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A Smart Mix of Leniency Programmes and Own-Initiated Investigations As Tools For Cartel Detection And Deterrence: An Impact of Technological Developments

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Authorship declaration

I hereby declare and confirm that this thesis is entirely the result of my own work except where otherwise indicated. I acknowledge the supervision and guidance I have received from Prof. Pierre Garello. This thesis is not used as part of any other examination and has not yet been published.

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Abstract

During the last two decades, leniency policy became the most used tool for cartel detection and deterrence. At the same time, there is a decrease in the number of leniency applications and an increase in the number of research that evaluate the shortcomings of the programmes. These factors lead to concerns regarding the effectiveness of the anti-cartel enforcement system. In order to balance the enforcement system, it is crucial to combine reactive tools (leniency programmes) and proactive tools (own-initiated investigations). Since both these tools have their strengths and weaknesses, their combination allows for balancing them. Importantly that own-initiated investigations were always time-consuming and required extensive resources; thus, there is a need to overcome this problem. One of the ways to do it is to use technological developments that provide the opportunity to automate task performance, shorten the time of investigations, simplify the collection and analysis of evidence, and screen markets for potential collusive patterns. The increase in the number of own-initiated investigations will lead to an increase in leniency attractiveness.

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Abbreviations and acronyms

CA/CAs – Competition authority/(authorities)

CMA – Competition and Market Authority

EC – European Commission

EU – European Union

FTC – Federal Trade Commission

ICN – International Competition Network

ICP – International Competition Policy

OECD – Organization for Economic Co-operation and Development

OFT – Office of Fair Trading

U.S. – United States

UK – United Kingdom

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1. Introduction

Cartel detection and deterrence are always a priority for CAs worldwide. For a long time, investigations were the main tool used by the CAs to detect and punish cartels. This tool aligned with the CAs' wide rights and investigative powers; however, this method required extensive resources, and it was still challenging to detect secret agreements. The introduction of the leniency programme, a significant evolution in cartel detection methods, resulted from a long discussion about capturing illegal collusive behaviour with fewer resources.

Following the successful implementation of the leniency policy in the U.S., the programme gained global recognition and was adopted by numerous jurisdictions. Thus, CAs started relying on this tool. Michael Hellwig and Kai Hüschelrath's research, which investigated the enforcement of cartel cases in the EU between 2001 and 2015, clearly showed that leniency applications were the main way to start an investigation of the case, starting from 2007 (Hellwig, Hüschelrath, 2017, p. 424-425). The same is highlighted by Thibault Schrepel with reference to the OECD report (Thibault, 2021, p. 5).

Curiously, recent research has pointed to a concerning decline in the number of leniency applications. The OECD highlighted this trend between 2015 and 2021 (OECD, 2023, p. 6). In contrast, the number of studies exploring the unintended consequences of potential leniency drawbacks on cartel detection and deterrence rates is increasing. Results of the laboratory experiment conducted by Jeong Yeol Kim and Charles N. Naussair showed that leniency does not impact the probability that a cartel will form, and the lenient treatment of a second applicant does not increase the programme's effectiveness (Kim and Noussair, 2023, pp. 187-188). At the same time, Michael Hellwig and Kai Hüschelrath also found the tendency that overtime the proportion of leniency applications concerned cartel that had

already ended their activity is increasing compared to leniency applications concerning active cartels (Hellwig, Hüschelrath, 2017, p. 425).

All these factors are causes for concern, as they may indicate that CAs not only rely on leniency policy but over-rely on it. This means that the leniency programmes may bring cases that do not really impact competition, markets, and consumers while own-initiated investigations are not conducted. The competition law enforcement system loses its balance when it mainly focuses on investigations triggered by leniency applications. The need for leniency was clear; however, it does not automatically mean that own-initiated investigations should be abandoned.

Therefore, this thesis aims to (1) evaluate if there is a need for the combination of reactive tool in the form of leniency applications with proactive tool in the form of own-initiated investigations to increase cartel detection and deterrence rate and (2) identify opportunities for balancing the ratio of investigations triggered by leniency applications and own-initiated investigations. Accordingly, the research questions are: (1) is there a need for increasing the proportion of own-initiated investigations to increase cartel detection and deterrence rate? (2) How the proportion of own-initiated investigations can be increased, considering agencies' limited resources and cost constraints?

