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Challenges and Pitfalls in Cartel Policy and Fining

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Résumé/Abstract

We analyze significant challenges and pitfalls faced by antitrust authorities in the implementation of competition policies particularly against naked cartels and propose measures principled in economic theory to circumvent these issues. We review leniency programs in different jurisdictions, the private versus public control of cartels, as well as the determination of cartel fines and other punishment instruments. Regarding cartel fines, we first discuss the sometimes-conflicting objectives of restitution and deterrence, then the economic-based versus legal- and proportional-based punishment. Moreover, we assess the proper modeling of cartel dynamics including the probability of detection and conviction, the relevant cartel duration, and the estimation of but-for prices and cartel overcharges.

Mots clés/Key words: Cartels, Fines, Leniency, Competition Policy, Antitrust, Dynamics.

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1. Introduction

Antitrust authorities around the world use punishment instruments, and in particular monetary penalties, to prevent the formation of cartels or destabilize operating cartels. Fines against cartels are usually higher than those imposed against other infringements of competition laws, reflecting the consensus that price-fixing, limitation of production, and market allocation cases, the so-called naked cartels, are serious antitrust offenses to be severely punished. By imposing high enough fines, antitrust authorities hope to achieve two objectives: restitution and deterrence.

Statistics show that the average amount of fines imposed on cartel participants has increased substantially, even reaching record amounts in Europe and the U.S. during the last decade. One of the factors behind the increase in fines in recent years is the willingness of antitrust authorities to strengthen the deterrent objective of fines as recognized, for example, by the European Commission in its 2006 Guidelines. Recent trends also suggest that for most jurisdictions, including the newcomers to antitrust policy, achieving deterrence supersedes the objective of restitution.[1]

Economic analysis has played a substantial role in the development of antitrust public policy from the pioneering contributions of economists in the 1960s to recent advances in evaluation methods and econometrics. The dominant economic theory underlying the deterrence of criminal activities is based on the approaches developed by Gary S. Becker (1968) and William M. Landes (1983). Based on this theory, a firm will refrain from cartel behavior and activity if its expected net incremental profit of so doing is negative. The expected illegal profit must be lower than the expected loss upon detection, given by the anticipated fine multiplied by the probability of being discovered and convicted. Other penalties could include loss of reputation, negative financial market reactions, as well as costs and penalties from private litigation and class actions. Moreover, the efficiency of antitrust authorities in detecting and prosecuting cartels and the efficiency of courts in avoiding Type I and Type II errors will raise the deterrence effect of a given level of punishment.[2] As discussed in this paper, both the harm caused by cartels - or the illicit profits

[1] International Competition Network, Setting of Fines for Cartels in ICN Jurisdictions, Report to the 7th ICN Annual Conference in Kyoto, April 2008.

[2] See Boyer and Porrini (2008) for a discussion of the different but related effect of court efficiency in determining the level of firms' liability in industrial or environmental accidents.

gained - and the probability of detection pose significant measurement problems and are sources of challenges and pitfalls.

The importance of economic analysis in the development and implementation of antitrust policy is continuously reaffirmed. In 2007, Thomas Barnett, Assistant Attorney General of the Antitrust Division of the U.S. Department of Justice, stated that "our courts have increasingly turned to economic principles to guide their interpretation of the antitrust laws … Relying on economic analysis is now routine for U.S. courts in the antirust arena, a salutary development helping our courts make sound decisions."[3] John Pecman, Canadian Commissioner of Competition, stated in a 2015 speech that "[t]he Supreme Court's decision - SCC Tervita Decision, January 2015 - demonstrates a need for more econometric evidence and analysis in merger reviews, and that should be a great boost for the profession."[4] Massimo Motta, Chief Competition Economist at the European Union Commission, said in a 2015 interview that "[i]n the case of mergers, I think it would be difficult to find a case where economic analysis has not made a difference. Indeed, not only the standard used to assess mergers has changed from dominance to significant impediment to effective competition, the latter often requiring a detailed economic assessment of the likely effects of the merger upon prices and consumers, but also economic considerations have become more central at all stages of the merger investigations, from the identification of a possible theory of harm down to the design and the implementation of remedies."[5]

More recently, Boyer, Ross, and Winter (BRW 2017) draw a historical overview of how economics was gradually integrated into competition policy. They suggest that fifty years ago economists were playing a minor role in the antitrust world, typically collecting statistics under lawyers' instructions. They argue that "[t]he economic basis for competition policy towards cartel pricing was understood from the start. Some empirical work has been undertaken on the extent to which cartels raise prices, but the basic proposition was clear: cartels lead to higher prices to the detriment of consumers and the economy. Competition policy towards cartels continues to center on this fundamental proposition."

[3] Presentation to the Lisbon Conference on Competition Law and Economics (Lisbon, Portugal, November 16, 2007).
[4] Speech at Bennett Jones LLP (Toronto, Canada, February 17, 2015).
[5] Interview with Kai Uwe-Kühn, New Frontiers of Antitrust 2015, Concurrence Journal 6th International Conference (Paris, France, June 15, 2015).

The authors also characterize more recent developments in competition policy as an effort to integrate the analysis of mergers, more generally the analysis of cooperation between competitors, into a more holistic vision of economics, organizations, and institutions. In such a world, economists and policy makers are involved in tracing a blurred line between the collaboration mechanisms that could enhance efficiency and wealth creation and the outright exercise of market power by cartels to the detriment of consumers, buyers, suppliers, and the overall economy.

In fact, economic theory and analysis extensively contribute to the setting of adequate fines and penalties aimed at deterrence and restitution in cartel cases. Prior to fine setting, a cartel must be discovered. Harrington (2006) developed a set of collusive indicators, which if present, can help distinguish between collusion and competition.[6] In particular, Harrington argues that certain price markers are particularly relevant in informing whether a cartel may be in operation. These include: a higher list (or regular) price and reduced variation in prices across customers; a series of steady price increases preceded by steep price declines; price rises and imports decline; whether firms' prices are strongly correlated; whether there is a high degree of uniformity across firms in product price and other dimensions including the prices for ancillary services; whether there is low price variance across customers; and whether prices are subject to regime switches.

Although these price-based markers may also be characteristics of competitive markets reacting to changes in their environment, they are nevertheless useful starting points. Their most important drawback is that to be estimated, these price-based markers require a detailed data gathering on specific markets. The number of such markets may also be very large. Despite these limitations, relevant metrics and measures to conduct antitrust policies are in place and under ongoing developments.

Notwithstanding the jurisdiction and despite the administrative shortcuts used in setting fines and other penalties, the optimal level of "punishment" must be determined based on economic efficiency and legal requirements. To achieve a balance between law and economics, antitrust authorities rely on fine setting methodologies, which albeit different, often involve lengthy assessment procedures not devoid of challenges and pitfalls. In this paper, we review key aspects of cartel policies, raise issues of methodological importance in setting optimal cartel fines, and

[6] Harrington, J.E. Jr. (2006).

propose solutions using economic reasoning and econometric techniques. In doing so, we show how economics, law, and antitrust practices and rules find some signs of reconciliation.

The remainder of this paper is organized as follows. Section 2 presents a general public policy overview of collaboration between competitors and regulators, through a brief historical account of antitrust law, a discussion of antitrust guidelines and leniency programs, and a review of private versus public control of cartels. Section 3 reviews the sometime conflicting objectives of antitrust policies and discuss specific challenges and pitfalls in the setting of cartel fines, namely the identification of the relevant period of cartel activity, the estimation of cartel overcharges, and the modeling of cartel dynamics. We conclude in Section 4.

2. Challenges and Pitfalls in Cartel Policy

We provide a brief overview on how collaborative agreements among competitors, the extreme form of which are cartels, were put under scrutiny and recognized as criminal activities in the 19th century in North America and subsequently elsewhere in the world. We then review the increased reliance on leniency programs as primary discovery tools of antitrust policies, based on advanced game theoretic analysis, and their impact on deterrence. Finally, we briefly discuss the two pillars of antitrust laws namely public and private enforcement instruments.

A BRIEF HISTORICAL OVERVIEW

The world of economics was in turmoil in the late 19th century. The industrial revolution of the second half of the century brought significant innovations in technologies and large scale integration of the railroad, telegraph, steamship and cable industries, as well as travel and communications. These developments gave rise to giant industrial works and business plants as firms could organize around value chains on a national basis to source supplies and access markets. Large plants and large industrial organizations or corporations became increasingly common. These developments made possible on a national basis opened the gate to international trade, increased globalization with significant movement of labor and capital, and enhanced market power in many industries.

