ARTICLES

CHALLENGES AND PITFALLS IN CARTEL FINING*

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We analyze challenges and pitfalls faced by antitrust authorities in the fining of cartels. We review economics and legal approaches to cartel fining and the sometimes-conflicting objectives of restitution, deterrence, and proportionality. We also discuss various theoretical and empirical hurdles that antitrust authorities and courts must overcome to determine appropriate cartel fines, namely regarding cartel impact duration, but-for prices, and overcharges.

Nous analysons les défis et les pièges rencontrés dans l'imposition des amendes de cartel. Nous passons en revue les approches économique et juridique relatives à la détermination des amendes et les objectifs parfois contradictoires de restitution, dissuasion et proportionnalité. Nous discutons des obstacles théoriques et empiriques à surmonter pour déterminer les amendes appropriées, à savoir la durée de l'impact, les prix contrefactuels et les surprix.

1. Introduction

Antitrust authorities around the world use punishment instruments, and in particular fines and prison terms, to prevent the formation of cartels or destabilize operating cartels. Cartel fines are usually higher than those set for 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 that should be punished severely. By imposing relatively high cartel 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 over the last decade, even reaching record amounts in the U.S. and Europe.[5] One of the factors behind the recent increase in fines is the willingness of antitrust authorities to strengthen a deterrence objective as recognized, for example, by the European Commission in its 2006 Guidelines.[6] Recent trends also suggest that for most jurisdictions, including the newcomers to antitrust policy, achieving deterrence supersedes the objective of restitution.[7]

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 economic approach developed by Gary S. Becker (1968) and William M. Landes (1983) constitutes the dominant theory underlying the deterrence of criminal activities. The basic proposition of this approach is that a firm will refrain from cartel activity if its expected net incremental profit of so doing is negative, i.e., if the expected cartel profit is lower than the expected loss upon detection, provided by the anticipated fine multiplied by the probability of detection and conviction.

The importance of economic analysis in the development and implementation of antitrust policy is continuously reaffirmed. Boyer, Ross, and Winter (BRW 2017) draw a historical overview of how economics was gradually integrated into competition policy. While suggesting 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 [and] the basic proposition was clear: cartels lead to higher prices to the detriment of consumers and the economy."

BRW characterize recent developments as an effort to incorporate into competition policy a more holistic vision of economics, organizations, and institutions: "Economists had significant influence in promoting a two-pronged approach that distinguished between naked cartels and cooperation between competitors, in strategic alliance and joint ventures for example that can be beneficial and should not be caught up in anti-cartel law. This dual track approach was formally adopted in Canadian competition policy with amendments to the *Competition Act* in 2010." In such a world, economists and policy makers attempt to draw a somewhat blurred line between collaboration mechanisms that could enhance efficiency and wealth creation and the outright exercise of market power.

In this paper, we review key aspects of cartel policies, raise issues of methodological importance in setting optimal cartel fines, and propose solutions using economic reasoning and econometric techniques. Our review provides perspectives on how economics, law, and antitrust practices and rules can converge towards the common goal of setting optimal cartel fines.

The remainder of this paper is organized as follows. Section 2 presents a general public policy overview of collaboration between competitors

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 sometimes conflicting objectives of antitrust policies and discusses specific challenges and pitfalls in the setting of cartel fines, namely the identification of the relevant period of cartel activity, the estimation of cartel overcharge, and the modeling of cartel dynamics. We conclude in Section 4.

2. Collaboration between Competitors and Cartel Policy

We briefly review 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 discuss the reliance on leniency programs as primary tools of discovery of cartels, based on advanced game theoretic analysis, and their impact on deterrence. Finally, we briefly discuss the two pillars of anti-cartel policies, namely public and private enforcement instruments.

A. The Perception of Cartels

In response to profound changes in the economic landscape around the mid-19th century – *e.g.*, international trade, increased globalization with significant movement of labor and capital, and enhanced market power in many industries - competition policy began to emerge culminating in competition legislation in 1889 in Canada and in 1890 in the U.S.[8] The 1889 Canadian Act established cartels as criminal activities, with possible sanctions upon conviction reaching up to two years of imprisonment, while the U.S. 1890 Sherman Act set a maximum penalty of one year.

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*".

In Canada, the maximum imprisonment penalty remained at the two-year level until 1976 when it was increased to five years. It was increased to fourteen years in 2010, the "highest of any anti-cartel regime in the world."[9] 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, market allocation, and/or restrained production levels, as well as engage in other anti-competitive practices.[10] However, to be considered legal, cartels had to register their agreements with a government authority.[11]

In Austria, this pro-cartel policy, dating back to 1951, rested on the Austrian version of corporatism called Social Partnership, in which price ceilings or increases were effectively regulated. As unregistered cartel agreements were subject to criminal law, registered cartels served to implement regulated prices such that firms could reach price ceilings and avoid their undercutting. Moreover, those registered cartels were allowed to implement policies aimed to enforce cartel agreements, namely inter-firms compensation schemes, reporting requirements, rules for entry and exit, and quick and credible punishment upon deviations.

The Austrian model could be seen as validating collaboration between competitors although it goes beyond the types of collaboration generally allowed in vertical integration schemes, strategic alliances, and international business relationships. However, distinguishing between so-called naked cartels aimed at price-fixing, limiting production, and allocating markets, which are serious antitrust offenses, and bona fide collaboration between competitors, is a difficult endeavour.

