tag{3.A12}$$

However,

$$(Q_0 - Q_1) = \varepsilon - (\varepsilon - \theta) = \theta \tag{3.A13}$$

And, since $Q_1 = (\varepsilon - \theta)$ and $2(\varepsilon - \theta) \approx 1$

$$Q_1 \approx 1/2 \tag{3.A14}$$

So:

$$\frac{D}{R_1} = \frac{2\theta(1-\psi)}{(1+\theta)} \tag{3.A15}$$

Equation (3.A10), on the other hand, shows the action's efficiency effect: the increase in profits caused by a reduction in cost due to the action. If:

$$c_1 = \gamma c_0,\ 0 < \gamma \leq 1 \tag{3.A16}$$

then:

$$\frac{E}{R_1} = \frac{c_0(1-\gamma)}{p_1} = \frac{c_0(1-\gamma)}{(1+\theta)} = \frac{\psi(1-\gamma)}{(1+\theta)} \tag{3.A17}$$

Substituting equations (3.A15) and (3.A16) in (3.A8) we have:

$$\frac{\Delta\pi}{R_1} = \frac{\theta}{(1+\theta)} + \frac{\psi(1-\gamma)}{(1+\theta)} - \frac{2\theta(1-\psi)}{(1+\theta)} \tag{3.A18}$$

or

$$\frac{\Delta\pi}{R_1} = \frac{\theta}{(1+\theta)}\left[1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right] \tag{3.A19}$$

Now, the other term of equation (3.9) is:

$$-\Delta CS/R = \theta \tag{3.A20}$$

when $2(\varepsilon - \theta) \approx 1$, as shown above. So substituting equations (3.A20) and (3.A19) in (3.9), we have:

$$\varphi^* = \frac{F^*}{R} = \frac{(1-a)\Delta\pi - a\Delta CS - a\Delta SO}{\chi R} \tag{3.A21}$$

or

$$\varphi^* = \frac{F^*}{R} = \frac{\theta}{\chi R}\left[\alpha + \frac{(1-\alpha)}{(1+\theta)}\left\{1 + \frac{\psi(1-\gamma)}{\theta} - 2(1-\psi)\right\}\right] - \alpha\frac{\Delta SO}{\chi R} \tag{3.A22}$$

where if the offence harms the others (except the consumers), $\Delta SO < 0$.

3.6. Annex B: The Optimal Base Fine - Additional Examples

Alternative Scenarios	φ^*
α= 0, χ= 0.8, θ=0.2, γ= 1, ψ=1	21%
α= 0, χ= 0.8, θ=0.2, γ= 0.9, ψ=1	31%
α= 0, χ= 0.8, θ=0.2, γ= 0.8, ψ=1	42%
α= 0, χ= 0.8, θ=0.2, γ= 1, ψ=0.9	17%
α= 0, χ= 0.8, θ=0.2, γ= 1, ψ=0.8	13%
α= 0, χ= 0.8, θ=0.2, γ= 0.9, ψ=0.9	26%
α= 0, χ= 0.8, θ=0.2, γ= 0.8, ψ=0,8	29%
α= 0, χ= 0.5, θ=0.2, γ= 1, ψ=1	33%
α= 0, χ= 0.5, θ=0.2, γ= 0.9, ψ=1	50%
α= 0, χ= 0.5, θ=0.2, γ= 0.8, ψ=1	67%
α= 0, χ= 0.5, θ=0.2, γ= 1, ψ=0.9	27%
α= 0, χ= 0.5, θ=0.2, γ= 1, ψ=0.8	20%
α= 0, χ= 0.5, θ=0.2, γ= 0.9, ψ=0.9	42%
α= 0, χ= 0.5, θ=0.2, γ= 0.8, ψ=0,8	47%
α= 0.5, χ= 0.5, θ=0.2, γ= 1, ψ=1	37%
α= 0.5, χ= 0.5, θ=0.2, γ= 0.9, ψ=1	45%
α= 0.5, χ= 0.5, θ=0.2, γ= 0.8, ψ=1	53%
α= 0.5, χ= 0.5, θ=0.2, γ= 1, ψ=0.9	33%
α= 0.5, χ= 0.5, θ=0.2, γ= 1, ψ=0.8	30%
α= 0.5, χ= 0.5, θ=0.2, γ= 0.9, ψ=0.9	41%
α= 0.5, χ= 0.5, θ=0.2, γ= 0.8, ψ=0,8	43%

If $\alpha = 1$, from (3.13′) we have that φ is independent of γ and ψ, so we calculate alternative scenarios by setting different values to χ and θ.

Alternative Scenarios	φ^*
α= 1, χ= 0.8, θ=0.1	13%
α= 1, χ= 0.8, θ=0.2	25%
α= 1, χ= 0.8, θ=0.3	38%
α= 1, χ= 0.7, θ=0.1	14%
α= 1, χ= 0.7, θ=0.2	29%
α= 1, χ= 0.7, θ=0.3	43%
α= 1, χ= 0.6, θ=0.1	17%
α= 1, χ= 0.6, θ=0.2	33%
α= 1, χ= 0.6, θ=0.3	50%

3.7. Annex C: The Effect of Desistance

In this Annex we derive equations (3.16) and (3.17) in the text. Suppose that $\alpha = 0$ (dissuasive penalties). If we assume that the infringement is detected after its natural life when the violator will have already gained the profit $\Delta\pi$, then the offender's expected profit is $\Delta\pi - \chi F$ or $\Delta\pi - \chi\varphi R$, so

$$\varphi^{CS} = \frac{\Delta\pi}{\chi R}$$

With desistance, let us assume that the infringement's natural life is normalized to unity. Given that, suppose that the duration of the violation is d, $0 < d \leq 1$, where the duration is the period from the beginning of the infringement until it is detected and investigated by the CA. The expected profit is then

$$(1-\chi)\Delta\pi + \chi d\Delta\pi - \chi d\varphi R$$

which means that in this case

$$\hat{\varphi}^{CS} = \frac{\Delta\pi[1-\chi(1-d)]}{\chi dR} = \varphi^{CS}\left(\frac{\delta}{d}\right), \qquad \delta = 1-\chi(1-d) \tag{3.A23}$$

The fine in these two cases are:

$$F^{CS} = \varphi^{CS}R \text{ and } \hat{F}^{CS} = \hat{\varphi}^{CS}dR$$

i.e.:

$$\hat{F}^{CS} = \delta F^{CS} = [1-\chi(1-d)]F^{CS} \tag{3.A24}$$

or

$$\hat{F}^{CS} = [1-\chi(1-d)]\varphi^{CS}R = \frac{[1-\chi(1-d)]\Delta\pi}{\chi} \tag{3.A25}$$

If $\alpha = 1$ (restitutive penalties) without desistance, the expected fine must be equal to the expected harm to others, that is:

$$\chi F^{TW} = -\Delta WO$$

or

$$F^{TW} = -\frac{\Delta WO}{\chi}$$

or

$$\varphi^{TW} = -\frac{\Delta WO}{\chi R}$$

When we have desistance:

$$\chi d\varphi R = -(1-\chi)\Delta WO - \chi d\Delta WO = -\Delta WO[1-\chi(1-d)]$$

and

$$\hat{\varphi}^{TW} = \frac{-\Delta WO}{\chi R}\left(\frac{\delta}{d}\right) = \varphi^{TW}\left(\frac{\delta}{d}\right) \qquad (3.A26)$$

so:

$$\hat{F}^{TW} = \hat{\varphi}^{TW} dR = \frac{-\Delta WO}{\chi}\delta = \frac{-\Delta WO}{\chi}[1-\chi(1-d)] \qquad (3.A27)$$