It is in response to these profound changes in the economic landscape that competition policy began to emerge and culminated in Competition Acts (1889 in Canada and 1890 in the U.S.).[7] The 1889 Act considered cartels as criminal, with possible sanctions upon conviction reaching up to two years of imprisonment, while the U.S. Sherman Act set a maximum penalty of one year. In Canada, the maximum imprisonment penalty remained at the two year level until 1976 when it was increased to five years. The number of years of imprisonment increased to fourteen years in 2010, the "highest of any anti-cartel regime in the world."[8]

This history of how economic theory and empirics have been integrated in actual policy centers on four developments: (1) the Kennish-Ross argument for a balanced evaluation of collaboration between competitors, of which cartels are an extreme form; (2) the screening of cartels, which requires discerning between cartel and competitive signals; (3) the analysis of coordinated conduct and facilitating practices; and (4) the development and role of leniency and compliance programs, an area where policy is continuously sharpened, bringing a lot more cases under the scrutiny of antitrust officials.

As these developments towards increasing efforts to prevent cartels through larger fines and longer prison terms as well as increased prosecution capabilities were taking place in different jurisdictions, some jurisdictions held different views on cartels. For instance, Austria, Denmark, Finland, Norway, and Sweden allowed firms to engage in cartel formation and activities such as price fixing, markets allocation, and/or restrained production levels, and to engage in other anti-competitive practices.[9] However, to be considered legal, cartels had to register their agreements with a government authority.[10]

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[7] The Canadian law *An Act for the Prevention and Suppression of Combinations formed in restraint of Trade*, 52 Vict. c.41 (1889, "The Combinations in Restraint of Trade Act" and post 1910 "The Combines Investigation Act") received royal assent and entered into force on 2 May 1889. The US law *An act* to *protect trade and commerce against unlawful restraints* and monopolies, c.647, 26 Stat.209 (1890, "The Sherman Act") entered into force on 2 July 1890. Halladay (2012) characterizes as follows the debates that rocked the Canadian Parliament at that time: "While the governing Conservatives and opposition Liberals both publicly supported the goal of restraining combines, they were sharply divided in their methods. The Liberals accused [the Conservatives] of trying to *"chew meal and whistle at the same time"* and argued that the true evil was the Conservatives' protective tariff regime, known as the National Policy. According to the Liberals, Canadian combines thrived because they were protected from foreign competition. The Conservatives responded that many of the industries suffering from a lack of combines control were not subject to tariffs and, in any case, removing the Canadian tariffs would only drive the combines *"jackals"* out of Canada and replace them with *"a horde of American wolves"*.

[8] Halladay (2012).

[9] See Nikolaus Fink, Philipp Schmidt-Dengler, Konrad Stahl, and Christine Zulehnery (2015).

[10] The United States, at the time of the National Industrial Recovery Act (NIRA) of 1933 had a similar policy.

In Austria, this pro-cartel policy, dating back to 1951, rested on the so-called Austrian version of corporatism called Social Partnership, in which price ceilings or increases were effectively regulated. Unregistered cartel agreements were subject to criminal law while registered cartels served or contributed to implement regulated prices thus allowing firms to better reach the price ceilings and avoid their undercutting. One may wonder if court-registered cartels are really cartels. However, those registered cartels implemented typical policies aimed to enforce the cartel agreement namely inter-firms compensation schemes, reporting requirements, rules for entry and exit, and quick and credible punishment if deviations were observed.

The Austrian model could be seen as a version of collaboration between competitors although it goes further than, for instance, the forms of collaboration generally allowed in complex mergers, vertical integration schemes, strategic alliances, and international business relationships. In general, distinguishing between cartels aimed at price-fixing, limiting production, and allocating markets, the so-called naked cartels, which are serious antitrust offenses, and bona fide collaboration between competitors, is a difficult endeavor. Applying the rule of reason on competitor collaborations, including soft or non-naked cartels, that may reduce competition intensity but improve efficiency or resource allocation, increase effectiveness or reduce costs, and foster innovation as well as dynamic competition, must come together with elements that strengthen criminal provisions on hard-core cartels through a *per see* liability.

Recent changes in the treatment of valuable pro-competition and pro-efficiency collaboration between competitors and the treatment of hard-core cartels followed significant contributions by economists over the years advocating for a more rigorous treatment of naked cartels and a balanced analysis of non-naked ones. T. Kennish and T.R. Ross (1997) combined previous economic contributions and claimed that the law had to make room for the benefits of cooperation among competitors. Antitrust regulations should then reflect recent findings in the study of firm organization and value chains, which underlines certain forms of business as a potential generator of wealth. Kennish and Ross wrote "[i]n some cases, productive activities are best undertaken within the walls of a single firm and in others it is best for independent organizations to serve each other through markets. In still other cases, firms surrender some of their independence as part of a co-operative endeavour to undertake some productive activity. This co-operation could involve jointly-conducted research and development, shared distribution facilities, agreement on product standards or a number of other things."

The emerging notions and models of value chains and value networks are challenging competition policy at its roots. The Canadian guidelines for collaboration between competitors is a particularly well balanced approach to the fine-tuning of cartel policy.[11]

ANTITRUST GUIDELINES AND LENIENCY PROGRAMS

A comparative review of guidelines highlights similarities and differences in the methods used by antitrust authorities to deter cartels and punish cartel members. In Europe, participation in a cartel is punished mostly through fines. The methodology followed by the Directorate-General for Competition of the European Commission when setting fines in cartel cases can be divided into two sequential steps. First, a basic amount is set by reference to the total value of relevant sales. As a rule, the fine will be set at a level of up to 30 % of the value of sales, depending on the gravity of the illicit practice, multiplied by the number of years of duration of the cartel. Second, adjustments are made according to aggravating and mitigating circumstances. In any case, the total fine must not exceed 10% of the total annual turnover of an undertaking, which may be much larger than the affected sales.

In Canada, the Competition Bureau is responsible for the administration and enforcement of the *Competition Act*. Section 45 of the *Competition Act* provides the relevant provisions, which considers a cartel a criminal offense known as a conspiracy punishable by a fine of up to $25 million, or imprisonment for a term of up to 14 years, or both.

In the U.S., cartel activity is punished with criminal sanctions including fines and imprisonment. Most criminal antitrust cases are prosecuted pursuant to the Federal Sentencing Guidelines (USSG), which recommends the imposition of a base fine of 10% of the affected volume of commerce of a firm convicted of participation in a cartel plus another 10% for the harm inflicted upon consumers. Although these sentencing guidelines are merely advisory, sentencing courts are required to consider their provisions and tailor the sentences accordingly based on each case's specific factors. Usually, the Antitrust Division of the Justice Department settles cartel cases with plea agreements. The basic amount of the fine is the greatest of: a) the amount based on the offense level as recommended by the USSG; b) the infringing firm's pecuniary gain from the offence; or c) the pecuniary loss (harm) resulting from the offence caused by the infringing firm.

[11] Canadian Competition Bureau, *Competitor Collaboration Guidelines*, December 2009.

Over the last decades, leniency programs have proliferated in many jurisdictions where competition authorities are eager to dismantle cartels by encouraging self-reporting and cooperation from cartel participants. There are currently over 40 jurisdictions around the world with active leniency programs.[12]

These various leniency programs have the common goal of deterring antitrust violations and detecting cartel offences before they form by offering the possibility of less severe sanctions. Cartel participants are allowed to turn themselves in and cooperate with authorities in order to receive full immunity from prosecution or fines reduction. Competition authorities in Australia, Canada, the EU, and the U.S. are increasingly bringing cartel members to justice through the valuable cooperation of whistleblowers. Although a progressively convergent approach in leniency programs has been taking place over the last years in these jurisdictions, some differences remain on how infringing firms and their executives receive a lenient treatment. The following paragraphs succinctly compare leniency regimes in Australia, Canada, the EU, and the U.S. and discuss their impact on cartel enforcement over the years.

In all jurisdictions, leniency applicants request a marker whenever they decide to come forward with their illegal involvement in a cartel. The marker request establishes the position in line (i.e., first applicant, second applicant, etc.) of an application to the leniency program. After a marker is granted, the applicant's rank is guaranteed for a given period of time during which the applicant needs to provide evidence of the alleged cartel and demonstrates that it meets all requirements of the leniency program. A corporation participating in a cartel can request a marker in the EU while individuals and corporations are allowed to apply for a marker for cartel offences in Australia, Canada, and in the U.S.

In all but one jurisdiction, corporations and individuals charged with cartel conduct may be eligible for full immunity from prosecution. The term "full immunity" carries a different meaning across jurisdictions. In general, full immunity will refer to the lack of prosecution of cooperating corporate defendants and/or executives, where such individual prosecution is available, if these defendants were the first qualifying applicant to report the cartel activity. In the EU, the only cartel enforcement regimen with an administrative procedure, full immunity is only provided for

[12] Ann O'Brien (2008).

corporations. In addition, all jurisdictions offer, under their leniency programs, other procedures for substantial reductions in fines.