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 over the years by economists advocating for a more rigorous treatment of naked cartels and a balanced analysis of non-naked ones. For instance, Kennish and Ross (1997) combined previous economic contributions and claimed that the law had to make room for the benefits of cooperation among

competitors. They 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." Although models of value chains and networks are challenging competition policy at its roots, applying the rule of reason to competitor collaboration, including soft or non-naked cartels, that may reduce competition intensity but improve efficiency in resource allocation, need not be done at the detriment of strengthening criminal provisions on hard-core cartels through a *per se* liability.[12]

B. 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.[13]

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 or conspiracy punishable by a fine of up to $25 million, or imprisonment for a term of up to 14 years, or both.[14]

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 level as recommended by the USSG; b) the infringing firm's pecuniary gain from the offence; or c) the pecuniary loss to consumers (harm) resulting from the offence.[15]

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.[16]

These various leniency programs have the common goal of deterring antitrust violations and detecting cartel offences earlier by using the pledge of less severe sanctions. Cartel participants may turn themselves in and cooperate with authorities to receive full immunity from prosecution or fine reductions. Competition authorities in Australia, Canada, the European Union, and the U.S. continue to bring cartel members to justice through the valuable cooperation of whistleblowers.[17] 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 more lenient treatment.

Fine reductions in Canada and in the U.S. follow 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 benefit from reduced sentences (fines) in exchange for their guilty plea and full cooperation.

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 antitrust legislation different versions of leniency policies.[18] With the introduction of leniency programs in antitrust legislation of Australia, Canada, the European Union, and the U.S., the number of cartels detected in these jurisdictions has considerably increased in the last decade compared to previous ones and most of these cartels were detected through immunity applications.

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 on detection rates is somewhat ambiguous. Leniency programs typically reduce cartel stability by creating a prisoner's dilemma situation among cartel participants and inducing confessions;[19] by allowing whistleblowers to gain a competitive advantage on competitors, which incur cost increases through fines and compliance costs;[20] and by allowing cartel members to apply for immunity and leniency while having taken advantage of the collusion.[21] Researchers have also found that leniency programs induce collusive arrangements, insofar as the program is not restricted to the first reporting firm, which can cause a decrease in deterrence because of reductions in expected fines.[22]

Nevertheless, leniency programs contribute to hastening 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 cartels. In any case, antitrust officials in many jurisdictions have praised the importance of their respective leniency programs.[23]

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 next, 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.[24]

C. 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.[25] Both private and public enforcement are expensive, ranging from the cost of detecting an infringement, to seeking punishment, to the compensation of victims.

Public resources are used for 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 serve deterrence objectives, and private enforcement is usually perceived as favouring 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.

The U.S. is the OECD jurisdiction with the most extensive experience with private enforcement. Both individuals and businesses may bring about civil actions in relation to various antitrust violations such as monopolization, cartels, and other horizontal conspiracies and vertical arrangements. Class actions are also broadly available in the U.S. If the civil actions are successful, relevant parties can benefit from different forms of compensation including treble damages, i.e., damages three times 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 does allow for persons affected by antitrust violations such as anticompetitive arrangements and abuse of dominance to recover damages.[26] The use of class actions is also less prevalent in Europe. In Canada, various class actions mostly related to price-fixing conspiracies have been initiated over the years.

3. Challenges and Pitfalls in Cartel Fining

Below, we review important issues related to the theoretical design and empirical implementation of an optimal fining rule. Two major difficulties arise when it comes to evaluating empirically the overcharge imposed by cartels: (a) the precise identification of the period covered by the collusion and (b) the lack of reliable data to estimate the but-for price accurately, hence the difficulty to evaluate the price increase or overcharge due to the cartel. As for the cartel overcharge estimates available in the empirical literature, they are typically subject to estimation biases.

A. 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 and profits in the legal sector, the reduction of benefits in the criminal sector, the increase in

the probability of detection and conviction, 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 as long as socially costless means of punishment (such as fines) are available.[27]

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 punishing antitrust violations in such a way that proper behaviour is encouraged: harm-based rather than gain-based penalties. A large body of the economic literature on the deterrence of cartel activities relies mainly on the theory developed by Becker and Landes: The optimal fine should equal the harm caused by the cartel divided by the probability of detection and conviction. In principle, the harm caused by a cartel includes not only the damages incurred by competitors and clients but also the resources devoted by antitrust authorities and courts in their fight against cartels. However, the bulk of this harm imposed by a cartel is epitomized by the price overcharge.

The Becker-Landes rule aims for the return of the cartel excess profits to all stakeholders in the economy that have been harmed by the activity of cartels. This rule is designed such that the expected net gain of a firm contemplating joining a cartel is equal to zero. At the aggregate level, the rule guarantees that the "cartel game" clears: Firms found guilty of price-fixing behaviour 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, Boyer, Kotchoni, and Ponssard (ABKP 2015) is compatible with a dynamic view of the game faced by firms who are contemplating joining or remaining in a cartel. Indeed, cartel members play a repeated game where at periodic times each member decides whether to continue with 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 idea that individuals who engage in illegal behaviour should be punished by punitive or exemplary fines beyond the harm that they have caused to society. Admissible fines may therefore be an inflated version of the optimal fine under restitution or even deterrence. In practice, the severity

of the punishment is determined by accounting for aggravating and mitigating factors. As discussed above, the notion of punishment goes beyond financial penalties and may include a jail sentence for convicted individuals as provided, for instance, by the USSG.

The concept of punishment is more legal than economic as is the concept of proportionality, which stipulates that a sanction should be set in proportion to or be of the same order as the harm caused. A fining rule that is aiming at deterrence à la Becker-Landes will often violate the principle of proportionality. However, a fining rule aiming at dynamic deterrence (via the destabilization of cartels) à la ABKP may be more in line with the principle of proportionality.

B. 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 increase according to 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 assess the duration of cartels. The authors use a database of 184 convicted cartels in the U.S. 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 this model using a database of 86 cartels convicted in Europe between 1969 and 2007 and find a probability of detection of 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 or based on those cartels being "eventually detected". 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*.