Equations (3.7) - (3.9) in the text change, due to the existence of desistance, as follows:

$$\hat{F}^{*} = \alpha\hat{F}^{TW} + (1-a)\hat{F}^{CS} = \delta[aF^{TW} + (1-a)F^{CS}] = \delta F^{*} \qquad (3.A28)$$

and

$$\hat{\varphi}^{*} = \frac{\hat{F}^{*}}{dR} = a\hat{\varphi}^{TW} + (1-\alpha)\hat{\varphi}^{CS} = \frac{\delta}{d}\varphi^{*} \qquad (3.A29)$$

3.8. Annex D: List of Variables and Parameters (and their reasonable values)

χ	The probability that the firm's action is going to be investigated by the CA (coverage rate). $0 < \chi \leq 1$. Although for CAs χ can be small, for Regulatory Authorities the possibility that a significant violation is not detected by the RA is small, i.e. χ in this case is relatively large.
F	Fine as a percentage of the firm's revenue (R) $F > 0$
ΔWO	The harm to all the others or welfare loss due to the anti-competitive behavior. $\Delta WO = \Delta CS + \Delta SO$
ΔCS	The harm (welfare loss) to the consumers due to the anti-competitive behavior. $\Delta CS < 0$
ΔSO	The harm (welfare loss) to others due to the anticompetitive behavior.
CS	Consumer Surplus
$\Delta\pi$	The increase of the firm's profit due to the anticompetitive behavior. $\Delta\pi > 0$
ΔW	The change in social welfare due to the anticompetitive behavior.
R	The firm's revenue due to the anticompetitive behavior.
φ	The fraction of the adjusted for the duration of the infringement revenue from the anti-competitive behavior. $\varphi > 0$
p_0, p_1	Prices before and after the infringement respectively. $p_0 > 0, p_1 > 0, p_0 < p_1$

$\boldsymbol{\theta}$	The price overcharge $\frac{\Delta p}{p_0}$.
	$\theta > 0$. Suggested reasonable values $\theta = 0.05, 0.1, 0.2, 03$
$\boldsymbol{\varepsilon}$	The inverse elasticity of demand.
	$\varepsilon > 0$
$\boldsymbol{\alpha, 1\text{-}\alpha}$	The parameter with which the CA weights the restitutive and dissuasive elements of the base fine.
	$0 \leq \alpha \leq 1$. See text above for suggested values.
$\boldsymbol{Q_0, Q_1}$	The output before and after the anticompetitive behavior respectively.
	$0 < Q_1 < Q_0$
$\boldsymbol{c_0, c}$	The cost before and after the anticompetitive behavior.
	$0 < c_1 < c_0$
$\boldsymbol{d}$	The duration of the infringement as a fraction of its "natural life" normalized to unity.
	$0 < d \leq 1$
$\boldsymbol{\psi}$	$\frac{c_0}{p_0}$, Measures the intensity of the competition before the infringement.
	$0 < \psi \leq 1$ (with $\psi = 1$, "perfect competition"). Reasonable ψ values, $\psi = 0.8, 0.9, 1$
$\boldsymbol{\gamma}$	$\frac{c_1}{c_0}$, Measures the efficiency effect (cost reduction) from the anticompetitive behavior.
	$0 \leq \gamma \leq 1$,– Reasonable values for γ, $0.8 \leq \gamma \leq 1$
$\boldsymbol{\bar{\rho}}$	The average probability that the CA, after investigating an action, will decide that the action is deemed to be harmful and a fine must be imposed.
	$0 < \bar{\rho} \leq 1$, Reasonable values for Regulatory Authorities, $0{,}8 \leq \bar{\rho} \leq 1$

$\boldsymbol{\delta}$ Parameter used in the calculation of φ to in order to include cases where we have desistance.

δ depends on how fast the CA detects the infringement.

$\boldsymbol{\sigma^{v}}$ Parameter used in the calculation of the base fine in order to include repeated infringements.

$\sigma > 1$, v = the number of the repeated infringements. Reasonable values $\sigma = 1.05$ and 1.1.

$\boldsymbol{\mu}$ Parameter used in the calculation of the base fine in order to include the other factors that increase it, as mentioned above.

$\mu \geq 1$, depending on the significance of the factors we suggest $\mu = 1.05$, 1.1, 1.15, 1.2.

$\boldsymbol{\lambda}$ Parameter used in the calculation of the base fine in order to include the other factors that decrease it, as mentioned above.

$\lambda \leq 1$. Depending on the significance of the factors, we suggest $\lambda = 0.85$, 0.9, 0.95.

Chapter 4

Dominance, Product Differentiation and the Effects of Exclusion

4.1. Introduction – Objectives – Motivation

While the standard textbook definition of market power is that of the ability of an undertaking to increase price above the marginal cost (i.e. above the competitive levels), in antitrust it is generally presumed that an undertaking with market power will also have the ability and incentive to harm the process of competition, for example by excluding competitors, raising entry barriers or affecting the competitive process in general.[72]

Indeed, as shown in Chapter 1, in antitrust law the notion of market power "is frequently used as a screen: a firm (or group of firms) must be shown to have some level of market power as a prerequisite to considering whether the conduct in question gives rise to antitrust liability. As a result, antitrust investigations and adjudications devote substantial attention[73] to whether or not the requisite market power exists"[74].

When "sufficient market power is established it is then asked whether the conduct in question – say, a horizontal merger or an alleged act of monopolization – constitutes an antitrust violation. If sufficient market power is not demonstrated, the inquiry terminates with a victory for the defendant"[75]. While the terminology used in these quotes is that of

[72] OFT 402 (2004), "Abuse of a dominant position".
[73] The significant expansion of the concept of market power and its integration in competition law through the years is demonstrated by Lianos (2009), who measured the total number of citations to market power in court cases, Commission's decisions, guidelines and regulatory texts relevant to competition law and saw an extensive increase over the last decades.
[74] Kaplow and Shapiro (2007), p. 20
[75] Ibid p. 2.

the US law[76], in EU the principles are similar, but instead of the notion of "market power" the notion of "dominance" is used and instead of the notion of "act of monopolization" the notion of "abusive (exclusionary) conduct" is used[77].

A number of reasons are usually offered in order to justify the market power requirement in Competition Law enforcement. First, "If one were minimizing a loss function in which there was uncertainty about the practices under scrutiny, *and if the degree of harm conditional on the practices being detrimental was rising with the extent of market power*, an optimal rule could be stated as entailing a market power requirement that was highly contextual"[78], in order to minimize false positives. Second, the high costs of litigation have to be constrained and, third, to avoid adverse deterrence effects ("chilling routine competitive behavior"[79])[80].

However, a number of important issues are raised by the market power requirement, the first of which concerns the issue of how high the market power requirement should be[81]. How much market power constitutes what the US and EU laws describe as «monopoly power» or «dominance», respectively? The law does not provide an answer. Even if a quantitative answer was given it would, in any case, be very difficult to obtain direct estimates in any specific investigation and, from very early on, the legal approach has relied on *market share* to provide an (albeit, indirect) answer the question of what constitutes monopoly power or dominance[82]. In order to better apprehend this limitation we first have

[76] US Sherman Act, Section 2.