Table 1

Selected Characteristics of Leniency Programs

Characteristics	Australia	Canada	European Union	United States
Last Revision Date	July 2009	(1) June 7, 2010 (2) September 29, 2010	December 8, 2006	(1) August 10, 1993 (2) August 10, 1994
Investigative Authority	Australian Competition and Consumer Commission	Competition Bureau Canada	European Commission, Directorate General for Competition	US Department of Justice, Antitrust Division
Prosecuting Authority	Commonwealth Director of Public Prosecutions	Public Prosecution Service of Canada	Commission of the European Communities	State and local Courts
Enforcement Regimen	Civil	Criminal	Administrative	Criminal
Settlement System	Yes	Yes	Yes	Yes
Type of Settlement System	Administrative / Civil	Criminal	Administrative	Criminal

Sources:
1. European Commission http://ec.europa.eu/competition/index_en.html
2. US Department of Justice http://www.justice.gov/atr/index.html
3. Australia http://www.accc.gov.au/content/index.phtml/itemId/142
4. Canada http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/home

In Canada and the U.S., full immunity is only offered to the first qualifying applicant reporting the cartel when authorities are unaware of the offence or when enforcers are aware of the offence but face insufficient information to carry out an investigation. The other qualifying criteria for full immunity in these jurisdictions include that the first qualifying applicant in the case of corporations, offer timely, valuable cooperation and full disclosure and that the applicant has not coerced other participants nor is a leader of the cartel. In addition, whenever an infringing corporation makes a confession about its cartel conduct under the corporate leniency program, its employees may be eligible for a derivative full corporate immunity. However, in both the U.S. and Canada, individuals may turn themselves in without representing the corporation in order to seek full immunity. In both jurisdictions, other companies or individuals ineligible for full immunity but seeking to cooperate

with authorities may have their fines or sentences reduced under certain conditions outside of the jurisdiction's leniency program.

In other jurisdictions, such as the EU and Australia, full immunity is also only available to the first qualifying applicant although other subsequent applicants may be eligible for reduced fines under the leniency program. These jurisdictions have expanded their leniency programs to reward applicants not eligible for full immunity from fines who provide substantial evidence to the investigation. The extent and procedure providing for reduction in fines for second and subsequent applicants usually differ among leniency programs.

Fines reductions in Canada and in the U.S. are provided pursuant to a procedure distinct from the leniency program. Cartel enforcement authorities in these countries offer applicants who have lost the race for full immunity, the possibility to enter into plea agreements or settlements to benefit from reduced fines or sentences in exchange for their guilty plea and full cooperation. In these jurisdictions, cartel members have strong incentives to settle their case with the promise of lower fines instead of facing trial or administrative proceeding.

In Australia and the EU, applicants not eligible for full immunity may still receive fines reduction under the leniency program. In general, the reduction in fines depends on the timeliness as well as the extent and nature of disclosure or cooperation offered by leniency applicants. While certain regimes offer a fixed discount to cooperating cartel participants, others provide a range of discounts for first-in-the-door, second-in, and subsequent leniency applicants. For instance, under the EU leniency program cartel participants that do not meet the criteria for full immunity but can still provide evidence of the alleged violations may be eligible for: a) a reduction of 30-50% for the first cartel member who provide significant added value to the investigation; b) a reduction of 20-30% for the second cartel member to do so; c) a reduction for up to 20% for subsequent cartel members doing so. In the jurisdictions where a reduction in fines is available for leniency applicants, additional incentives are often implemented to encourage the settlement of cartel cases.

For antitrust authorities around the world, leniency programs are an increasingly important tool to deter or detect and break cartels. Since the launch of the first program by the U.S. Department of Justice in 1978, several jurisdictions have followed suit by introducing in their antirust legislation

different versions of leniency policies.[13] With the introduction of leniency programs in antitrust legislation of Australia, Canada, the EU, and the U.S., the number of cartels detected in these jurisdictions has considerably increased in the last decade compared to previous ones. The majority of these cartels were brought about by immunity applications, corroborating recent trends on the prolific use of leniency programs.

However, this increase in the number of cartels detected often reported as an apparent success of leniency programs by competition authorities, may also be due to an increase in cartel activity. In fact, the economic literature related to the impact of leniency programs is somewhat ambiguous.

A few studies have reported that leniency programs typically reduce cartel stability: a) by creating a prisoner's dilemma situation among cartel participants which could induce confessions,[14] b) or when the whistleblower firm gains a competitive advantage on competitors, which incur a cost increase through fines and compliance costs,[15] c) or because cartel members could simultaneously apply for immunity and take advantage of the collusion.[16] In contrast, other authors found that leniency programs may induce collusive arrangements, for instance when the program is not restricted to the first reporting firm, which can cause a decrease in deterrence because of expected reduced fines.[17]

Nevertheless, leniency programs contribute to speeding up the investigation and prosecution of cartels as cooperating participants provide substantial evidence on their activities. Further benefits include that authorities can also redirect public resources to the detection of other non-reported

[13] The idea that it may be socially desirable to grant criminals some form of immunity or leniency if they turn in and testify successfully against their accomplices dates back a few centuries. Musson (1999) writes: ""From at least the 12th century it has been recognized that a man accused of a crime in medieval England could confess his guilt and turn king's evidence: provide the Crown with full details of his criminal activities, including the names and whereabouts of his accomplices. The success of the approvers' appeal as a system for prosecution was enshrined in the Crown's willingness to barter for information by offering discharge to suspected felons. In the 12th century the system was fairly mercenary and huge sums of money were paid to special 'king's approvers', some of whom seem to have been retained on a professional basis. In late medieval this mutually convenient expedient, far from demonstrating the weakness judicial system, actually proved remarkably effective: any such offer of freedom was usually a fiction. For the Crown, the approver offered the means of prosecuting crimes which otherwise might have gone undetected. The information provided could be useful in breaking up professional criminal gangs and putting the finger on highway robbers and their confederates."

[14] G. Spagnolo (2008).

[15] C. Ellis and W. Wilson (2003).

[16] G. Spagnolo (2005).

[17] E. Motchenkova (2004).

cartels. In any case, antitrust officials in many jurisdictions have praised the importance of their respective leniency programs as illustrated with the following quotes:

> *"We have in place a successful leniency policy, so that nowadays the majority of the Commission's cartel decisions are the result of leniency applications by parties to cartels."* (Keynote address by Philip Lowe, Director General DG Competition, on "Reflections on the past seven years, Competition policy challenges in Europe", GCR 2009 Competition Law Review, Brussels, 17 November 2009.)

> *"Leniency programs provide unparalleled information from cartel insiders about the origins and inter-workings of secretive cartels. In the United States, companies have been fined more than $5 billion for antitrust crimes since Fiscal Year 1996, with over 90 percent of this total tied to investigations assisted by leniency applicants. The Antitrust Division typically has approximately 50 international cartel investigations open at a time, and more than half of these investigations were initiated, or are being advanced, by information received from a leniency applicant."* (Presentation by Scott Hammond, Deputy Assistant Attorney General, on "The Evolution of Criminal Antitrust Enforcement Over the Last Two Decades", 24th National Institute on White Collar Crime, February 25, 2010.)

The granting of leniency to cartel members for their cooperation in legal proceedings may not be the end of the story for those successful leniency applicants. As we discuss in the next section, other penalties, outside public authorities' power to grant leniency, such as loss of reputation and private disbarment, class actions, and private litigation may turn out to be significant.[18]

THE PRIVATE VS. PUBLIC CONTROL OF CARTELS: REVIEW AND POLICY

Public enforcement and private enforcement are two complementary competition law instruments. For instance, private enforcement has long driven antitrust enforcement in the U.S. In contrast, European enforcement of antitrust laws relies more on public enforcement. Both private and public

[18] An early example of private law enforcement against successful leniency applicants can be found in Leighton (1876). He writes that, in the famous November 1828 trial of innkeepers William Burke and Helen McDougal for three murders (corpses were sold at good prices to surgeon-doctors at the Edinburg medical school), William Hare and his wife were "received as King's evidence in the character of *socii criminis*", that is, as witnesses bringing evidence to the court as accomplices in the crimes. For such testimony leading to the hanging in public of the accused, they benefited of immunity and escaped the gallows. However, the people of Edinburg were upset to the point of preventing at numerous times their release from jail by blocking roads around the prison in order to capture and hang those *socii criminis* who finally had to rely on the significant decoying help of authorities to escape from the crowd and allegedly disappeared never to be heard of again.

enforcement are expensive ranging from the cost of detecting an infringement, to seeking punishment, to the compensation of victims.