Moreover, 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 cartel profit $\Delta\pi$ above the competitive level 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 cartel profit is equal to $N\Delta\pi$ 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:

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

The denominator $1-(1-\alpha)^N$ is larger than the per-period probability of detection α. Intuitively, the longer a cartel operates, the more likely it will end up being detected. A significant mistake here would be to divide the cumulative overcharge $N\Delta\pi$ by the one-period probability of detection α. Replacing the denominator $1-(1-\alpha)^N$ by the smaller value α would lead to overestimating the optimal fine, and the severity of the overestimation is increasing in the number of periods N. 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.*

A (misapplied) static framework has a major drawback: It does not account for the dynamic nature of the interaction between the firms participating in the 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.

C. The Proper Assessment of Cartel Dynamics

In real life, firms make strategic decisions in a dynamic environment with the objective 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 it perceives a deviation as more profitable than the status quo. This has implications for the formation of cartels, their stability over time, as well as the optimal fining rule. Analyzing such implications requires a dynamic framework.

Allain, Boyer, Kotchoni, and Ponssard (ABKP 2015) consider an infinitely repeated game where a number of symmetric firms communicate at the beginning of each period to decide whether to form or continue a cartel or not. By assumption, the consent of all firms is needed for the cartel to be created or maintained. In each period, any given firm can decide to participate and abide by the rules of the cartel or deviate. There

is no simple way to characterize the dynamic environment of cartels but the ABKP proposed formulation is sufficiently general to be representative of most cases. In each period, firms first communicate and agree or not to form or continue the cartel (stage 1) and then, if the cartel is agreed upon, each firm decides (stage 2) whether to abide by it or not. If one or more firms do not agree to participate (stage 1), the cartel does not proceed. If all firms agree to participate, then each firm may either follow the cartel strategy or deviate (stage 2) – if one firm deviates, all firms observe the deviation at the end of the current period and the cartel dissolves for all future periods.

When assessing its different options, a firm typically considers three levels of possible one period profit: its cartel profit, its deviation profit, and its no-cartel profit. ABKP makes the usual assumption that the deviation profit level is the largest, followed by the cartel profit level, and the no-cartel competitive one. Assuming that all other firms abide by the cartel agreement, a given firm will abide by it if its value under the cartel is larger than its value under deviation, and will deviate otherwise. Its value under the cartel is the present value of the forever sequence of cartel profit levels. Its value under deviation is the larger one-period deviation profit plus the present value of the forever sequence of lower no-cartel profit levels starting next period.

Assuming that antitrust authorities can discover a cartel only if it is active, then the expected fine, given by the probability of detection and conviction α – typically considered to be of the order of 15% – times the fine level F, reduces the value of the firm under the cartel abiding strategy. If the firm deviates, the cartel dissolves and the authorities will never discover it and impose a fine on cartel members. Comparing the two discounted firm values leads ABKP to characterize the fine level F^* which, given α, induces the firm to deviate and makes the cartel disintegrate. ABKP show that F^* equals the difference $\Delta\pi$ between the cartel profit and the competitive profit levels divided by α. In other words, the expected fine must be larger than or equal to the difference in profit levels: $\alpha F^* \geq \Delta\pi$. The fine F^* is radically different from what we find in the usual N-period cartel framework à la Becker-Landes, where the optimal fine F_N is equal to the cumulative difference between the cartel and the competitive profits $N\Delta\pi$ divided by the probability of detection over N periods $(1 - (1 - \alpha)^N)$ as we showed above. It is of course quite different for the standard but false application of the Becker-Landes static

approach where the N-period cartel excess profit $N\Delta\pi$ is divided by the one-period probability of detection α.

ABKP conduct a firm level analysis of European cartels between 2005 and 2012. For each cartel case, they collect data on the cartel duration, size of annual sales of firms involved, and the firm level fines imposed before adjustments, resulting in a database of 138 firms. For each firm, they compare the actual fine with the deterrence fine level in their dynamic model under several scenarios of cartel overcharges, competitive mark-ups, and demand elasticities. 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 scenario considered).

D. Identification of the Beginning and End of the Cartel Episode

Harrington (2006) developed a set of collusive indicators, which if present, can help distinguish between collusion and competition. In particular, Harrington argues that certain price markers are especially 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 detailed data gathering on specific markets. The number of such markets may also be very large.

The knowledge of the period during which a cartel operated is important for a precise calculation of its cumulative overcharges and resulting damages. 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. The latter estimate can then be

multiplied by N to obtain an estimate of the total cumulative overcharge of the cartel.

In general, antitrust authorities have to rely on information collected by investigators or on the conclusions of experts in order to estimate the duration of cartels. Unfortunately, cartels members tend to understate the true duration of the cartel in their statements to investigators. In some cases, cartels continue to operate several months after investigations have started in order to cast ambiguity on the but-for price, hence the level of the actual overcharge, since keeping a high price after the "legally defined" end of the cartel would raise the but-for price. Lowering the price immediately after the beginning of an investigation would contribute to proving that an effective and successful cartel was in fact in operation.

Unless they recognize the cleverness of cartel members, antitrust authorities may end up underestimating the cartel overcharge. It is therefore important to distinguish between the legal collusion period as defined in the indictment and the relevant period for purposes of estimating the effect of the collusion. This relevant period is the period during which coordination between the parties had or could have an influence on prices. The collusion may have started before or may have continued beyond the legal period. If the analysis is performed on the wrong period, economic experts may find insignificant cartel price overcharges despite the overwhelming evidence that a cartel operated during the alleged period.

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 or alleged 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.*"

Hüschelrath and Veith (2016) write about a cartel in the cement industry in Germany:

> "*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 or alleged period of collusion as indicated in prosecution documents and the relevant period of collusion for damages evaluation.