[77] These are the notions that underline art. 102 TFEU on abuse of dominance. There is however an importance difference between the two jurisdictions: in US, in contrast to EU, the mere possession of market power is not violation of antitrust law. Thus, in US law a monopolization offence must have two elements: "(1) the possession of monopoly power in the relevant market *and* (2) the willful acquisition or maintenance of that power as distinguished from growth or development as a consequence of a superior product, business acumen, or historic accident" (ibid., p.20, our italics).

[78] Ibid., p. 20 (our italics).

[79] Ibid., p. 101.

[80] Another way of putting this is to say that when firms lack significant market power or any serious prospect of acquiring it then "there is likely to be little benefit from examining in detail the effects of their conduct, whereas substantial costs of administration, mistaken prohibition and inhibition of competitive rigor can be avoided by in essence granting them immunity" (ibid, p. 101).

[81] Also, the cost and potential for error in the market power inquiries themselves –Kaplow and Shapiro (2007), p. 102.

[82] Thus in the famous US (1945) *Alcoa case*, a prominent group of judges pronounced that a 90% market share "is enough to constitute a monopoly; it is doubtful whether sixty or sixty-four per cent would be enough; and certainly thirty three per cent is not". As Kaplow and Shapiro (2007, p. 106) note "The difficulty in interpreting this statement is that two distinct issues are conflated: how much market power was thought to exist in that case? (a fact question distinctive to that industry under the then-existing conditions), and how

to consider the determinants of market power. It is often argued that a firm's market power is related to its market share. However, share is not necessarily equivalent to market power. Product differentiation and market concentration (that depends on rivals' share distribution) account for much of an undertakings exercise of market power. Kaplow points out that: "… the inferences drawn from market shares in relevant markets generally contain less information and accordingly can generate erroneous legal conclusions" (2010).

The fundamental problem is that, as the standard models of industrial organization theory show a given market share in a properly defined market does not convey the same information about market power regardless of the market. The standard models of Cournot oligopoly or of a dominant firm with a competitive fridge of rivals indicate that a small market share can imply significantly different market power depending on the elasticity of demand and the elasticity of supply of the competitive fridge, and the problem becomes even more acute in differentiated product markets. As Landes and Posner illustrated many years ago (1981), while it is meaningful to interpret shares in homogeneous goods markets, a given share can convey significantly different levels of market power in different markets characterized by different demand elasticities and/or elasticities of rivals' supply. On the same premises Schmalensee (1981) argued that "computation of market share can provide information about the importance of market power, but markets differ considerably, and shares should be interpreted in light of evidence on market demand elasticities and other conditions". In differentiated product markets the intensity of competition and substitution between products is a more important indicator of market power than market shares in assessing the effects of an anticompetitive action. Farrell and Shappiro (2010) stress a similar issue, "Because of the differentiation, defining the relevant market (in order to obtain estimates of market shares) can be problematic, and the link between market shares and competitive effects can be weak and/or confusing". An implication is that, as Evans (2010) mentions, there is no basis in economics for relying on market shares for triggering **safe harbor provisions.**

much market power is deemed sufficient to constitute monopoly power? The standard procedure for obtaining estimates of market shares is to first define the "relevant" antitrust market.

Notwithstanding the above issues, for many practices, as Kaplow and Shapiro (2007) conclude "it may make sense both to insist that the firm possess some significant level of market power and that the challenged practices contribute importantly to it. Regarding the former, it often would not much matter whether the overall level of market power was measured with or without the challenged practices".[83] Regarding the latter, that the challenged practices should *contribute* significantly to market power, while it would seem that, beyond a possible *de minimis* level, any increment should be condemned, again the need to avoid false positives and, very importantly, the fact that mergers as well as many monopolization practices can have also significant efficiency effects, imply that for a liability finding one would need to balance anticompetitive (market power enhancing) effects with efficiency effects and that balance "would importantly depend on whether the standard is limited to consumer surplus or is defined in terms of total economic welfare"[84].

In relation to the latter question, there is currently great controversy over the proper antitrust substantive standard. Among those who have recently reviewed the debate concerning whether consumer surplus or total surplus should be the substantive standard for competition authorities, we can include Farrell and Katz (2006) and Salop (2010). Kaplow (2012), examines an important issue that bears on this choice. He looks at how the extant market power (or, *initial price elevation*) in a market affects the change in Consumer Surplus (ΔCS) and the change in Total Welfare (ΔTW) of a given price increase. He notes that, the higher the initial price elevation, the *smaller* the ΔCS and the *larger* the ΔTW generated by a given price increase. He uses this observation to question the current approach in competition law enforcement (for mergers and monopolization cases) which, as mentioned above, imposes «stricter scrutiny» in the cases where the initial price elevation (or market power) is high, since, as he mentions, «This approach is rational if a total welfare standard is embraced... By contrast, if consumer welfare standard were the objective, priorities should be reversed... (p.17). Thus, according to Kaplow the initial

[83] Unless they had a very large impact in which case it usually makes sense to consider power with the practices. If practices "have had time to take effect and the result is substantial market power, it hardly seems sensible to excuse the defendant that asserted its power would be small without the practices, for that would be admission of large anticompetitive effects" (ibid. p. 103 – 104).
[84] Ibid, p. 104.

significant market power requirement cannot, *ceteris paribus*, be justified if a *CSS* is used but can be justified if a *TWS* is used.

In this chapter, we extend Kaplow's analysis and discuss in detail the role of the size of *extant market power* (measured by the size of the extant Lerner index) as a predictor of the size of the reduction in welfare generated by anticompetitive actions. We concentrate on monopolization or abuse of dominance cases in which an exclusionary action by the dominant firm eliminates one of the rival firms. We emphasize the point, which emerges from our analysis, that the *source* of market power is important in understanding how changes in the size of extant market power affect the size of the reduction in welfare, distinguishing between Consumer Surplus and Total Welfare, generated by anticompetitive actions. We consider the *type of product differentiation*, vertical and horizontal, and *market structure* as alternative sources of market power[85].

Taking into account[86] that it is important, in order to justify the market power requirement, that *the degree of harm conditional on the practices being detrimental is rising with the extent of market power,* we show that a significant extant market power requirement can indeed be justified if a *TWS or* a *CSS* is used and this will be the case if the market power is the result of horizontal product differentiation or the result of a smaller initial number of competing firms. However, we also show that an initial significant market power requirement cannot be justified under *either* a *CSS* or a *TWS* when the market power is the result of vertical product differentiation.

We also discuss the relationship between the degree of extant market power and the *market share* under different market configurations relating to product differentiation and market structure as well as the extent to which the market share can be a reliable indicator of the change in welfare induced by anti-competitive (exclusionary) conduct.

The earliest and probably closest predecessor to the analysis undertaken in this chapter, in terms of modeling assumptions, is the paper by Hackner (2001). Hackner, analyses theoretically the implications of applying the standard procedure for market

[85] We assume throughout an exogenously given level of entry barriers that sustain market power – we recognize of course that product differentiation and the determinants of market structure can affect entry barriers.
[86] As noted above, given the objective to minimize false positives.

delineation and examined whether a positive relation between actual and assessed market dominance (i.e., market power) can be justified. Actual market power is measured in terms of the price-cost margin and assessed market power is measured in terms of market shares. He also studies whether the market delineation test does not discriminate between different sources of market power. In order to address these issues, he extends the Dixit (1979) model to allow for an arbitrary number of firms as well as for vertical and horizontal product differentiation. He concludes that "actual market power is positively related to quality and to horizontal product differentiation and negatively related to the number of firms active in the market". On the other hand, "the assessed degree of market dominance (i.e. market power) may be negatively related to product quality" and in this case "the results are ambiguous with respect to the total number of firms". Hence, combining these results suggests that "the correlation between actual market power and assessed market dominance is likely to be weak and that the procedure for market delineation discriminates strongly among different sources of market power."