To address the indicated questions, in Chapter 2, “Cartel and the need for a leniency programme”, we focus on the problems that cartel causes and the reasons behind the introduction of leniency. In order to observe the process of leniency establishment, we included the historical aspect, with a focus on numerous jurisdictions. Since the worldwide spread of leniency policy, this thesis also evaluates the main frequently occurring features of the programme designs and existing differences among jurisdictions. In the third sub-chapter we use Law and Economics to analyse the possible reasons that likely to explain

over-reliance on the leniency programme. With the assessment of disadvantages associated with the leniency programme and growing concerns, we close the evaluation of leniency.

Chapter 3 start with the assessment of need for a balanced approach to cartel detection and deterrence tools. The focus is on own-initiated investigations, the main characteristics of this tool, the pre-investigations phase, and full-scale investigations. We also shed light on aspects related to case prioritizations, resource plan, and investigation plan.

We analyse, in particular, the ways to tackle two key problems associated with own-initiated investigations: resource constraints and secrecy of cartels. Precisely, we analysed the technical development that CAs are slowly incorporating into their work and evaluated new research regarding tools that can be implemented in the future. The sub-chapter “State-of-the-art computational tools implementation by CAs” represents an analysis of three reports prepared by Schrepel T. and Groza T. within the framework of the “Computational Antitrust” project launched by Stanford University Codex Center (the Stanford Center for Legal Informatics). This analysis highlights the main trends and features in the field based on the CAs’ survey contributions The reports reflect contributions of CAs submitted in 2020, 2021, 2022. The analysis includes references to the specific pages of the reports when the examples are provided which concern some specific jurisdiction. In other circumstances, the specific page references are not provided because the analysis includes overall trends and does not refer to single paragraphs or pages.

In fine, this thesis reaches the conclusion that leniency works effectively only when there is a credible threat to be caught and punished. Therefore, to make leniency work, it is important to signal to potential cartelists that the enforcement of anti-cartel regulation is active and leads to real punishments. Additionally, CAs must find the right balance between the different tools available, as one tool's strengths can compensate for the others'

weaknesses. Accordingly, the smart mix of the required tools is always different and must be adjusted after careful cost and benefits analysis.

The work brings a new view on the interconnection of leniency programmes, cartel investigations, and the implementation of technological developments. The thesis provides an overview of recent research and proposals concerning technological developments in cartel detection and deterrence areas. Importantly, this thesis also includes an analysis of reports on the computational antitrust implementation prepared within the framework of the "Computational Antitrust" project.

The research method used is literature and database research, as the topic requires analysing the literature regarding cartel detection and deterrence tools, cartel investigations, and the usage of computational tools.

2. Cartel threat and the need for a leniency programme

Cartels are one of the threats to the function of the free market; CAs all over the world agreed that it is the most serious anti-competitive conduct (ICN, 2010 (updated in 2021), p. 5). Therefore, the CAs of different jurisdictions are trying to tackle this type of competition law offence, including it in their priority plans. For instance, the CA in the UK reflected this goal in the Competition and Markets Authority Annual Plan 2023/24 (CMA - Annual Plan, 2023, p. 24). The cartel can be defined as an anti-competitive agreement or concerted practice that involves two or more competing firms willing to coordinate their behaviour to gain profits which are higher than competitive profit through distorting, limiting or eliminating competition (Fountoukakos, accessed in 2024). Cartel participants usually agree on matters such as prices, market shares, level of output, customers or territory

allocation, and bid-rigging; the fact that cartel participants agree on some actions makes it an explicit form of collusion (OECD, 1993, p. 19).

Fighting cartels is a priority because the existence of a cartel on the market leads to a price increase and allocation inefficiency in two forms: deadweight losses and wealth transfers from consumers to cartel participants. The absence of a competitive threat may also lead to productive and dynamic inefficiencies (Bergh, Camesasca, Giannaccari, 2017, p. 183).