The retail gasoline cartel in Québec

The Competition Bureau investigated retail gasoline markets in Sherbrooke, Thetford Mines, Victoriaville, and Magog and obtained proof of collusion through wiretaps over the period spanning from early 2004 to mid-2006. Criminal prosecution for the price-fixing conspiracy were launched in 2008.[28] The case is ongoing with more trials forthcoming.[29]

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 had defined a legal period from January 2004 to June 2006. A sharp reduction in price volatility across sellers can be considered a marker revealing cartel behaviour. Retail gasoline prices in the cities of Sherbrooke, Thetford Mines, Victoriaville, Saint-Hyacinthe, and Montréal for the period 1993-2006 were collected for all individual retail stations on a quarterly basis in the first four cities and a bi-monthly basis in Montréal. 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.[30]

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 Figures 1 and 2 present the data for Sherbrooke and Montréal-Center.

The statistical tests on differences between the variances and the averages are significant.[31] 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.[32] 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 or alleged period of collusion as mentioned in the indictment, could not be considered as a period free of collusion. In order to avoid falling into a Type II analytical error, i.e., discharging as not guilty a harmful cartel, three years of data prior to the legal period were dropped from the econometric analysis.

Fixing passenger fuel surcharges (PFS) by British Airways and Virgin Atlantic Airways

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.

The UK Office of Fair Trading (OFT 2012) investigated this conspiracy 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). This is a peculiar case. Why would BA and VA find it advantageous to coordinate their decisions on the fuel surcharge, which accounts for less than 10% of the ticket prices, but not on the final ticket prices?

Figure 1. Price variation dynamics between retailers in Sherbrooke[33]

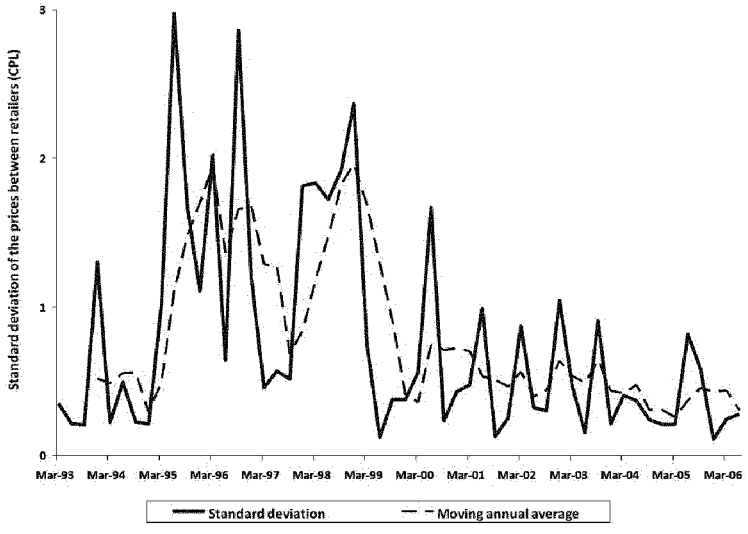
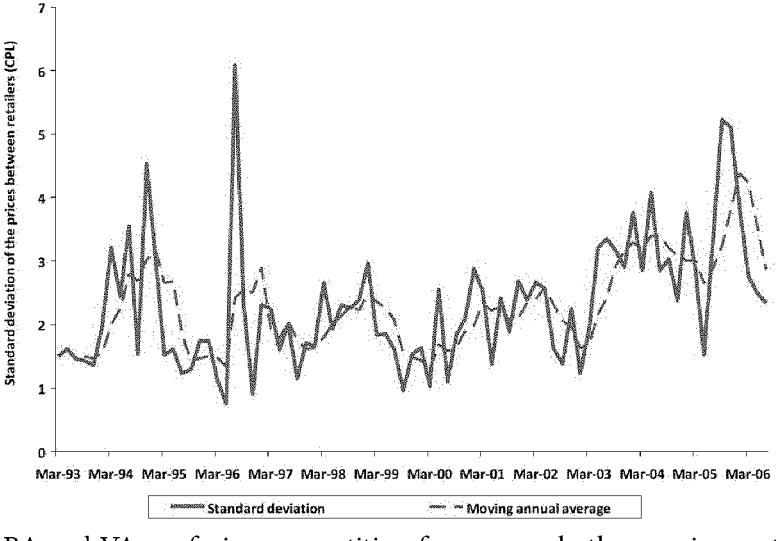


Figure 2. Price variation dynamics between retailers for Montréal-Centre



BA and VA are facing competition from several other carriers not part of the conspiracy. Moreover, according to the OFT inquiry, 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, and likely penalties (fines and class actions), exclusions,

disbarment, and prison sentences. Clearly, 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 was a "relevant market" in which BA and VA had some market power, making a coordination strategy to fix PFS jointly beneficial despite the risks involved. Indeed BA and VA were or might have been 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 on their national airlines. Those British citizens and organizations would most likely perceive a fuel surcharge imposed and announced in a coordinated way to all travelers as the result of a market phenomenon outside the control of their preferred national carriers. Uncoordinated announcements, possibly heavily covered in the British press, could have given rise to unfavourable reactions and reduced allegiance of their British customers for BA and VA.

In this conspiracy case, VA was a successful leniency 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 is a subset of affected markets. The OFT claims that the fine "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: "Managing 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 describes the positions of the two cartelists as follows (passim). From BA's perspective, the PFS mechanism was particularly problematic because negative stories in the UK media were more likely to focus on BA than on other airlines; For VA, the media and consumers' 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 a concerted strategy were twofold: a reduction in uncertainty regarding the competitor's actions and reactions (BA and VA) 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." Both advantages were expected to generate profits for the airlines.