Despite the initial similarities, the ultimate objectives and hence much of the analysis contained in Hackner and in this chapter are different. His objective is to examine the extent to which the use of the standard market delineation procedures lead to outcomes in which market power is correlated with assessed market dominance independently of the sources of market power related to product differentiation. We have nothing to say about issues of market definition. Instead we wish to examine in detail the role of the size of extant market power (measured by the size of the extant Lerner index) as a predictor of the size of the reduction in welfare generated by anticompetitive actions and the implications of this for the choice of substantive standard used by Competition Authorities.

The structure of the chapter in as follows. In the next section we describe in detail our model, while in section 4.3 we derive and discuss our results on the relations between extant market power, market share and the effects on *CS* and *TW* of exclusionary actions. Section 4.4 offers concluding remarks.

4.2. Description of the Model

To examine the effects of exclusionary actions and relate these effects to the level and sources of extant market power we construct a simple linear model of oligopolistic competition with product differentiation, similar to those used in the analysis of the impact of mergers. The main innovation, relative to these alternative models, which assume some form of horizontal product differentiation, is the presence in the model below of both horizontal and vertical product differentiation. Indeed in our model, while there is some degree of horizontal differentiation between the products of all firms, it is vertical differentiation that distinguishes one of the firms, the dominant firm, from the other firms in the market and that is ultimately responsible for the difference in market shares between firms in market equilibrium. Vertical differentiation, implying that for equal prices all consumers show a preference for a product relative to the other products, can be the result in practice of objective quality differences but also the result of perceived differences supported by investments in advertisement. Exclusionary actions and their effects can be modelled «as-if» the degree of vertical differentiation between the firm taking these actions and other firms increased. Thus, in our model, market power is affected by the number of firms, the degree of horizontal product differentiation and the degree of vertical product differentiation. Firms are assumed to be symmetric in terms of costs.

As just noted, to model exclusion of rivals, we assume that the dominant firm can take some action that, in the context of the model, can be said to enhance the vertical differentiation gap between its product and the product of rival firms. That is an action leading to a shift in consumers' purchases towards its product for any given prices. This action can be the offering of a scheme of retroactive (loyalty) rebates or of exclusive contracts to the products' distributors. As a result, a smaller number of rivals can survive in the market. We examine the Bertrand-Nash equilibrium before and after the exclusionary action.

More specifically, let us assume that four firms are producing differentiated products[87]. Following Vives (1999) the utility function for the products of the four firms 1, 2, 3 and 4 is as follows[88]:

$$u(x) = \sum_{i=1}^{4} a_i x_i - \frac{1}{2}(\beta \sum_{i=1}^{4} x_i^2 + 2s \sum_{j \neq i} x_i x_j)$$

We simplify by assuming that: $a_1 = \alpha,\ \alpha_2 = \alpha_3 = \alpha_4 = \tilde{\alpha},$ and $\beta = 1$. So, for firm 1 we get the inverse demand function:

$$p_1 = \frac{\partial u}{\partial x_1} = a - x_1 - s \sum_{j \neq 1} x_j \ \rightarrow$$

$$p_1 = a - x_1 - s(x_2 + x_3 + x_4)$$

$$0 < a, 0 < s < 1$$

Similarly for firms 2, 3 and 4, so we have the demand functions:

$$\begin{aligned} p_1 &= a - x_1 - s(x_2 + x_3 + x_4) \\ p_2 &= \tilde{a} - x_2 - s(x_1 + x_3 + x_4) \\ p_3 &= \tilde{a} - x_3 - s(x_1 + x_2 + x_4) \\ p_4 &= \tilde{a} - x_4 - s(x_1 + x_2 + x_3) \end{aligned} \qquad (4.1)$$

$$0 < \tilde{a} < a, 0 < s < 1$$

where *s, 0 < s < 1*, measures the degree of horizontal differentiation among the products of the four firms – assumed symmetric. The higher the value of the parameter *s* the smaller the degree of horizontal differentiation. Parameters α and $\tilde{a}$, $\tilde{a} < a$, are demand-shift parameters that can also be thought of as measuring the degree of vertical differentiation between the products of firm 1 and its competitors. Given that $\tilde{a} < a$ if prices are the same, consumers will prefer to purchase a relatively greater quantity of product 1 than any of the

[87] The analysis is easily extended to markets with a different number of firms.
[88] See Vives X. (1999) "Oligopoly Pricing" MIT Press, pp. 146. See also Hackner (2000), Journal of Economic Theory and Hsu J & Henry Wang (2005), Review of Industrial Organization.

other products and the strength of this preference increases as the difference between $\tilde{a}$ and a increases (equations (4.2) below). We will call firm 1 the "dominant" firm.

From (4.1) we can obtain the demand functions (4.2):

$$\begin{aligned} x_1 &= \gamma[A - p_1(1+2s) + s(p_2 + p_3 + p_4)] \\ x_2 &= \gamma[\Gamma - p_2(1+2s) + s(p_1 + p_3 + p_4)] \\ x_3 &= \gamma[\Gamma - p_3(1+2s) + s(p_1 + p_2 + p_4)] \\ x_4 &= \gamma[\Gamma - p_4(1+2s) + s(p_1 + p_2 + p_3)] \end{aligned} \qquad (4.2)$$

$$\gamma = \frac{1}{1 + s(2 - 3s)} > 1$$

where:

$A = [a(1+2s) - 3\tilde{a}s]$

$\Gamma = [\tilde{\alpha} - \alpha s]$

From equations (4.2) we can define the CS, which is given by[89]:

$$CS = \left(\frac{1-s}{2}\right)\sum_{i=1}^{4} x_i^2 + \left(\frac{s}{2}\right)\left(\sum_{i=1}^{4} x_i\right)^2 \qquad (4.3)$$

and the *TW*, as the sum of *CS* and profits.

Bertrand Nash Equilibrium (BNE) prices and market shares

We assume that all firms have a constant marginal cost of *c*. So the profit of firm *i = 1, 2, 3, 4* is given by:

$$\Pi_i = (p_i - c)x_i - F$$

where $F \geq 0$ is the fixed cost, the same for all firms. Profit maximization with price competition requires that:

[89] See also Hsu J & Henry Wang (2005), Review of Industrial Organization.

$$\frac{\partial \Pi_i}{\partial p_i} = x_i - \gamma(1+s)(p_i - c) = 0$$

From the last condition, we have for each firm:

$$\begin{aligned} A - 2(1+2s)p_1 + s(p_2 + p_3 + p_4) + c(1+2s) &= 0 \\ \Gamma - 2(1+2s)p_2 + s(p_1 + p_3 + p_4) + c(1+2s) &= 0 \\ \Gamma - 2(1+2s)p_3 + s(p_1 + p_2 + p_4) + c(1+2s) &= 0 \\ \Gamma - 2(1+2s)p_4 + s(p_1 + p_2 + p_3) + c(1+2s) &= 0 \end{aligned} \tag{4.4}$$