Public resources are used for the establishment and functioning of competition authorities and courts while private parties direct their own financial resources to pursue costly litigation. From an economic perspective, both public enforcement and private enforcement pursue deterrence objectives, and private enforcement is usually perceived as favoring a compensation objective. Whether used in combination or alone depending on the type of antitrust violation, the benefits and costs of the two enforcement approaches need to be carefully assessed to design the optimal competition law enforcement system.

Public enforcement refers to the enforcement of antitrust laws by governmental authorities, such as a competition or antitrust authority. The public authority is vested with a defined set of rules to detect, investigate an infringement, and recommend sanctions, which are subject to judicial review prior to application. Detecting anticompetitive behavior is the first step in enforcing antitrust laws. During the detection phase, the antitrust authority, among other responsibilities, monitors different segments of business sectors to separate pro-competitive behavior from illegal conduct. The antitrust authority also analyzes on a case-by-case basis the impact, of a merger or acquisition for instance, weighing pro-competitive against anti-competitive effects. These control strategies are applied to prevent (ex-ante) an infringement to take place.

At the intervention phase, the antitrust authority having determined that an infringement occurred or is likely to occur, chooses to intervene by recommending fines (pecuniary or imprisonment), behavioral and /or structural remedies (non-pecuniary). The choice of the intervention depends on the type of infringement, where fines are generally appropriate ex-post the illegal conduct while behavioral and structural remedies are used ex-ante the likely anticompetitive conduct. The antitrust authority can also rely, where it deems appropriate, on a combination of interventions including fines, behavioral remedies, and structural remedies such as divestitures, price terms, and cease-and-desist orders.

Private enforcement refers to litigation initiated by private parties before a court to remedy a violation of antitrust laws. Following a ruling where the legal action is successful, the court imposes civil sanctions such as interim relief, injunction, restitution, or damages. In general, private enforcement is used as a tool to repair harm to competition and to recover some form of loss. In

comparison to antitrust authorities, private parties may be better informed, better funded, and possess greater incentives to undertake antitrust violation litigation, thus strengthening deterrence.[19] However, private enforcement is also seen as potentially creating incentives problems where private parties can use strategic litigation to undermine competition.

The U.S. is the OECD jurisdiction with the most extensive experience with private enforcement. Both American individuals and businesses bring about civil actions in relation to various antitrust violations such as monopolization, horizontal conspiracies, and vertical arrangements. Class actions are also broadly available in the U.S. If the civil actions are successful, relevant parties can recover many forms of compensation including treble damages, i.e., damages three time the estimated amount of loss in addition to legal fees.

In the European Union, private enforcement has historically been more limited than in the U.S. although European law allows for persons affected by antitrust violations such as anticompetitive arrangements and abuse of dominance to recover damages. The use of class actions is also less prevalent in Europe despite the right for compensation for the harm caused by an anticompetitive conduct. Few private actions for damages are initiated in Europe following cartel and antitrust violations decisions by the EU Commission.

In Canada, a person has a right to bring a private action for any loss or damage sustained from illegal conduct under the Competition Act. Over the years, various class actions mostly related to price-fixing conspiracies have been initiated. These private actions in Canada usually pertain to litigation following similar U.S. class actions or guilty pleas in criminal proceedings.

Whether public and private enforcement tools are used separately or in combination, cartel fining remains the ultimate goal against antitrust law infringing individuals or corporations. As discussed in the next section, determining an optimal cartel fine is not a trivial exercise.

3. Challenges and Pitfalls in Cartel Fining

Two major difficulties arise when it comes to empirically evaluating the overcharge imposed by cartels: (i) the precise identification of the period covered by the collusion and (ii) the lack of reliable data to accurately estimate the but-for price. In general, neither the but-for price nor the period spanned by the cartel activity can be directly observed by antitrust authorities and some

[19] McAfee et al. (2008).

forensic economists suggest that most overcharge estimates available in the empirical literature may be subject to biases. This section reviews important issues related to the theoretical design and empirical implementation of an optimal fining rule.

RESTITUTION, DETERRENCE, PUNISHMENT, AND LEGAL PROPORTIONALITY

Becker (1968) put forth an economic approach to crime and punishment and determined optimal policy tools to fight criminal offenses. In this paradigm, the reduction of crime can take place through different channels including the increase in wages in the legal sector, the reduction of crime benefits, the increase in the probability of being caught, and the punishment then imposed. According to Becker, the government could reduce policing costs, hence the probability of discovery, and simultaneously increase the level of punishment for as long as socially costless means of punishment (such as fines) are available.[20]

Landes (1983) built on the pioneering research of Becker to analyze the theoretical foundations of an optimal antitrust penalty and applied his findings to various antitrust violations including predatory pricing and cartels. Landes suggests that antitrust violations should be punished in such a way that proper behavior is encouraged: penalties that are harm-based rather than gain-based, except possibly in the case of cartels where gain-based fines are more likely to deter illegal behavior, as cartel members are likely more concerned with their own self-interest or gains.

A large body of the economic literature on the deterrence of criminal activities relies mainly on the theory developed by Becker and Landes. That theory stipulates that the optimal fine is equal to the harm caused by the cartel divided by its probability of detection and conviction. In principle, the harm caused by a cartel to society includes not only the damages incurred by competitors and clients, but also the resources devoted by antitrust authorities to fighting cartels. However, the bulk of this cost imposed by a cartel is epitomized by the price overcharge.

The Becker-Landes rule aims for the restitution of the illegal profits to all stakeholders that have been harmed by the activity of cartels in the economy. This rule is designed such that the *expected* net gain of a firm contemplating to join a cartel is equal to zero. At the aggregate level, the rule

[20] This argumentation is convincing although astronomical fines are not socially costless if they can cause a firm to go bankrupt.

guarantees that the "cartel game" clears: firms found guilty of price-fixing behavior pay for those that remain unnoticed forever.

Another approach to setting cartel fines consists of aiming for dynamic deterrence, as opposed to the explicit goal of compensation or indemnification. This approach (advocated by Allain et al., 2015) is compatible with a dynamic view of the situation faced by firms who are contemplating to join a cartel. Cartel members play a repeated game where at periodic times each member decides whether to continue the cartel agreement or deviate. In this paradigm, the optimal fine equals the minimum amount needed to trigger a deviation and destabilize the cartel.

A third philosophy to setting cartels fines is based on the concept of punishment, which should not be confused with the notion of "economic deterrence," nor with that of "criminal sanction." Underlying this approach is the idea that individuals who engage in illegal behavior should be sanctioned beyond the fair harm that they have caused to society. Admissible fines in this case may therefore be obtained as an inflated version of the optimal fine under restitution or deterrence. In practice, the severity of the punishment is determined by accounting for aggravating and mitigating factors. Note that the notion of punishment goes beyond financial penalties and may include a jail sentence for convicted individuals as provided, for instance, by the USSG.

Strictly speaking, the concept of punishment is more a legal than an economic term. Another legal concept to think of when setting cartel fines is the principle of proportionality, which stipulates that a sanction should be set at the minimum level required to deter the crime. A fining rule that is aiming at restitution will often violate the principle of proportionality. A fining rule aiming at deterrence (via the destabilization of cartels) is quite in line with the principle of proportionality. A fine aiming at punishment can easily deviate from the principle of proportionality depending on the severity of the punishment.

IDENTIFICATION OF THE BEGINNING AND END OF THE CARTEL EPISODE

The knowledge of the period during which a cartel operated is important for a precise calculation of its cumulative overcharges and resulting damages. In fact, econometric-based methods (including the simplest regression-based approach) require a dummy variable I_t that takes the value 1 if t belongs to the cartel episode and 0 otherwise. Sometimes, the detailed data needed to calculate the overcharge (e.g., marginal cost, markup, etc.) are available only for one year. If it is clearly established that the cartel operated during N years, these data may be used to estimate the

overcharge for that particular year. This estimate can then be multiplied by *N* to obtain an assessment of the total cumulative overcharge of the cartel.

In general, antitrust authorities have to rely on information collected by investigators and/or experts' findings to estimate the duration of cartels. Unfortunately, cartel members tend to undercut the true duration of the cartel in their declarations to investigators. In some cases, cartels continue to operate several months after investigations have started in order to cast ambiguity on the end of the cartel period, hence the level of actual overcharges during the cartel period. Lowering the price immediately after the beginning of investigations would contribute to proving that a cartel was in fact in operation. If antitrust authorities consider the date of the first search notification as the cartel's end date (as expected by cartel members), using prices observed during subsequent periods in the calculation of the but-for price may lead to underestimating the overcharge. In some extreme cases, economic experts may find insignificant price increases despite the overwhelming evidence that a cartel operated during the alleged period as discussed in the next section.

This raises the following question: what date should be considered as the end date of a cartel by antitrust authorities? The date of the first search notification or the date on which the prosecution ended and the firms involved are officially declared guilty? The true end date will likely lie somewhere between these two extremes. Therefore, it is important to perform sensitivity analyses on the beginning and end dates of the cartel.