One should not underestimate the sophisticated reasoning of BA's strategists, once the cartel was exposed. 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, Boyer (2017) has found that it is only from November 2006, not from June 2006, that ticket prices fell and became more volatile and the co-movement of prices and fuel costs became less direct and stable. This indicates that the relevant period of collusion insofar as the impact of the conspiracy on ticket prices is concerned may have extended until November 2006, that is, five months after the OFT's raid at BA offices (June 2006) and three quarters after the end of the legal or alleged conspiracy period (February 2006). Whether this is the appropriate period or not is in good part an empirical question but a significant one in estimating cartel damages.[34]

E. 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.

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) 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, hence the fine level.

It is well-known how biased an overcharge (expressed as a percentage of the but-for price) obtained from the conversion of a Lerner index is relative to the fair overcharge if the but-for world was properly modeled. The estimation bias is proportional to the ratio of the mark-up over the marginal cost. Note that this ratio is higher when the market power is more important. Intuitively, the outcome of an oligopolistic or monopolistic competition game is closer to that of a collusion than to that of pure and perfect competition. As an implication, firms that operate in oligopolistic sectors where market power is high would have a higher likelihood of incurring inflated fines, that is, fines larger than those justified by the formulae applied to firms that were more competitive prior to colluding.

The estimation risk associated with the conversion of a Lerner index is avoided by considering alternative methods such as "before-and-after" or "with-and-without/yardstick" methods (Connor, 2010). In the before-and-after method, one estimates the overcharge as the difference between the sample averages of prices observed during and outside the periods covered by the cartel episode. In the "with-and-without/yardstick" method, one compares the average price that prevailed on the cartelized market with the average price on a yardstick market that operated under competitive conditions during the same period. However, these other methods have their own estimation risk.

Besides the fact that the period covered by the cartel is difficult to identify with precision, the before-and-after method is not robust to shifts in firms' cost structure and shifts in market conditions that naturally change prices in a competitive environment. Moreover, a cartel may start or end by a price war that pushes prices below the marginal cost.[35] As to the with-and-without/yardstick method, it must take into account that the increase in price caused by the cartel can cause a demand shift toward nearby (yardstick) markets. Similarly, neighbouring firms that are not participating in the collusion may tend to follow the cartel price (the so-called "umbrella effect").[36]

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 structural or of reduced form. However, structural models require internal accounting data that may not be available to the experts in charge of damages calculation.

F. Characterization and Reliability of Average Overcharge Estimates

Given the hurdles 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 interval that can be used in cases where the exact evaluation of the cartel overcharge is overly costly.

Antitrust authorities are aware of this matter. As discussed above, the USSG prescribe 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% of affected sales, 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 as in other jurisdictions. 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.

Certain academic researchers have questioned whether the fines implied by these guidelines are too high or too low. For instance, Cohen and Scheffman (1989) argue 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 judge 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*". Indeed, they find an average overcharge in the range of 31% to 49% and a median in the range of 22% to 25%. Connor (2010, 2014) reaches similar conclusions by using an extended sample of overcharge estimates.[37]

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 some 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 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) analyze 64 European cartels and conclude that the fines imposed against cartels by the European Commission are too low. However, Allain, Boyer, and Ponssard (2011) using a dynamic rather than static model of cartel stability to reassess those results find that fines imposed by the European Commission in these 64 cartels are on average 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 some 1,119 overcharge estimates as well as several variables that

describe the cartel episode (e.g., duration, scope, geography, etc.). The database also includes variables that describe facts that are posterior to the cartel episode (e.g., estimation method or publication source). While the first group of variables is likely related to the true overcharge, the latter group clearly does not, but may capture potential estimation biases.

Boyer and Kotchoni (2015) employ a more appropriate econometric methodology that involves a trimming of the dataset in a first stage to remove unrealistically large estimates, and so-called influential observations,[38] and a Heckit (Heckman, 1979) regression analysis in a second stage to control for the potential truncation bias.

They find mean and median bias-corrected overcharge estimates of 16.7% and 16.2% for the subsample of effective cartels (with strictly positive overcharge estimates), and of 15.5% and 16.0% for the whole sample. These representative bias-corrected overcharge values are significantly lower than the corresponding mean and median of the raw overcharge estimates data. Building on those results, Allain et al. (2015), considering a more recent database at the firm level, conclude that the majority of firm-level fines imposed by the European Commission over the period 2005-2012 are above the deterrence level.

4. Conclusion

We presented and discussed challenges and pitfalls faced by public policymakers and antitrust authorities in their fight against naked cartels through the determination of financial fines, 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.

Both the harm caused by cartels – or the illicit profits gained – and the probability of detection pose significant measurement problems and are sources of challenges and pitfalls. In fact, a 2017 ICN report also recognizes that "the link between the theory of optimal fines for deterrence, and actual methodologies used to set fines is often tenuous, partly because the statistical information needed to set fines at an economically optimal level (amount of excess profit gained, likelihood of detection) is very difficult to obtain."

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 deterrent fines. Those developments bring theoretical and empirical support to the administrative rules used by European and American antitrust authorities, among others, in determining cartel fines.[39]

References

Adler, H and DJ Laing, "Explosion of international criminal antitrust enforcement" (1997) 11 The Corporate Counsellor 1.

Adler, H and DJ Laing, "As corporate fines skyrocket" (1999) 6 Business Crimes Bulletin 1.

Allain, ML, M Boyer, R Kotchoni & JP Ponssard, "Are Cartel Fines Optimal? Theory and Evidence from the European Union" (2015) 42 International Review of Law and Economics 38.

Allain, ML, M Boyer & JP Ponssard, "The determination of optimal fines in cartel cases: Theory and practice" (2011) 4-2011 Concurrences - Competition Law Journal 32.