From the last three of equations (4.4), clearly the prices of firms 2, 3 and 4 will be the same, say:

$$p_2 = p_3 = p_4 = \tilde{p}^B = \frac{\Gamma + (1+2s)c + sp_1}{2(1+s)} \tag{4.5}$$

So, from the first of equations (4.4) using (4.5) we get the Bertrand-Nash Equilibrium value of price for firm1 (the Dominant firm):

$$p_1^B = \frac{2A(1+s) + 3s\Gamma + (1+2s)c(2+5s)}{(2+s)(2+5s)} \tag{4.6}$$

and substituting back in (4.5) we get the BNE price of firms 2, 3 and 4:

$$\tilde{p}^B = \frac{As + 2\Gamma(2s+1) + (1+2s)c(2+5s)}{(2+s)(2+5s)} \tag{4.7}$$

We can also write the BNE quantities as follows:

$$\begin{aligned} x_1^B &= \gamma[A - (1+2s)p_1^B + 3s\tilde{p}^B] \\ x_2^B &= \gamma[\Gamma - \tilde{p}^B + sp_1^B] \\ x_3^B &= \gamma[\Gamma - \tilde{p}^B + sp_1^B] \\ x_4^B &= \gamma[\Gamma - \tilde{p}^B + sp_1^B] \end{aligned} \tag{4.8}$$

Thus, using (4.5), (4.6) and (4.8), we can define the shares of the 4 firms as follows:

$$s_i = \frac{p_i^B x_i^B}{\sum_{i=1}^4 p_i^B x_i^B} \tag{4.9}$$

and the profit in BNE:

$$\Pi_i^B = (p_i^B - c)x_i^B - F \qquad (4.10)$$

From (4.3) and (4.10) we can calculate the CS and profit arising in the BNE, and therefore also Total Welfare.

4.3. Relations between Extant Market Power, Market Shares and the Effects of Exclusionary Actions

4.3.1. Market Share as a Predictor of Extant Market Power

a. We start by examining how extant market power and market share vary with the degree of horizontal differentiation for given vertical differentiation and number of firms.

Considering the BNE under alternative levels of horizontal differentiation for given vertical differentiation and number of firms (see Table 4.1), we observe that if the degree of horizontal differentiation is low, say s = 0.9, the Lerner index of Firm 1 is quite small (25%) and its market share appears to be substantially high. When the degree of horizontal differentiation is increased (s = 0.4), the Lerner index increases to 53%, and the market share of Firm 1 decreases. On the other hand, concerning the Lerner index and market shares of the other firms we can see that they both increase as horizontal differentiation increases. So we have:

Result 1: Given the degree of vertical differentiation and the number of firms, as horizontal differentiation increases (s is smaller), on the one hand market shares become much more symmetric while on the other hand the Lerner index increases. Thus, *market shares vary inversely with the Lerner index as horizontal differentiation increases.*

Table 4.1. BNE with four firms: Firm 1 and Firms 2, 3, 4

$(c = 2,\ a = 10, \tilde{a} = 9)$

	$s = 0.4$	$s = 0.5$	$s = 0.6$	$s = 0.7$	$s = 0.8$	$s = 0.9$
p_1	4.2	3.9	3.5	3.2	2.9	2.7
$p_{2,3,4}$	3.7	3.3	3.0	2.7	2.4	2.1
L_1	0.53	0.48	0.43	0.38	0.32	0.25
$L_{2,3,4}$	0.46	0.40	0.33	0.25	0.16	0.05
ms_1	33.7%	35.7%	38.4%	42.7%	50.9%	72.7%
$ms_{2,3,4}$	22.1%	21.4%	20.5%	19.1%	16.4%	9.1%

Result 2: Vertical differentiation operates as a force that increases significantly market share when horizontal differentiation is low while, given the degree of vertical differentiation, market shares become much more symmetric with high horizontal differentiation. To illustrate this, we juxtapose the above findings (Table 4.1) with data from the extreme case where we assume complete absence of vertical differentiation (Table 4.2). As we can see, market share shows massive increase due to the existence of vertical differentiation, when horizontal differentiation is low (*s = 0.9*) - up to 190% compared to the symmetric case. On the other hand, when horizontal differentiation is high (*s = 0.4*) the market share increase due to the existence of vertical differentiation is much smaller (about 50%).

Table 4.2. BNE with four firms: Firm 1 and Firms 2, 3, 4

$(c = 2)$

	$s = 0.4$		$s = 0.5$		$s = 0.6$		$s = 0.7$		$s = 0.8$		$s = 0.9$	
	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 10$
p_1	4.2	4.0	3.9	3.6	3.5	3.2	3.2	2.9	2.9	2.6	2.7	2.3
$p_{2,3,4}$	3.7	4.0	3.3	3.6	3.0	3.2	2.7	2.9	2.4	2.6	2.1	2.3
L_1	0.53	0.5	0.48	0.44	0.43	0.38	0.38	0.31	0.32	0.22	0.25	0.12
$L_{2,3,4}$	0.46	0.5	0.40	0.44	0.33	0.38	0.25	0.31	0.16	0.22	0.05	0.12
ms_1	33.7%	25%	35.7%	25%	38.4%	25%	42.7%	25%	50.9%	25%	72.7%	25%
$ms_{2,3,4}$	22.1%	25%	21.4%	25%	20.5%	25%	19.1%	25%	16.4%	25%	9.1%	25%

Thus, in markets where vertical differentiation is the main source of differentiation (horizontal differentiation is low) market share is a particularly unreliable proxy of market power. Further as we see below, it is a very unreliable proxy for the harm generated by anticompetitive actions.

b. Next we examine how extant market power and market share vary with vertical differentiation for given horizontal differentiation and market structure.

In this case we assume a constant level of horizontal differentiation (s) and allow the degree of vertical differentiation (α and $\tilde{\alpha}$) to vary. The results are summarized in Table 4.3. Here, we notice that as vertical differentiation increases the Lerner index and market share of Firm 1 increase as well, while the Lerner index and market share of the rivals decrease. Thus we have:

Table 4.3. BNE with four firms: Firm 1 and Firms 2, 3, 4

$(c = 2,\ s = 0.4)$

	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 8$	$a = 10$ $\tilde{a} = 7$	$a = 10$ $\tilde{a} = 6$	$a = 10$ $\tilde{a} = 5$	$a = 10$ $\tilde{a} = 4$
p_1	4.2	4.5	4.7	4.9	5.1	5.4
$p_{2,3,4}$	3.7	3.4	3.0	2.7	2.4	2.1
L_1	0.53	0.55	0.57	0.59	0.61	0.63
$L_{2,3,4}$	0.46	0.40	0.34	0.26	0.16	0.02
ms_1	33.7%	44.6%	57.3%	71.5%	85.7%	98.3%
$ms_{2,3,4}$	22.1%	18.5%	14.2%	9.5%	4.8%	0.6%

Result 3: For given horizontal differentiation and market structure, as vertical differentiation increases the dominant firm's Lerner index increases likewise and market shares become more asymmetric. In other words, market shares vary directly with the Lerner index as vertical differentiation increases.

c. Finally, we examine how extant market power and market share vary with changes in the number of firms for given horizontal and vertical differentiation

As standard industrial organization predicts and as already mentioned, except of product differentiation, *market structure,* is another alternative source of market power. This is of course a prediction that also holds with the current model. As Table 4.4 indicates the Lerner index and the market shares of both the dominant firm and its rivals increase when the number of firms in the equilibrium is smaller. That is:

Table 4.4. BNE for various numbers of firms

$(c = 2,\ a = 10, \tilde{a} = 9, s = 0.4)$

	BNE with 5 firms	BNE with 4 firms
p_1	4.0	4.2
p_{others}	3.4	3.7
L_1	0.50	0.53
L_{others}	0.42	0.46
ms_1	28.5%	33.70%
ms_{others}	17.9%	22.10%

Result 4: The higher the number of firms active in the market, the lower their market share and Lerner index, i.e. market shares and the Lerner index vary directly as the number of firms in the BNE decreases. We show that this holds for all firms and regardless of the degree of differentiation (horizontal or vertical).