It is also important to distinguish between the period of legal collusion as defined in the indictment and the relevant period for purposes of estimating the effect of the collusion on prices. This relevant period is the period during which coordination between the parties had or could have an influence on prices.

The period of legal collusion is administrative and/or legal, but the economic estimate of the impact of the collusion may have started before or extend beyond that legal period. In such a case, considering a period that is too short, considering prices immediately before the legal starting date or immediately after the end of the legal period of collusion, could lead to a downward bias in estimating the effect of collusion on prices and thus lead to an underestimation of the amount of damages suffered by customers and suppliers of collusive firms.

This problem is well known. The American Bar Association (ABA 2014) econometric textbook explicitly warns analysts about the common mistake of simply taking the legal period as the relevant period for estimating cartel damages. The ABA summarizes the distinction to be made between the legal period and the relevant period as follows:

> "*When assessing damages using a before-during or a before-during-after approach, the beginning and end points of the damages period must be identified. However, the beginning and the end of the damages period alleged in many cases may not accurately reflect the actual beginning or end of the alleged unlawful conduct. For example, in price-fixing class action cases, the plaintiff's attorneys often choose the beginning and end dates for the 'class period' before discovery is undertaken. Moreover, the beginning or end of the effects of the alleged unlawful conduct may not coincide with the beginning or end of the conduct itself. The effects might occur later, end earlier, or last longer than the conduct. Experts should rely on the evidence developed in discovery, market facts, and the analysis of liability experts when determining the relevant starting and ending dates for calculating damages."*

In a Discussion Paper of ZEW on the cement cartel in Germany, Hüschelrath and Veith (2011) write:

> "*As gross prices are not only reported to industry associations and statistical offices but might also be used by antitrust authorities as part of market monitoring procedures, cartel members have incentives to keep these prices high during but also after the breakdown of the cartel agreement"*.

In Hüschelrath and Veith (2016), they write:

> *"On the other hand, after the breakdown of the cartel, the cartel members might have incentives to (strategically) reduce transaction prices to a larger degree than list prices as the former is much more difficult to observe and competition authorities, courts or private parties may therefore be forced to use the higher list price data to, e.g., estimate cartel damages*".

The following two cartel cases provide striking empirical examples of the difference between the legal period of collusion as indicated in prosecution documents and the relevant period of collusion for damages evaluation. In order to avoid falling into a Type II analytical error, i.e., discharging as

not guilty a real harmful cartel, three years of data prior to the legal period were dropped from the econometric analysis in the first case, while nine months of data posterior to the legal period were added to the relevant cartel period in the second case.

THE RETAIL GASOLINE CARTEL IN CANADA

The Competition Bureau investigated retail gasoline markets in Sherbrooke, Thetford Mines, Victoriaville and Magog and obtained a proof of collusion through wiretaps over the period from early 2004 to mid-2006 and criminal actions for price-fixing conspiracy were launched in 2008.[21] The case is ongoing in court with more trials forthcoming.[22]

Available data on price volatility between retailers suggested a relevant period of cartel operation between January 2001 and June 2006, while the indictment filed by the Public Prosecution Service of Canada in Criminal Court had defined a legal period from January 2004 to June 2006. A sharp reduction in price volatility not over time but across sellers can be considered a marker revealing of cartel behavior. Retail gasoline prices in the cities of Sherbrooke, Thetford Mines, Victoriaville, Saint-Hyacinthe, and Montreal for the period 1993-2006 were collected for all individual retail stations on a quarterly basis in the first four cities and on a bi-monthly basis in Montreal. Although the dates on which prices are observed vary from city to city, prices for a given city are collected on the same day over a short time span (at most a few hours) every quarter or every two months.[23]

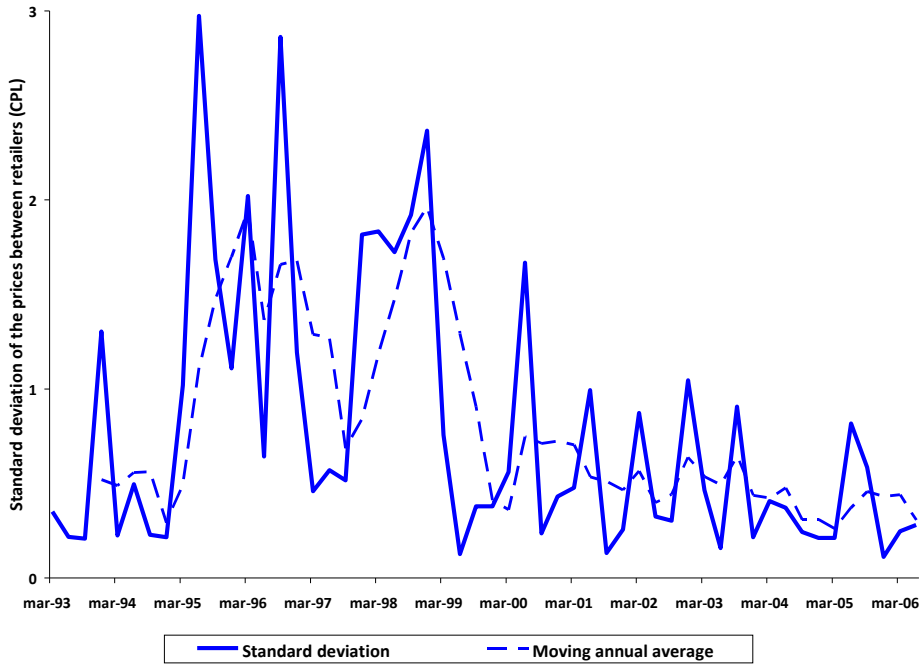
The data show that for the first three cities the volatility (standard error) of prices across retailers dropped significantly in early 2001 and remained low and stable afterwards. In contrast, the price volatility observed in Saint-Hyacinthe and Montréal did not drop during the period and in fact increased continuously with price increases, as one would expect in a normal competitive market. The following graphs present the data for Sherbrooke and Montréal-Center only.

[21] The period during which the cartel was operative was before the 2010 amendment to the Competition Act that made naked cartels per se criminal. Before 2010, cartel activities were illegal only if they generated an undue lessening of competition. It was therefore necessary for the Government to prove that the cartel led to an undue lessening of competition.

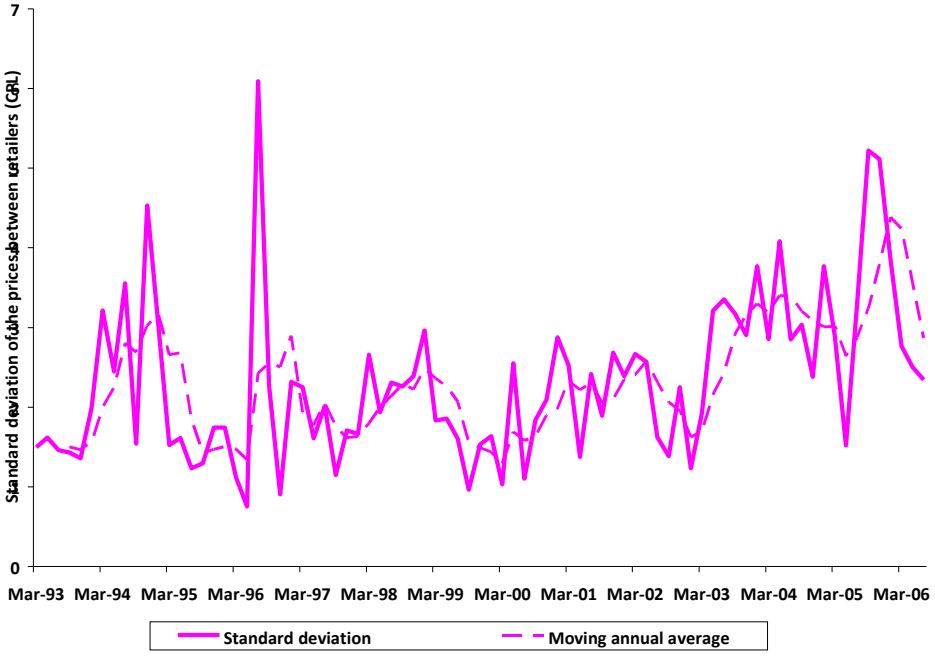
[22] To date, 39 individuals and 15 companies have been charged under section 45 of the Competition Act (making it the largest cartel criminal case in Canadian history with respect to the number of defendants), of which 33 individuals and seven companies have pleaded or were found guilty. Of the 33 individuals who have pleaded or were found guilty, six have been sentenced to terms of imprisonment totalling 54 months. Several trials are still ongoing before the Criminal and Penal Division of the Québec Superior Court.

[23] See Boyer (2015).