American Bar Association, *Econometrics: Legal, Practical and Technical Issues* (2014). Second Edition, 444 pages.

Appelbaum, E, "Testing Price Taking Behavior" (1979) 9 Journal of Econometrics 283.

Becker, G, "Crime and Punishment: An Economic Approach" (1968) 76 Journal of Political Economy 169.

Bageri, V, Y Katsoulacos & G Spagnolo, "The Distortive Effects of Antitrust Fines based on Revenue" (2013) 123 The Economic Journal 545.

Boyer, M, "The Retail Gasoline Cartel in Québec: Background and Damages" (Canadian Economics Association Meeting, May 2015, 29 pages). (The original report, filed in court in 2008, is: Boyer, M, "Collusion présumée des essenceries de plusieurs villes du Québec: analyse de données et évaluation d'impact économique", 126 pages).

Boyer, M, "Rapport sur l'estimation des dommages dans le cadre de l'action collective Option consommateurs v. British Airways" (2017) Superior Court of Quebec, District of Montreal, 500-06-000410-072.

Boyer, M. & R Kotchoni, "How Much do Cartels Overcharge?" (2015) 47:2 Review of Industrial Organization 119.

Boyer, M, P Lasserre & M Moreaux, "A Dynamic Duopoly Investment Game without Commitment under Uncertain Market Expansion" (2012) 30 International Journal of Industrial Organization 663.

Boyer, M & D Porrini, "The Impact of Court Errors on Liability Sharing and

Safety regulation for Environmental/Industrial Accidents" (2011) 31 International Review of Law and Economics 21.

Boyer, M., T. Ross & R. Winter, The Rise of Economics in Competition Policy: A Canadian Perspective. (2017) 50:5 *Canadian Journal of Economics* 1489.

Canada, Canadian Competition Bureau, *Competitor Collaboration Guidelines* (December 2009).

Competition Bureau Canada, "What are the penalties" (2 January 2018) online: <http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04265.html>

Cohen, MA & DT Scheffman, "The Antitrust Sentencing Guideline: Is the Punishment Worth the Costs?" (1989) 27 American Criminal Law Review 331.

Combe, E & C Monnier, "Fines against hard core cartels in Europe: The myth of over-enforcement" (2011) 56 Antitrust Bulletin 235.

Combe, E & C Monnier, "Quelle est l'ampleur de la sous-dissuasion des cartels en Europe ? Compléments sur nos résultats" (2013) 1-2013 Concurrences - Competition Law Journal 16.

Connor, JM, "Our Customers Are Our Enemies: The Lysine Cartel of 1992-1995" (2001) 18 Review of Industrial Organization 5.

Connor, JM, *Price-fixing Overcharges, 2nd Edition* (2010) online: <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1610262>

Connor, JM, "Price-fixing Overcharges" in *The Law and Economics of Class Actions: Research in Law and Economics*, Volume 26 (2014) 249.

Connor, JM & Y Bolotova, "A Meta-Analysis of Cartel Overcharges" (2006) 24 International Journal of Industrial Organization 1109.

Connor, JM & RH Lande, "Cartel Overcharges and Optimal Cartel fines" in *Issues in Competition Law and Policy*, SW Waller (ed.), Volume 3, AMA Section of Antitrust Law (2008) chapter 88, pp. 2203-2218.

Denger, ML, "Too Much or Too Little, A Summary of Discussion" (2003) American Bar Association's Antitrust Remedies Forum, Washington, DC.

EC, *Commission recommendation of 11 June 2013 on common principles for injunctive and compensatory collective redress mechanisms in the Member States concerning violations of rights granted under Union Law*, [2013] OJ, L 201/60, online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013H0396&from=EN>

EC, Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003, [2006] OJ, C 210/02.

Ellis, C & W Wilson, "Cartels, price fixing, and corporate leniency: What doesn't kill us makes us stronger" (2003) University of Oregon, Department of Economics.

Fink, NP, P Schmidt-Dengler, K Stahl & C Zulehnery, "Registered Cartels in Austria - An Overview" (2015) Mimeo, December.

Finkelstein, M & H Levenback, "Regression Estimates of Damages in Price-Fixing Cases" (1983) 46 Law and Contemporary Problems 145.

Froeb, LM, RA Koyak & GJ Werden, "What Is the Effect of Bid-Rigging on Prices?" (1993) 42 Economics Letters 419.

Hall, RE, "The relation between price and marginal cost in U.S. industry" (1988) 96 *J Polit Econ* 921.

Halladay, CW. "The Origins of Canada's Cartel Laws" (2012) 25 Can Comm L Rev.

Harrington, JE Jr., "Behavioral Screening and the Detection of Cartels," (2006) European University Institute 2006 EU Competition Law and Policy Workshop Proceedings.

Heckman, J, "Sample Selection Bias as a Specification Error" (1979) 47 *Econometrica* 153.

Hüschelrath, K & T Veith, "The Impact of Cartelization on Pricing Dynamics: Evidence from the German Cement Industry" (2011) Zentrum für Europäische Wirtschaftsforschung GmbH, #11-067.

Hüschelrath, K & T Veith, "Cartelization, Cartel Breakdown, and Price Behavior: Evidence from the German Cement Industry" (2016) 16 Journal of Industry, Competition and Trade 81.

International Competition Network, "Setting of Fines for Cartels in ICN Jurisdictions" (Report to the 16th ICN Annual Conference in Porto, May 2017).

Juska, Z, "The Effectiveness of Private Enforcement and Class Actions to Secure Antitrust Enforcement" (2017) 62(3) The Antitrust Bulletin 603.

Katsoulakos, Y, E Motchenkova & D Ulph, "Penalizing cartels: the case for basing penalties on price overcharges" (2015) 42 International Journal of Industrial Organization 70.