For a long time, the CAs conducted investigations regarding possible cartel offences, starting with customer complaints, complaints from competitors, and rarely own-identified information, often due to the work of other agencies. In the U.S., CA was called a passive agency with a reactive approach (Harrington, 2006. p. 2-3). Investigations usually took a substantial amount of time and scarce resources in the form of human capital and budget allocated for an investigation. Additionally, cartel prosecutions can be intensive in terms of complexity and international scale (Harrington, 2006. p. 3-5). Moreover, not all investigations were and are successful, meaning that allocated resources can be used without reaching any result; each investigation failure makes it more difficult to justify further investigations and allocation of resources. Thus, investigations were expensive and time-consuming.

Besides cost considerations, secrecy is another problem related to the difficulty of cartel detection and deterrence through own-initiated investigations (OECD, 2018, p. 4; Fountoukakos, assessed in 2024). As the cartel members are willing to earn a supra-competitive profit, they keep their activities secret, and there are no incentives for them to leave the cartel. Thus, there was a need to enhance the cartel detection level and break the internal trust between cartel members.

This required new solutions that can bring new cases in order to increase detection and deterrence levels and will be less resource requiring. One of the newly offered solutions was the leniency programme.

2.1. The introduction of the leniency programmes: worldwide aspects

The leniency programme is one of the tools used by CAs to detect and punish cartels. This tool has a relatively short history; despite this, it became widespread during the last twenty years. It is important that a "leniency programme" is a general term that refers to the system of mitigations offered by the state to cartel members in exchange for disclosing information about the existence of the cartel and providing evidence to support their claims. Different jurisdictions refer to this programme as "leniency", "amnesty", and "immunity"; however, the main idea behind the programme is the same, and there are some common characteristics and principles of the policy (ICN, 2014, p. 5).

For the first time, it was implemented in the U.S. in 1978 as an amnesty programme. Under the programme, the company that was a cartel participant was eligible for immunity from criminal sanctions for its participation in the cartel in case it provided the CA with the information about the cartel before the CA began an investigation on its own. The programme was unpopular, with one application for amnesty per year (U.S. Department of Justice, updated in 2015). One of the reasons behind this was that the immunity was not granted automatically and the Antitrust Division of the Department of Justice had wide discretionary power while making amnesty decisions (Bergh, Camesasca, Giannaccari, 2017, p. 392). Later, it was reformed in 1993 when the U.S. Antitrust Division of the Department of Justice offered clear conditions for granting full immunity to the company

that reported a cartel, improving incentives to leave a cartel (Klein, 2011, p. 4; Kim and Noussair, 2023, p. 187-188). According to the U.S. Department of Justice, these amendments increased the number of applications from one per year before the changes to one and, in a few years, two per month after the implementation of changes (U.S. Department of Justice, updated in 2015).

"Automatic amnesty" of the whistle-blower companies for leniency in case of absence of the prior investigation, the opportunity to be granted an "alternative amnesty" in case of submission of the application after the beginning of the investigation, and protection of corporate directors, officers, and employees from criminal sanctions are other major revisions that made the U.S.' leniency policy successful (UNCTAD, 2016, p. 1; U.S. Department of Justice, updated in 2015). Further, the programme was modified in 1994 with the leniency policy for individuals and in 2004 with the exclusion of the possibility of claiming treble damages from the company qualified for immunity (Bergh, Camesasca, Giannaccari, 2017, p. 392).

After this, some other jurisdictions and unions that represent significant economies, such as Canada, Singapore, the EU, New Zealand, Australia and the United Kingdom, introduced this policy as well; however, in different variations. Referring to the EU, the policy was introduced in 1996 (Obersteiner, 2013, p.16) with further amendments in 2002 and 2006 to make it more attractive and predictable for potential whistle-blowers (Carmeliet, 2011-2012, p. 465). It is important to note that during the implementation of the leniency policy in 1996, complete immunity was not granted to any of the potential claimants. Only after the first adjustments, it was possible to grant the first applicant complete immunity and the subsequent applicant a fine reduction; a comparably high evidence requirement was also relaxed (Bergh, Camesasca, Giannaccari, 2017, p. 392).