Graph 1. Price variation dynamics between retailers in Sherbrooke[24]



Graph 2. Price variation dynamics between retailers for Montréal-Centre



[24] The moving annual average (dotted line) simply illustrates the average of the last 4 observations, to show a more even and aggregated annual view of the overall dynamics.

The statistical tests on differences between the variances and the averages are significant.[25] Those results suggest the presence of a price fixing collusion starting in early 2001 in the first three cities namely Sherbrooke, Thetford Mines, and Victoriaville.[26]

As a result, in estimating the effect of the cartel on prices, the data from January 2001 to December 2003 (3 years of data), even if outside the legal period of collusion as mentioned in the indictment, could not be considered as a period free of collusion. Hence, the price data covering those three years were dropped from the empirical analysis.

THE FIXING OF PASSENGER FUEL SURCHARGE (PFS) BY BA AND VA

In a different case, British Airways (BA) and Virgin Atlantic Airways (VA) were involved in a conspiracy related to the fixing of passenger fuel surcharge (PFS) in the mid-2000s. But why would BA and VA have an advantage in coordinating the level of the fuel surcharge (between 7% and 9% of their revenues)? BA and VA are facing competition from several other carriers not part of the conspiracy. Moreover, managers at BA and VA were aware that their strategy was at risk of being discovered by the competition authorities and, as a result, could lead to antitrust actions in the United Kingdom, Canada and the United States, among others, in the form of penalties (fines and class actions), exclusions, disbarment, and prison sentences.

The competence and analytical capacity of BA and VA executives who conceived this conspiracy on fuel surcharge and who implemented it despite the risks incurred must not be underestimated. Where is the value or the profitability of this strategy? A possible answer to this question is that there is or existed a “relevant market” on which BA and VA had some market power, making a coordination strategy fixing PFS beneficial despite the costs and risks involved.

[25] The price variation level between retailers has gone from an average level of 1.02 CPL before 2001 to 0.44 CPL after 2001, which represents a decrease in the price dispersion of more than 50%. This decrease in the dispersion over time also saw an important stabilization, since the standard deviation variance went from 0.69 to 0.09 during the same period. The average price dispersion level between retailers was 1.98 CPL between 1993 and 2000, whereas that same average reached 2.79 CPL between 2001 and 2006, a statistically significant difference. The variation of this dispersion over time has however remained stable, only varying between 0.91 and 0.89, which is a non-significant difference.

[26] In his April 17 2015 court decision for one of the trials in this case, Justice Tôth writes (free translation): "[61] Professor Boyer observed from 2001 a price dynamics in the target markets that contrasted with the reference markets and which could not be explained by local conditions. The collusion was the most plausible explanation, confirmed by the Competition Bureau's investigations and searches. [62] The evidence at trial, particularly the testimony of Pierre Bourassa [one of the defendants], demonstrated that Professor Boyer was right. The collusion began at that time."

BA and VA are or might be the main competitors and dominant suppliers in a particular non-negligible market, which is the most plausible “relevant market” in this case: the British citizens and organizations showing a preference for travelling using national airlines. A fuel surcharge imposed and announced in a coordinated way to all travelers would be perceived as the result of a market phenomenon outside the control of carriers. Both carriers have probably held that travelers in the “relevant market” would maintain their allegiance to BA and VA if the price increase were concealed in the form of a market phenomenon and not as a price increase aimed at generating supra-competitive profits. Uncoordinated advertisements, possibly heavily covered in the British press, could have given rise to unfavorable reactions towards BA and VA by reducing the allegiance of their British customers.

The UK Office of Fair Trading (OFT 2012) investigated this cartel and found that: “[VA and BA] infringed Article 101 and/or the Chapter I prohibition by participating between August 2004 and January 2006 (the 'Relevant Period') in an agreement and/or concerted practice by which they coordinated their pricing in relation to their respective passenger fuel surcharges for long-haul flights ('PFS') through the exchange of pricing and other commercially sensitive information regarding the PFS, with the object of preventing, restricting or distorting competition (the 'Infringement')” (par. 3).

In this case, VA was a successful immunity applicant and benefited from total immunity, while BA admitted participating in the cartel in exchange for a reduction in penalties from the original fine of £121.5 million to a final £58.5 million. The fine was based on a “conservative approach to market definition which is favourable to the Parties” namely the markets where VA and BA overlap, which, although being a subset of affected markets, “will be sufficient in this case to meet the twin objectives of the OFT's policy on financial penalties: (i) to impose penalties which reflect the seriousness of the infringement; and (ii) to ensure that the threat of penalties will deter undertakings from engaging in anti-competitive practices.” More importantly, the OFT states that: “[m]anaging the tone of media coverage of the PFS was clearly very important for both Parties throughout the Relevant Period.” Clearly, VA and BA must have perceived the potential gains from the strategy to be greater than the potential losses in other markets where the market power of VA and BA is less important or non-existent.

The OFT described the positions of the two cartelists as follows (passim). From BA's perspective, the PFS mechanism of dealing with those increasing costs was particularly problematic because negative stories in the UK media were more likely to focus on BA than other airlines; For VAA the media and consumer reaction to its PFS action was a significant business concern as its reputation as the *"the customers' champion and underdog"* was at stake. The advantages of such concerted strategies were twofold: a reduction in uncertainty regarding the competitor's actions and reactions and "a less hostile reaction in the media than would be the case if they were to risk announcing an increase that may not be followed by the other Party."

One should not underestimate the sophisticated reasoning of BA's strategists. In that vein, one cannot but consider unlikely that BA would adjust its prices to competitive levels immediately after the raiding of its offices by investigators of the Office of Fair Trading (OFT) in June 2006. Two factors suggest that this was not the case. First, the fuel surcharge was increased in April 2006 to a level that remained unchanged until January 2007. Second, ticket prices fell and became more volatile and the co-movement of prices and fuel costs became less direct and stable from November 2006, not from June 2006. This indicates that the relevant period of collusion insofar as the impact of the conspiracy on prices is concerned extended until November 2006.

One could therefore consider it reasonable to estimate the effect of the collusive PFS fixing on ticket prices by extending the collusion period, insofar as its effects on prices are concerned, until November 2006, that is, five months after the OFT's raid at BA offices in June 2006 and three quarters after the end of the legally defined conspiracy period in February 2006, and to compute damages accordingly. Whether this is the appropriate period or not is in good part an empirical question.

CHALLENGES AND PITFALLS IN ESTIMATING THE BUT-FOR PRICE

The but-for price is the price that would prevail on the alleged cartelized market in a hypothetical world where the cartel is absent. This counterfactual world is difficult to characterize because the trajectory of observed prices over time is the result of several causes. For instance, an inelastic demand may grant a firm significant market power that translates into high mark-ups. Product differentiation can create and maintain the conditions for an oligopolistic competition. In this case, an estimation bias would arise from ignoring the oligopolistic mark-up.

Oligopolistic mark-ups are quite substantial for some industries even in the absence of coordination between firms. For instance, Morrison (1990) found that mark-ups in most U.S. manufacturing firms have increased over time and tend to be countercyclical. Hall (1988, Table 4) noted that the ratio of price to marginal cost is in the range of 2 to 4 in U.S. industries. Antitrust authorities may decide to ignore the market power that would prevail in the counterfactual competitive markets when evaluating the cartel fine, notably by assuming that the but-for price is equal to the marginal cost. However, this would lead to overestimating the overcharge and increasing the severity of the fine. It is important to assess how severe the resulting fine is relatively to the fair fine that would be imposed if the but-for world was properly modeled.

In order to gauge the impact of ignoring the competitive mark-up, let $\tilde{p}$ denote the price observed during the cartel episode and let p be the but-for price. The cartel overcharge expressed as a percentage of the but-for price is given by $\delta = (\tilde{p} - p)/p$. The true but-for price (p) is equal to the marginal cost (c) plus a mark-up (m). In pure and perfect competition, this mark-up is roughly equal to zero in theory.