Kearney, E, "The Competition Bureau '20 Percent Solution': Does the Punishment Fit the Crime?" (2009) The Marker, CBA National Competition Law Section, March.

Kennish, T & TW Ross, "Toward a New Canadian Approach to Agreements between Competitors" (1997) 28 Can Bus LJ 22.

Kullback, S & RA Leibler, "On Information and Sufficiency" (1951) 21:1 The Annals of Mathematical Statistics 1.

Landes, WH, "Optimal Sanctions for Antitrust Violations" (1983) 50 U Chicago L Rev 652.

Leighton, A, *The Court of Cacus; The Story of Burke and Hare* (London: Houlston

and Wright, 1861, retrieved from the Harvey Cushing / John Hay Whitney Medical Library at Yale University).

Morrison, CJ, "Market Power, Economic Profitability, and Productivity Growth Measurement: An Integrated Structural Approach" (1990) NBER Working Paper No 3355.

Motchenkova, E, "The effects of leniency programs on the behaviour of firms participating in cartel agreements" (2004). Tilburg University, Manuscript.

Musson, AJ, "Turning King's Evidence: The Prosecution of Crime in Late Medieval England" (1999) 19:3 Oxford J L Stud 467.

O'Brien, A, "Cartel Settlements in the US and EU: Similarities, Differences & Remaining Questions" (13th Annual EU Competition Law and Policy Workshop, Florence, Italy, 2008).

Office of Fair Trading, *Airline passenger fuel surcharges for long-haul flights – Infringement of Chapter I of the CA98 and Article 101 of the TFEU by British Airways Limited and Virgin Atlantic Airways Limited*, Decision No. CA98/01/2012 Case CE/7691-06, 19 April 2012, 122 pages.

Spagnolo, G, "Divide et Impera: Optimal Leniency Programs" (2005). Stockholm School of Economics and C.E.P.R.

Spagnolo, G, "Leniency and whistleblowers in antitrust". In: P Buccirossi, Editor, *Handbook of Antitrust Economics* (Cambridge, MA: MIT Press, 2008).

United States Sentencing Commission, Guidelines Manual, §3E1.1 (November 2016).

Endnotes

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[5] The U.S. Department of Justice, Antitrust Division levied record criminal fines of $3.6 billion in 2015 (See criminal enforcement trend charts at https://www.justice.gov/atr/criminal-enforcement-fine-and-jail-charts). The European Commission has imposed during the 2005-2014 periods aggregate cartel fines of $15.5 billion nearly five times higher than those of $3.4 billion

imposed during the 1995-2004 periods (See cartel statistics at http://ec.europa.eu/competition/cartels/statistics/statistics.pdf).

[6] EC, Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003, [2006] OJ, C 210/02 at 2-5 [EC Guidelines].

[7] International Competition Network, "Setting of Fines for Cartels in ICN Jurisdictions" (Report to the 16th ICN Annual Conference in Porto, May 2017) at 5-6: "Several competition authorities noted that their fining policy in cartel cases pursues multiple goals (deterrence, retribution, recovery of excess cartel profits), and these are not mutually exclusive. Having said this, the vast majority of responding agencies have indicated that fines are intended to deter the addressees from engaging in the same illicit conduct in the future (i.e. specific deterrence), as well as to dissuade other potential infringers from forming or joining anticompetitive cartels (i.e. general deterrence). Some agencies mentioned other aims in addition to deterrence, others did not."

[8] 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.

[9] CW Halladay, "The Origins of Canada's Cartel Laws" (2012) 25 Can Comm L Rev at 157-163.

[10] In Austria, registered cartels were classified according to their main cartel instrument (production quotas, product specialization, price agreement, payment conditions) and according to their orientation (buyer, seller, import, and export cartels) with some cartels having more than one orientation. Most cartels were seller cartels (97%), followed by buyer cartels (13%) and export cartels (11%), with some falling in more than one orientation. Proposed cartels needed to be justified; most were formed to allegedly solve a lack of job security (35%), a lack of security of supply (29%) and the presence of excessive competition (27%) (Fink, NP, Schmidt-Dengler, P, Stahl, K & Zulehnery, C, "Registered Cartels in Austria - An Overview" (2015) Mimeo, December).

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

[12] See Canada, Canadian Competition Bureau, *Competitor Collaboration Guidelines* (December 2009).

[13] EC Guidelines at 2-5.

[14] Competition Bureau Canada, "What are the penalties" (2 January 2018) online: <http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04265.html>

[15] United States Sentencing Commission, Guidelines Manual, §3E1.1 (November 2016).

[16] A O'Brien, "Cartel Settlements in the US and EU: Similarities, Differences & Remaining Questions" (13th Annual EU Competition Law and Policy Workshop, Florence, Italy, 2008).

[17] In Canada, the Competition Bureau's immunity program is currently under revision.

[18] 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: "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." (AJ Musson, "Turning King's Evidence: The Prosecution of Crime in Late Medieval England" (1999) 19:3 Oxford J L Stud 467)

[19] G Spagnolo, "Leniency and whistleblowers in antitrust". In: P Buccirossi, Editor, *Handbook of Antitrust Economics* (Cambridge, MA: MIT Press, 2008).

[20] C Ellis & W Wilson, "Cartels, price fixing, and corporate leniency: What doesn't kill us makes us stronger" (2003) University of Oregon, Department of Economics.

[21] G Spagnolo, "Divide et Impera: Optimal Leniency Programs" (2005). Stockholm School of Economics and C.E.P.R.

[22] E Motchenkova, "The effects of leniency programs on the behaviour of firms participating in cartel agreements" (2004). Tilburg University, Manuscript.

[23] See, for instance, "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.); and "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.).

[24] 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.