4.3.2. Extant Market Power and the Effects of Exclusion

We turn now to an examination of how the level of extant market power (or of the *initial price elevation*) affects the magnitude of the change in *CS* and of the change in *TW* that is produced by an anticompetitive action that results in the exclusion of a rival firm.

As noted above, this issue was stressed by Kaplow (2012). He looked at how the initial price elevation in a market affects the *ΔCS* and the *ΔTW* of a given price increase. He noted that the higher the initial price elevation the *smaller* the *ΔCS* and the *larger* the *ΔTW generated by a given price increase*. He used this observation to question the current approach in competition law enforcement (for mergers and monopolization cases) which on the one hand imposes «stricter scrutiny» in the cases where the initial price elevation is high and on the other relies on a *CS* standard. As he mentions, the market power

requirement «is rational if a total welfare standard is embraced.....By contrast, if consumer welfare standard were the objective, priorities should be reversed.....» (p.17).

The insight of Kaplow (2012), concerning the importance of the initial price elevation is very important. However, in practice, the initial price elevation will be associated to many different factors, for example, differences in costs, demand factors or differences in the market structure (different number of rivals) or in competitive behavior. For each case the welfare implications of price increases cannot be deduced in the manner that Kaplow (2012) proposes. *The source of the initial price elevation can be important to the result.* Further, in practice competition authorities will be concerned with the implications for prices of specific conduct or actions and, the same anticompetitive action, is unlikely to produce the same price increase across these different cases.

Here, we consider the implications of the extant market power or the initial price elevation, in the context of monopolization cases, but we do so by considering different sources of market power and looking at how the initial price elevation across markets with different degrees of horizontal and/or vertical differentiation and different market structures affects ΔCS and ΔTW produced by the *exclusion of a rival firm*. In contrast to Kaplow (2012) we show that depending on the *source* of the extant market power its size can vary directly or inversely with the effects of exclusion on *CS* and *TW* and a significant initial market power requirement can either be justified for *both* a *CSS* and a *TWS* or for *neither* of them.

More specifically, our main results are as follows:

Result 5: The greater is the extant market power, as measured by the Lerner index, due to higher horizontal differentiation, for given market structure and degree of vertical differentiation, the *greater* the ΔCS *and* the ΔTW due to the exclusion of a rival firm. Note also that in this case the market share of the dominant firm varies *inversely* with the welfare effects of exclusion. These can be seen by inspection of Table 4.5.

Table 4.5. Effects of exclusion - 4 to 3 Firms for various degrees of horizontal differentiation ($c = 2,\ a = 10, \tilde{a} = 9$)

	$s = 0.4$	$s = 0.5$	$s = 0.6$	$s = 0.7$	$s = 0.8$	$s = 0.9$
BNE with four firms: Firm 1 and Firms 2, 3, 4						
p_1	4.2	3.9	3.5	3.2	2.9	2.7
$p_{2,3,4}$	3.7	3.3	3.0	2.7	2.4	2.1
L_1	0.53	0.48	0.43	0.38	0.32	0.25
$L_{2,3,4}$	0.46	0.40	0.33	0.25	0.16	0.05
ms_1	33.7%	35.7%	38.4%	42.7%	50.9%	72.7%
$ms_{2,3,4}$	22.1%	21.4%	20.5%	19.1%	16.4%	9.1%
BNE with three firms: Firm 1 and Firms 2, 3						
p_1	4.6	4.2	3.9	3.5	3.1	2.8
$p_{2,3}$	4.0	3.6	3.3	2.9	2.5	2.2
ms_1	42.2%	43.8%	46.1%	49.7%	56.4%	74.3%
$ms_{2,3}$	28.9%	28.1%	26.9%	25.1%	21.8%	12.8%
Percentage Differences in CS and TW						
ΔCS	-18.3%	-15.7%	-12.7%	-9.5%	-5.9%	-2.3%
ΔTW	-9.0%	-6.4%	-4.1%	-2.2%	-0.7%	-0.1%

Thus when the extant market power is the result of horizontal differentiation its size varies directly with the harm (as measured either in terms of *ΔCS* or in terms of *ΔTW*) that is generated by the exclusionary action and so an initial significant market power requirement can be justified if either a *TWS or* a *CSS* is used, in contrast to Kaplow's (2012) contention.

Result 6: The greater the extant market power due to a higher degree of vertical product differentiation, for given market structure and degree of horizontal differentiation, the *smaller* the *ΔCS and* the *ΔTW* due to the exclusion of a rival firm. Thus, when the initial market power is due to vertical differentiation, the higher this is the *smaller* the

welfare effects of exclusion. Note also that in this case the market share of the dominant firm varies *directly* with its extant market power (the Lerner index) and so inversely with welfare effects of exclusion. See Table 4.6.

Table 4.6. Effects of exclusion - 4 to 3 Firms for various degrees of vertical differentiation ($c = 2,\ s = 0.4$).

	$a = 10$ $\tilde{a} = 9$	$a = 10$ $\tilde{a} = 8$	$a = 10$ $\tilde{a} = 7$	$a = 10$ $\tilde{a} = 6$	$a = 10$ $\tilde{a} = 5$	$a = 10$ $\tilde{a} = 4$
BNE with four firms: Firm 1 and Firms 2, 3, 4						
p_1	4.2	4.5	4.7	4.9	5.1	5.4
$p_{2,3,4}$	3.7	3.4	3.0	2.7	2.4	2.1
L_1	0.53	0.55	0.57	0.59	0.61	0.63
$L_{2,3,4}$	0.46	0.40	0.34	0.26	0.16	0.02
ms_1	33.7%	44.6%	57.3%	71.5%	85.7%	98.3%
$ms_{2,3,4}$	22.1%	18.5%	14.2%	9.5%	4.8%	0.6%
BNE with three firms: Firm 1 and Firms 2, 3						
p_1	4.6	4.8	4.9	5.1	5.3	5.5
$p_{2,3}$	4.0	3.6	3.2	2.9	2.5	2.1
ms_1	42.2%	52.6%	64.3%	76.5%	88.4%	98.4%
$ms_{2,3}$	28.9%	23.7%	17.9%	11.7%	5.8%	0.8%
Percentage Differences in CS and TW						
ΔCS	-18.3%	-16.0%	-13.2%	-10.1%	-6.9%	-4.2%
ΔTW	-9.0%	-6.7%	-4.3%	-2.2%	-1.1%	-1.3%

Thus when the extant market power is the result of vertical differentiation its size varies inversely with the harm, both in terms of *ΔCS* and *ΔTW*, generated by the exclusionary action and so an initial significant market power requirement cannot be justified under either a *TWS or* a *CSS* - in contrast again to Kaplow's (2012) contention.