The Lerner index of market power is defined as:

$$\mathbf{L = \frac{p - c}{p} = \frac{m}{p}}$$

If the condition that would prevail in the absence of the cartel is pure and perfect competition, then the but-for price is given by $p = c$ and the Learner index is $L = 0$. As the market is cartelized, the Lerner index becomes $L = (\tilde{p} - c)/\tilde{p}$.The overcharge can be deduced from the Lerner index via the formula $\boldsymbol{\delta = \frac{L}{1-L}}$**.** In general, markets may not operate under pure and perfect competition. The but-for price is therefore given by $p = c + m$ for some $m > 0$. The Lerner index of the cartelized market becomes $L = \frac{\tilde{m}}{c+\tilde{m}}$, where $\tilde{m}$ is the inflated mark-up imposed by the cartel. Hence, the true cartel overcharge is given by:

$$\boldsymbol{\delta = \frac{\tilde{m} - m}{c + m}}$$

Note that the overcharge that would be inferred from the Lerner index that (wrongly) assumes pure and perfect competition in the counterfactual market is:

$$\boldsymbol{\tilde{\delta} \equiv \frac{L}{1 - L} = \delta + \frac{m}{c}(\delta + 1)}$$

Hence, the overcharge estimation bias depends on the mark-up, the marginal cost, and the actual overcharge such that bias equals:

$$\mathbf{Bias}(\mathbf{m}, \mathbf{c}, \boldsymbol{\delta}) = \widetilde{\boldsymbol{\delta}} - \boldsymbol{\delta} = \frac{\mathbf{m}}{\mathbf{c}}(\boldsymbol{\delta} + \mathbf{1})$$

The Table below illustrates the magnitude of this bias for different values of *m*, *c* and δ. Considering a constant overcharge of 10% and a constant mark-up of 2%, the bias is increasing as the marginal cost decreases. Moreover, the bias is larger than the true overcharge in this illustrative but realistic example.

Pitfall in the Conversion of a Lerner Index into an OE

Parameters	**Values**				
$\boldsymbol{\delta}$	**10%**	**10%**	**10%**	**10%**	**10%**
$\boldsymbol{m}$	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**
c	**0.20**	**0.1625**	**0.1250**	**0.0875**	**0.05**
$\mathbf{Bias} = (\mathbf{m}/\mathbf{c})(\boldsymbol{\delta} + \mathbf{1})$	**11%**	**14%**	**18%**	**25%**	**44%**
$\mathbf{Bias}/\widetilde{\boldsymbol{\delta}}$	**52.4%**	**58.3%**	**64.3%**	**71.4%**	**81.5%**

The estimation risk associated with the conversion of a Learner index is avoided by considering alternative methods such as "before-and-after" or "with-and-without" methods. However, these other methods have their own estimation risk. In the before-and-after method for instance, one estimates the overcharge as the difference between the sample averages of prices observed during and outside the periods covered by the cartel episode. Besides the fact that the period covered by the cartel is hard to identify with precision, the before-and-after is not robust to shifts in firms' cost structure and shifts in market conditions that naturally change prices in a competitive environment.[27] Moreover, a cartel may start or end by a price war that pushes prices below the marginal cost.

In the "with-and-without" approach, one compares the average price that prevailed on the cartelized market with the average price on a yardstick market that operated under competitive forces during the same period. However, this method meets the objection that the increase in price caused by the

[27] See Finkelstein and Levenback (1983) and Connor (2010).

cartel can cause a demand shift toward nearby markets. Similar neighboring firms that are not participating in the collusion will tend to follow the cartel price (the so-called "umbrella effect").

Given the complexity of the estimation of the but-for price, simplistic overcharge calculation methods will often be biased. Carefully specified econometric models are needed to handle the complexity of the real world and mitigate any estimation bias. Econometric methods can be used to simulate an oligopolistic competition (e.g., Cournot and/or Bertrand), predict the Lerner index of market power, or estimate demand and cost functions that account for dynamic strategic interaction among firms. The econometric approach can be of a structural or reduced form. However, structural models may require data that may not be available to the experts in charge of the damages calculation.

CHARACTERIZATION AND RELIABILITY OF OVERCHARGE ESTIMATES

Given the difficulties identified above, the estimation of a cartel overcharge would be tedious and costly if antitrust authorities had to conduct detailed investigations on a case-by-case basis. Antitrust authorities therefore need a reference number that can be used in cases where the exact evaluation of the cartel overcharge is overly costly.

The U.S. antitrust authorities use a base fine of 10% of the affected volume of commerce for a firm that is convicted of cartel activity, plus another 10% for the harms "inflicted upon consumers who are unable or for other reasons do not buy the product at the higher price." This yields a recommended fine of 20%, subject to further adjustments for aggravating and mitigating factors. The total cartel fines generally range from 15% to 80% of affected sales in the U.S.

Similar rules apply in Europe as well. The European Commission sets the base fine in the range of 0% to 30% of affected commerce. To this base fine, 15% to 25% may be added as a dissuasive measure. However, the total fine must be kept under 10% of the worldwide group turnover in the financial year preceding the decision.

Some academic researchers have questioned whether the fines implied by these guidelines are too high or too low. For instance, Cohen and Scheffman (1989) argued that an increase of 1% of a price above its competitive level will likely result in a reduction of sales of more than 1%. Based on this, they concluded with respect to the USSG that "*at least in price-fixing cases involving a large volume of commerce, ten percent is almost certainly too high.*" More recently, Adler and

Laing (1997, 1999) and Denger (2003) also judged that fines imposed to cartels in the U.S. are "*astronomical*" or "*excessive*."

Connor and Lande (2008) examine a large number of overcharge estimates available in previous studies and conclude that: *"the current Sentencing Commission presumption that cartels overcharge on average by 10% is much too low"*. They find an average overcharge lying in the range of 31% to 49% and a median in the range of 22% to 25%. Connor (2010) reaches similar conclusions by using an extended sample of overcharge estimates.

Connor and Bolotova (2006) conduct a meta-analysis of overcharge estimates in order to check whether they are sensitive to bias factors such as the estimation method or the publication source. They find that the overcharge estimates are indeed biased, but the bias factors do not explain much of the R^2. However, Boyer and Kotchoni (2015) point out that certain characteristics of the overcharge estimates have been ignored by Connor and Bolotova. First, the overcharge data consists of estimates previously published by different experts and researchers. Therefore, they are potentially subject to model errors, estimation errors, and sample selection. Second, the sample contains a few number of influential observations that distort the descriptive statistics. For instance, roughly 1% of overcharge estimates are larger than 400%. When the 5% largest observations are left out, the sample average drops from 49% to 32%. These outliers must be treated carefully when using OLS regressions. A bias-correction methodology developed by Boyer and Kotchoni (2015) that appropriately deal with the previous data problems is reviewed in more detail below.

In criticizing the Canadian Competition Bureau, Kearney (2009) endorses the view of Connor and Lande (2008) by writing that "*[t]he assumption of an average overcharge of 10 percent also has been put into question by economic survey evidence which suggests that the median long-run overcharge is much greater than 10 percent."*

Combe and Monnier (2011, 2013) performed an analysis of 64 European cartels and concluded that the fines imposed against cartels by the European Commission are sub-optimal. However, Allain, Boyer, and Ponssard (2011) used a dynamic model of cartel stability to reassess this study and find that fines imposed by the European Commission in these 64 cartels are on average above the deterrence level. Considering a more recent database at the firm level, Allain et al. (2015) conclude that the majority of firm-level fines imposed by the European Commission over the period 2005-2012 are above the deterrence level.

Boyer and Kotchoni (2015) re-assess the study of Connor and Bolotova (2006) using an extended version of their database. This database contains overcharge estimates as well as three types of variables. The first group (Y) consists of variables that describe the cartel episode (e.g., duration, scope, geography, etc.). The second group (Z) consists of factors that are posterior to the cartel episode (e.g. estimation method or publication source). The third group (W) consists of a single dummy variable that indicates whether the cartel or its participants are "found or plead guilty." While Y and W are likely related to the true overcharge, Z clearly doesn't but may capture potential estimation and publication biases. The raw overcharge estimates are potentially biased because the variable W is likely endogenous. Hence, a naive OLS regression of the overcharge estimates (OE) on Y, W, and Z as done in Connor and Bolotova (2006) should be avoided.

Boyer and Kotchoni use advanced econometric methods to circumvent potential biases. There is no simple way to characterize the methodologies used. Hence, the following paragraph is intended for experienced specialized readers.

We can summarize the methodology of Boyer and Kotchoni as follows. They use a Kullback-Leibler divergence to compare the probability of an OE being larger than some value θ conditional on (Y,W) to the same probability conditional on (Y,W, and Z). The two conditional probabilities are quite close for $\theta \in [0\%, 65\%]$ but diverge sharply for $\theta > 65\%$. This divergence is caused by the fact that the joint distribution of the variables that are involved in the Probit models that are specified for the probability of (OE>θ) become degenerate as θ exceeds a certain threshold. Next, they regress the logarithm of OEs on Y, W, and Z on increasing subsamples of type $(0, \theta]$. This allowed them to identify the range $OE \in (0\%, 49\%]$ as the most reliable for the meta-analysis. Thus, their final results are derived from a Heckit regression that infers bias-corrected OEs for the whole sample by using unbiased estimates of coefficients obtained from the subsample $OE \in (0\%, 49\%]$.

After applying the methodology described above to control for potential biases, Boyer and Kotchoni find mean and median bias-corrected overcharge estimates of 16.68% and 16.17% for the subsample of effective cartels (with strictly positive OEs), and of 15.47% and 16.01% for the whole sample. These numbers are significantly lower than the means and medians of the raw overcharge estimates data.