[25] Z Juska, "The Effectiveness of Private Enforcement and Class Actions to Secure Antitrust Enforcement" (2017) 62(3) The Antitrust Bulletin 603.

[26] Things are changing though. See EC, *Commission recommendation of 11 June 2013 on common principles for injunctive and compensatory collective redress mechanisms in the Member States concerning violations of rights granted under Union Law*, [2013] OJ, L 201/60, online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013H0396&from=EN>

[27] This argumentation is convincing although astronomical fines are not socially costless if they can cause a firm to go bankrupt. Moreover, natural justice considerations might be a constraint (e.g. punishments should fit the crime).

[28] 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.

[29] 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.

[30] M Boyer, "The Retail Gasoline Cartel in Québec: Background and Damages" (Canadian Economics Association Meeting, May 2015, 29 pages). (The original report, filed in court in 2008, is: Boyer, M, "Collusion présumée des essenceries de plusieurs villes du Québec: analyse de données et évaluation d'impact économique", 126 pages).

[31] 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.

[32] In his 2015 Superior Court decision for one of the trials in this case (R c Pétroles Global Inc. Cour Supérieure - Chambre criminelle et pénale, 450-73-000633-085 (002), 15 avril 2015), 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."

[33] 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.

[34] An econometric model developed in Boyer, M, "Rapport sur l'estimation des dommages dans le cadre de l'action collective Option consommateurs v. British Airways" (2017) Superior Court of Quebec, District of Montreal, 500-06-000410-072, to explain the evolution of London-Montréal ticket prices between August 2004 and December 2012, using all available data potentially impacting ticket prices (with an R^2 of 94.9%), indicates that the price increase specifically due to the collusive factor reputedly operating from August 2004 to November 2006 is of the order 11.2% of BA ticket prices. The trial has yet to take place in this matter.

[35] Connor (2014) warns that "*Shifts in buyer preferences, appearance or the disappearance of substitutes, or changes in the cost of production of the cartelized product during the affected period can cause overstatement or understatement of the overcharge.*" (Connor, JM, "Price-fixing Overcharges" in *The Law and Economics of Class Actions: Research in Law and Economics*, Volume 26 (2014) 249). This lack of robustness is also pointed out by Finkelstein and Levenback (1983): "*[...] This estimate, however, meets the immediate objection that it is likely to be incorrect because changes in factors affecting price other than the conspiracy would have produced changes in competitive prices if there had been competition during the conspiracy period.*" (M Finkelstein & H Levenback, "Regression Estimates of Damages in Price-Fixing Cases" (1983) 46 Law and Contemporary Problems 145. More recently, Boyer, Lasserre and Moreaux (2012) show that over the dynamic development of an industry, episodes of tacit collusion investments and prices may follow episodes of more intensely comp etitive investments and prices and vice versa, raising doubts on the

validity of the "before and after" method (M Boyer, P Lasserre & M Moreaux, "A Dynamic Duopoly Investment Game without Commitment under Uncertain Market Expansion" (2012) 30 International Journal of Industrial Organization 663.

[36] Other methods include the "Cost-Based" method, which is based on the observation that changes in price should reflect changes in costs. The direct way to apply this method is to estimate the production costs by using the (accounting) information on firms involved in the cartel. In the lysine cartel case for example, prosecutors introduced confidential production and sales records of ADM as exhibits, now publicly available (JM Connor, "Our Customers Are Our Enemies: The Lysine Cartel of 1992-1995" (2001) 18 Review of Industrial Organization 5). However, economic experts do not usually have access to such confidential information. Typically, the overcharge is thus approximated by subtracting a "*reasonable margin*" from the actual cartel profit and dividing by the production volume. Also the group of "Econometric" Methods, which gathers all methods using more or less sophisticated econometric models to assess the but-for price. Econometric methods can be used to simulate an oligopolistic competition (Cournot, Bertrand), to predict the Lerner index of market power, or to estimate a demand and cost function that account for dynamic market conditions. See E Appelbaum, "Testing Price Taking Behavior" (1979) 9 Journal of Econometrics 283, and LM Froeb, RA Koyak & GJ Werden, "What Is the Effect of Bid-Rigging on Prices?" (1993) 42 Economics Letters 419.

[37] Some authors have shown that fines based on sales encourage cartels to set higher prices while fines based on overcharges would encourage lower prices. See among others V Bageri, Y Katsoulacos & G Spagnolo, "The Distortive Effects of Antitrust Fines based on Revenue" (2013) 123 The Economic Journal 545, and Y Katsoulakos, E Motchenkova & D Ulph, "Penalizing cartels: the case for basing penalties on price overcharges" (2015) 42 International Journal of Industrial Organization 70.

[38] Based on the Kullback-Leibler divergence between two distributions (see S Kullback & RA Leibler, "On Information and Sufficiency" (1951) 21:1 The Annals of Mathematical Statistics 1.), which tells how dissimilar those distributions are. The probability of an overcharge estimate being larger than some value θ conditional on variables that describe the cartel episode and the same probability conditional on both those variables and variables that are posterior to the episode are quite close for $\theta \in [0\%,65\%]$ but diverge sharply for $\theta>65\%$. The divergence analysis thereby suggests that the presence of biases is an important problem for estimated overcharges above 65%.

[39] An additional and important factor, which falls outside the scope of this article, is the efficiency of antitrust authorities and courts in avoiding Type I (convicting a law-abiding party) and Type II (releasing a guilty party) errors. The higher this efficiency is, the larger the deterrence effect of a given level of punishment will be. See M Boyer & D Porrini, "The Impact of Court Errors on Liability Sharing and Safety regulation for Environmental/Industrial

Accidents" (2011) 31 International Review of Law and Economics 21, who analyze the related effect of court efficiency in avoiding Type I and Type II errors in determining the level of firms' liability in industrial or environmental accidents.