Result 7: The greater the extant market power due to a smaller initial number of firms, for given degree of vertical and horizontal differentiation, the *greater* the *ΔCS and* the *ΔTW* due to the exclusion of a rival firm. Thus, *ceteris paribus*, when the extent of the initial market power depends on *market structure*, the more concentrated the market structure the *greater* the welfare effects of exclusion.

Table 4.7. Effects of exclusion – Various numbers of firms ($c = 2, a = 10, \tilde{a} = 9, s = 0.4$).

	BNE with 5 firms	BNE with 4 firms
p_1	4.0	4.2
p_{others}	3.4	3.7
L_1	0.50	0.53
L_{others}	0.42	0.46
ms_1	28.5%	33.70%
ms_{others}	17.9%	22.10%
Exclusion	BNE with 4 firms	BNE with 3 firms
p_1	4.2	4.6
p_{others}	3.7	4.0
ms_1	33.70%	42.2%
ms_{others}	22.10%	28.9%
Percentage Differences in CS and TW		
ΔCS	-3.9	-18.3%
ΔTW	-2.8	-9.0%

Thus when the extant market power is the result of a smaller number of rivals, its size varies directly with the harm, both in terms of *ΔCS* and *ΔTW*, generated by the exclusionary action and so an initial significant market power requirement can be justified if either a *TWS or* a *CSS* is used, again in contrast to Kaplow's (2012) contention.

4.4. Concluding Remarks

In this chapter, we first examine how extant market power and market share vary with the degree of product differentiation and market structure and we show the irrelevance in many cases of market share as a predictor of market power. More specifically, we demonstrate that market shares vary inversely with the Lerner index as horizontal differentiation increases and directly as vertical differentiation increases and as the number of firms in the BNE decreases. We also note that the market share of the dominant firm varies inversely with the welfare effects of exclusion and therefore it cannot be a reliable indicator of the change in welfare induced by anti-competitive (exclusionary) conduct.

Finally, we examine how the level of extant market power (or of the initial price elevation) affects the magnitude of the change in *CS* and of the change in *TW* that is produced by an anticompetitive action that results in the exclusion of a rival firm. We show that depending on the source of the extant market power its size can vary directly or inversely with the effects of exclusion on harm and a significant initial market power requirement can either be justified for both a *CSS* and a *TWS* or for neither of them, thus contradicting Kaplow (2012), who argued that the market power requirement is justified only when a total welfare standard is embraced.

References

Allain, M. L., Boyer, M., Kotchoni, R. and Ponssard J. P. (2011). "The Determination of Optimal Fines in Cartel Cases: The Myth of Underdeterrence", Discussion Paper 2011s-34, CIRANO.

Ascione, Aurora and Motta, Massimo (2008). "Settlements in cartel cases". Published in: In Claus-Dieter Ehlermann and Mel Marquis (eds.), European Competition Law Annual 2008: Antitrust settlements under EC Competition Law, Oxford: Hart Publishing (2010): pp. 67-83.

Bageri, V., Katsoulacos, Y. and Spagnolo, G. (2013). "The Distortive Effects of Antitrust Fines Based on Revenue", *The Economic Journal*, 123, pp. F545–F557.

Becker, Gary (1968). "Crime and Punishment: An Economic Approach", *Journal of Political Economy*, vol. 76(2), pp. 169-217.

Bolotova, Y. and Connor, J. (2006). "Cartel overcharges: survey and meta-analysis", *International Journal of Industrial Organisation*, vol. 24, issue 6, pp. 1109 – 1137.

Bos, Iwan and Schinkel, Maarten Pieter (2006). "On The Scope for the European Commission's 2006 Fining Guidelines under the Legal Maximum Fine", *Journal of Competition Law & Economics*, vol. 2(4), pp. 673-682.

Boyer M. and R. Kotchoni (2011). "The Econometrics of Cartel Overcharges", Discussion Paper 2011s-35, CIRANO.

Buccirossi, Paolo & Spagnolo, Giancarlo (2006). "Antitrust Sanctions in the Presence of Leniency Programs", *Concurrences*, no. 4, pp. 25–9.

Buccirossi, Paolo & Spagnolo, Giancarlo (2007). "Optimal Fines in the Era of Whistleblowers: Should Price Fixers Still Go To Prison?", in (V. Goshal and J. Stennek eds.), *The Political Economy of Antitrust*, Amsterdam: Elsevier, North Holland.

Buccirossi, Paolo and Spagnolo, Giancarlo (2008). "Corporate governance and collusive behavior", in (D.W. Collins, ed.), *Issues in Competition Law and Policy*, Chicago, IL: Antitrust Section, American Bar Association.

Carlton D. W. (2007). "Does Antitrust Need to be Modernized?", Economic Analysis Group, Discussion Paper, EAG 07-3.

Che, Y.-K. and Spier, K.. (2008). "Strategic judgement proofing", *Rand Journal of Economics*, vol. 39(4), pp. 926–48.

Connor, John M. and Lande, Robert H. (2006). "The Size of Cartel Overcharges: Implications for U.S. and E.U. Fining Policies", *Antitrust Bulletin,* 51 (4), pp. 983-1022.

Connor, J. M. (2011). "Cartel Detection and Duration Worldwide", *CPI Antitrust Chronicle*, (2), pp. 1-10

Connor, J. M. and Robert H. Lande (2012). "Cartels as Rational Business Strategy: Crime Pays," *Cardozo Law Review*, 34, pp. 427-490.

Erbach, Gregor. (2014). “EU and US Competition Policies; Similar Objectives, Different Approaches”, European Parliamentary Research Service Briefing, available at: http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2014/140779/LDM_BRI(2014)140779_REV1_EN.pdf

European Commission (2009). “Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings”.

European Commission (2010). “Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements”.

European Commission (2013). “Competition: Antitrust procedures in anticompetitive agreements - Article 101 TFEU cases”, factsheet available at:
http://ec.europa.eu/competition/publications/factsheets/antitrust_procedures_101_en.pdf

European Commission (2013). “Competition: Antitrust procedures in abuse of dominance - Article 102 TFEU cases”, factsheet available at: http://ec.europa.eu/competition/publications/factsheets/antitrust_procedures_102_en.pdf

Evans, David S. (2010). “Lightening Up Market Definition”, Research Handbook on the Economics of Antitrust Law, Einer Elhauge, ed., New York: Edward Elgar.

Farell J. and M. L. Katz (2006). “The Economics of Welfare Standards in Antitrust”, Competition Policy Center, Institute of Business and Economic Research, UC Berkeley.

Farrell, J., and Shapiro, C. (2010). "Antitrust evaluation of horizontal mergers: An economic alternative to market definition", *The B.E. Journal of Theoretical Economics*, 10(1) (Policies and Perspectives), Article 9.

Federal Trade Commission and Antitrust Division of the U.S. Department of Justice (2000). "Antitrust Guidelines for Collaboration Among Competitors".

Federal Trade Commission. "An FTC Guide to the Antitrust Laws", available at: https://www.ftc.gov/tips-advice/competition-guidance/guide-antitrust-laws.

Garoupa, N. (2001). "Optimal Magnitude and Probability of Fines", *European Economic Review*, 45, pp. 1765-1771.

Geradin, Damien and Henry, David (2005). "The EC Fining Policy for Violations of Competition Law: An Empirical Review of the Commission Decisional Practice and the Community Courts' Judgments", GCLC Working Paper No. 2/05.