The results of Allain et al. (2011, 2015) and Boyer and Kotchoni (2015) bring prudent but significant theoretical and empirical support for the administrative rules used by antitrust authorities, in particular the European and American ones, in determining cartel fines, and thereby rationalize those rules.

ASSESSING THE PROBABILITY OF CARTEL DETECTION AND CONVICTION

The probability of detection plays a central role in the economic theory of optimal crime deterrence. Economic theory suggests that a cartel fine should be increasing in the harm caused to society by the cartel and be inversely related to the probability of its detection and conviction.

Bryant and Eckard (1991) postulate a statistical birth-and-death process to describe the onset and duration of cartels. The authors use a database of 184 convictions set by the Antitrust Division of the U.S. Department of Justice between 1961 and 1988 to calibrate their model and find an estimated probability of detection that lies between 13% and 17%. Combe, Monnier, and Legal (2008) calibrate a version of the model by Bryant and Eckard using a database of 86 convictions set by the European Commission between 1969 and 2007 and find that a probability of detection around 13%.

However, these estimates are only based on the data available on detected cartels. Consequently, they only represent the probability of a cartel being detected conditional on that cartel being detectable. The unconditional probability of cartel detection remains unknown and is probably lower than the estimates found by Bryant and Eckard (1991) and Combe, Monnier, and Legal (2008). The unconditional probability coincides with the conditional one only if all cartels are detectable ex ante.

Note that the probability of detection and overcharge estimates used in the optimal fine formula must be defined over the same length of time. For instance, assume that a cartel makes a constant illegal profit π in every period and that it has a probability α of being detected in every period. If the cartel operates for *N* periods before being detected and convicted, its cumulated illegal profit is equal to $N\pi$ and the ex-ante probability that it will be detected is $1-(1-\alpha)^N$. In this case, the optimal fine based on the Becker-Landes rule is:

$$F_N = \frac{N\pi}{1-(1-\alpha)^N}$$

Note that a cartel's discount factor is irrelevant when calculating the cumulative overcharge because F_N is the "ex post" fine of a cartel, which already existed for N years. A coarse mistake here would be to divide the cumulative overcharge $N\pi$ by the one-period probability of detection α. As the Becker-Landes rule treats the cartel game as a static one, the fine implied by this rule is equal to the *cumulative overcharge* of the cartel over its lifetime divided by the *cumulated probability* of detection and conviction.

This static framework has a major drawback: it does not account for the dynamic nature of the interaction between the firms participating in a cartel, nor does it account for the strategic nature of the decision of each firm to join and remain a cartel member. These cartel dynamics are discussed below.

A PROPER ASSESSMENT OF CARTEL DYNAMICS

In real life, firms have to make strategic decisions in a dynamic environment for the purpose of maximizing their profit or value. Although cartel members (implicitly or explicitly) agree to abide by the rules for an indefinite period, each of them can decide to deviate at any point in time if deviation is perceived as more profitable than the status quo. This has implications for the formation of cartels, their stability over time, and the optimal fining rule. These implications cannot be assessed in a static model.

Allain, Boyer, Kotchoni, and Ponssard (2015) (henceforth ABKP) consider an infinitely repeated game where a fixed and finite number of symmetric firms communicate at the beginning of each period to decide whether to form a cartel or not. The consent of all firms is needed before the cartel can be created or maintained. In each future period in the life of the cartel, each firm can decide to abide by the rules of the cartel or deviate. In the ABKP model, in each period, firms first choose whether to communicate or not (stage 1); if one or more firms do not communicate or participate, the cartel is dissolved forever; if all firms participate, then each firm may either follow the cartel strategy or deviate (stage 2). Again, there is no simple way to characterize the dynamic environment of cartels. The following simple but mathematical development is for an informed audience.

The one-period cartel profit is π^M, the one-period deviation profit is π^D, and the one-period but-for (non-cooperative) profit is π, with $\pi^D \geq \pi^M > \pi$. Let the cartel one-period profit over the but-for profit be $\Delta\pi = \pi^M - \pi$. There is a probability α that the cartel will be detected, in which case

each firm pays the fine F. ABKP assume that firms use trigger strategies and that the antitrust authority may detect the cartel, that is, the communication between conspirators on the spot but not retroactively.

The dynamic present value of a firm under the cartel is:

$$V^M = \pi^M + \alpha(-F + \frac{\delta}{1-\delta}\pi) + (1-\alpha)\delta V^M$$

The first term on the right hand side, π^M, is the current period profit generated by the cartel. The second term corresponds to a situation where the cartel is detected by antitrust authorities (this may happen with probability α), in which case each firm pays a fine F and the cartel is terminated starting next period. The third term is the continuation value if no deviation occurs and no discovery is achieved by the antitrust authorities. Solving for V^M yields:

$$V^M = \frac{\pi^M - \alpha F + \frac{\alpha\delta}{1-\delta}\pi}{1-\delta(1-\alpha)}$$

Two deviations are possible for a firm: The firm will deviate in stage 1 (it does not communicate and the cartel disintegrates immediately and forever) if its non-cooperative discounted present value in the absence of a cartel is larger than its expected discounted present value under the cartel, that is, if:

$$\frac{\pi}{1-\delta} > V^M \Leftrightarrow F > \frac{\Delta\pi}{\alpha} \equiv F^{(2)}$$

The firm will deviate in stage 2 (it does communicate, but does not implement the cartel agreement, a decision which makes the cartel disintegrate in the next period and forever) if its deviator's discounted present value is larger than its discounted expected present value under the cartel, that is, if:

$$V^D = \pi^D - \alpha F + \frac{\delta}{1-\delta}\pi > V^M$$

$$\Leftrightarrow F > \frac{\pi^M - \pi^D + \delta(1-\alpha)(\pi^D - \pi)}{\alpha\delta(1-\alpha)} \equiv F^{(1)}$$

Clearly, a stage 2 deviation is the more profitable deviation. Moreover, if $(\pi^D \rightarrow \pi^M)$, then $F^{(1)} \rightarrow F^{(2)}$ so that the deterrent fine in the dynamic model is the difference between the cartel and the

competitive profits ($\pi^M - \pi$) divided by the probability of detection (α). In general, $F^{(1)}$ meets the deterrence objective while $F^{(2)}$ is slightly larger than needed to achieve deterrence. Indeed:

$$F^{(1)} = \frac{\big(1-\delta(1-\alpha)\big)(\pi^M - \pi^D) + \delta(1-\alpha)(\pi^M - \pi)}{\alpha\delta(1-\alpha)} < \frac{\pi^M - \pi}{\alpha} = F^{(2)},$$

since $\pi^M - \pi^D < 0$. Hence, $F^{(2)}$ satisfies the principle of proportionality, while $F^{(1)}$ slightly violates it.

Either $F^{(1)}$ or $F^{(2)}$ are radically different from what we find in a *N*-period static game à la Becker-Landes, where the optimal fine (F_N) is equal to the cumulative difference between the cartel and the competitive profits $N(\pi^M - \pi)$ divided by the probability of detection over N periods ($1 - (1 - \alpha)^N$). The fine level F_N meets the restitution objective and coincides with $F^{(2)}$ only when N=1. Otherwise, F_N is larger than $F^{(1)}$ or $F^{(2)}$.

ABKP conduct a firm level analysis for European cartels between 2005 and 2012. For each cartel case, they collect data on the firms involved (e.g., duration, size of annual sales, fine imposed before adjustments) resulting in a database of 138 firms. For each firm, they compare the actual fine with the deterrence fine level in the dynamic model (used as benchmark) under several scenarios of cartel overcharge, competitive mark-up, and demand elasticity. They find that a significant proportion of fines imposed in the EU is above the deterrence benchmarks (between 30% and 80% of fines depending on the scenarios).

4. Conclusion

We presented and discussed two broad groups of challenges and pitfalls faced by public policymakers and antitrust authorities. The first group is related to the balance between allowing collaboration among competitors to enhance efficiency and social value through, for instance, proper value chains and networks, jointly-conducted R&D, patent pooling arrangements, agreements on product standards, shared distribution facilities, etc., *and* preventing cartel-like development of market power to the detriment of consumers, buyers and suppliers. The second group centers around the determination of fines in cartel cases, namely the sometimes conflicting objectives of restitution and deterrence, the identification of the relevant cartel duration, the

characterization and estimation of but-for prices and typical cartel overcharges, the assessment of the probability of detection and conviction, and the proper modeling of cartel dynamics.

We showed that the bias-corrected estimation of cartel overcharges and the modeling of cartel dynamics have significant impacts and lessons on the level of properly deterrent fines and bring prudent but significant theoretical and empirical support to the administrative rules used by antitrust authorities in determining cartel fines.

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