Ginsburg, Douglas H. and Wright, Joshua D. (2010). "Antitrust Sanctions", *Competition Policy International*, vol. 6, No. 2, pp. 3-39.

Häckner, Jonas (2000). "A Note on Price and Quantity Competition in Differentiated Oligopolies", *Journal of Economic Theory*, Elsevier, vol. 93(2), pp. 233-239.

Häckner, Jonas (2001). "Market Delineation and Product Differentiation", *Journal of Industry, Competition and Trade*, Springer, vol. 1(1), pp. 81-99.

Hammond, Scott D. and Barnett, Belinda A. (2008). “Frequently Asked Questions Regarding the Antitrust Division's Leniency Program and Model Leniency Letters”, US Department of Justice.

Hsu, Judy and Wang, X. (2005). “On Welfare under Cournot and Bertrand Competition in Differentiated Oligopolies”, *Review of Industrial Organization*, Springer, vol. 27(2), pp. 185-191.

Harrington, J. (2004). “Cartel pricing dynamics in the presence of an antitrust authority”, *The Rand Journal of Economics*, 35, pp. 651-673.

Harrington, J. (2005). “Optimal cartel pricing in the presence of an antitrust authority”, *International Economic Review*, 46, pp. 145-170.

Harrington, J. (2010). “Comment on ‘Antitrust Sanctions’”, *Competition Policy International Journal*, vol. 6, pp. 41-51.

Houba, H., Motchenkova, E., and Wen, Q. (2010). “Antitrust enforcement with price-dependent fines and detection probabilities”, *Economics Bulletin*, vol. 30 no.3 pp. 2017-2027.

Houba, H., Motchenkova, E. and Wen, Q. (2012). “Competitive Prices as Optimal Cartel Prices”, *Economics Letters*, 114, pp. 39-42.

Houba, H., Motchenkova, E. and Wen, Q. (2013). “Legal Principles in Antitrust Enforcement”, Tinbergen Institute Discussion Papers, 2013-178/II, Tinbergen Institute.

Kaplow, L., and Shapiro, C. (2007). “Antitrust”. In Polinsky, A. M., & Shavell, S., eds., Handbook of Law and Economics 2, pp. 1073–1225.

Kaplow, Louis (2010). “Why (Ever) Define Markets?”, *Harvard Law Review*, vol. 124, pp. 437-517.

Kaplow, Louis (2011). “On the Choice of Welfare Standards in Competition Law”, *Harvard Law and Economics Discussion*, No. 693.

Kaplow, Louis (2012). “On the Choice of Welfare Standards in Competition Law” in Zimmer (ed), Goals of Competition Law (Edward Elgar), 3-26 (Harvard Discussion Paper 693).

Katsoulacos, Y., Ulph, D. and Metsiou, E. (2011). “Competition Authority Substantive Standards and Social Welfare”, mimeo, available from www.cresse.info (Publications).

Katsoulacos Yannis and David Ulph (2012). “Legal Uncertainty and the Choice of Enforcement Procedures”, mimeo, available at: www.cresse.info (Publications).

Katsoulacos, Y. and Ulph, D. (2013). “Antitrust penalties and the implications of empirical evidence on cartel overcharges”, *Economic Journal*, vol. 123(572), pp. F558–81.

Katsoulacos, Y., Motchenkova, E. and Ulph, D. (2015). “Penalizing Cartels: The Case for Basing Penalties on Price Overcharge”, *International Journal of Industrial Organization*, vol. 42, pp. 70-80.

Landes, W. M., and Posner, R. A. (1981). “Market power in antitrust cases”, *Harvard Law Review*, 94, pp. 937–996.

Landes, W. M. (1983). “Optimal Sanctions for Antitrus Violations”, *The University of Chicago Law Review*, vol 50(2).

Lianos Ioannis (2009). “'Lost in Translation': Towards a Theory of Economic Transplants”. Jean Monnet Working Paper 08/09 (NYU School of Law). Current Legal Problems (CLP), pp. 346-404.

Motchenkova, E. (2008). “Determination of optimal penalties for antitrust violations in a dynamic setting”, *European Journal of Operational Research*, 189(1), pp. 296-291

Motchenkova, E. & Kort, P. (2006). “Analysis of Current Penalty Schemes for Violation of Antitrust Laws”, *Journal of Optimization Theory and Applications*, 128, pp. 431-451.

Motta, M., Polo, M. (2003). “Leniency programs and cartel prosecution”, *International Journal of Industrial Organization*, vol. 21, issue 3, pp. 347–379.

Motta, M. (2004). “Competition Policy. Theory and Practice”, Cambridge: Cambridge University Press.

O’Donoghue, R. and Padilla, J. A. (2006). “The Law and Economics of Article 82”, EC, Hart Publishing; Oxford.

Office of Fair Trading (2004), “Abuse of a dominant position”, 402.

Office of Fair Trading (2012). “OFT’s Guidance as to the Appropriate Amount of a Penalty”.

Pittman R. (2007). “Consumer Surplus as the Appropriate Standard for Antitrust Enforcement”, *CPI Journal*, vol. 3.

Polinsky, Mitchell, and Shavell, Steven (2000). “The Economic Theory of Public Enforcement of Law”, *Journal of Economic Literature*, vol 38(1), pp. 45-76.

Rey, P. (2003). “Towards a theory of competition policy”, in: Dewatripont, M., Hansen, L., Turnovsky, S. (Eds.), Advances in Economics and Econometrics: Theory and Applications. Cambridge University Press.

Rubinfeld, Daniel L. (2001). “Antitrust Policy”, in International Encyclopedia of the Social and Behavioral Sciences, Elsevier Science Ltd., 1, pp. 553-60.

Salop, S.C. (2010). “Question: what is the real and proper antitrust welfare standard? Answer: the true consumer welfare standard”, *Loyola Consumer Law Review*, vol. 22(3), pp. 336–53.

Schmalensee, Richard (1982). “Another Look at Market Power”, *Harvard Law Review*, 95.

Shavell, S. (1986). “The judgement proof problem”, *International Journal of Law and Economics*, vol. 6(1), pp. 45–58.

Spagnolo, G. (2004). “Optimal leniency programs”. CEPR Discussion Paper Series, Working Paper Number 4840 (revised 2008).

Stigler, G.J. (1964). “A theory of oligopoly”, *Journal of Political Economy*, vol. 72(10), pp. 44–61.

Stigler, G. J. (1970). “The Optimum Enforcement of Laws”, *Journal of Political Economy*, vol. 78 (3), pp. 526 – 536.

US Sentencing Commission (2014). “United States Sentencing Commission, Guidelines Manual”.

Veljanovski, Cento (2007). “Cartel fines in Europe: law practice and deterrence”, *World Competition*, vol. 29.

Vettas, N. and Katsoulacos, Y. (2004). “Regulatory Policy and Competition Policy”, Typothyto Dardanos.

Vives, Xavier (1999). “Oligopoly Theory”, MIT Press.

Whinston, M. (2006). “Lectures in Antitrust Economics”, Cambridge, MIT Press.

“1996 Commission Notice on the non-imposition or reduction of fines in cartel cases”, Official Journal of the European Communities.

“2002 Commission notice on immunity from fines and reduction of fines in cartel cases”,

Official Journal of the European Communities.

“2006 Commission notice on immunity from fines and reduction of fines in cartel cases”, Official Journal of the European Communities.