One more example of a country that followed the U.S. experience is South Korea, which implemented a leniency programme one year later than the EU. The programme was adjusted in 2005 by offering the possibility of a fine reduction for the second applicant (Kim and Noussair, 2023, p. 188).

On the other hand, some jurisdictions took more time to reform their anti-monopoly legislation. Japan introduced their leniency programme only in 2006 (Obersteiner, 2013, p. 16; Harrington, 2006. p. 2). Cyprus and Bulgaria adopted the policy in 2011 (ICN, 2021, p. 92). Argentina incorporated it only in 2018 and approved the Regulation for implementing the Leniency Programme in May 2024 (The National Commission for Competition Defense, 2024, p. 2-3). Additionally, according to the ICN Report on Trends and Development in Cartel Enforcement 2010-2020, at least eight jurisdictions out of thirty survey participants adopted the leniency programme between 2010 and 2020, and at least fifteen jurisdictions amended the programme during this time (ICN, 2020, p. 12-14, 92-94, 98 -102).

Therefore, the leniency programme took the beginning in the U.S. more than forty years ago; at the same time, the policy gained recognition and world adoption during the last twenty-five years. Some jurisdictions followed the U.S. example straight after the first success, while others took more time to analyse and adjust their regulation.

2.2. Leniency programme: frequently occurring features and main differences in the existing mechanisms

As explained, the leniency programme is a general term that reflects the main idea of granting full amnesty and, in some jurisdictions, also a lenient treatment to the cartel

participant or participants who deviate from the cartel and cooperate with a CA to punish the cartel. Thus, some characteristics are present in leniency policies worldwide. The main frequently occurring feature is that full immunity from possible state-imposed sanctions is granted to the first applicant who provides a CA with information about the participation in the cartel, supplemented by evidence of the cartel's existence (OECD, 2018. p. 4; ICN, 2014, p.8). This element also includes such obligations as explicit admission of a cartel existence and applicant's participation; full disclosure of information related to participation in a cartel and existence of the cartel; full and expeditiously cooperation from the applicant and his employees on a continuous basis; and termination of the applicant's involvement in the cartel in accordance with the CA's instructions (ICN, 2014, p. 8-9).

The "Marker" system is also a common characteristic that provides leniency applicants with the possibility to secure their place in the queue of potential receivers of the immunity or fine reduction (ICN, 2014, p. 8; ICP, 2016, p. 2; U.S. Department of Justice, 2022; Office of Fair Trading, 2013, p. 9) to give that applicant time to organise and file a leniency application. According to general practice, an applicant is granted a specific period to provide an official application. This element encourages cartel members to contact CAs even before preparing their leniency application to save their first place in the queue (ICN, 2014, p. 8; U.S. Department of Justice, 2023).

Another common feature reflects eligibility criteria – a company which organized a cartel and coerced others to join or stay in it cannot receive full immunity (EC - Commission Notice on Immunity from fines and reduction of fines in cartel cases, 2006, p. 3). The next frequently occurring feature is the possibility of anonymous preliminary consultation with the CAs to understand whether leniency measures can be applied to a company (OFT, 2013, p. 8). The imposition of confidentiality obligations on the CAs and the applicant is

also considered an important step in developing an attractive policy and facilitating an effective future investigation; thus, regulation usually addresses this (ICN, 2014, p. 5).

Additionally, there are some variations in the basic model of the programme design. Some jurisdictions allow lenient treatment in the form of sanction reduction to the second applicant and subsequent ones; for example, the EU and South Korea provide such an opportunity (Kim, Noussair, 2023, p. 188). In this case, the sanction reduction level is differentiated between jurisdictions. Usually, there is a maximum threshold of fine reduction, meaning that no full exemption for the second and further applicants is available. The possibility of obtaining a reduction of fines depends on the significance of the information provided.

Another feature that has two variations is the timing of leniency application. This refers to the possibility of receiving lenient treatment before and after the beginning of the investigation, collection of evidence, and the issuance of some documents by CAs (EC - Commission Notice on Immunity from fines and reduction of fines in cartel cases, 2006, p. 3). In the EU and the UK, typically, it is not possible to apply for leniency after the CA issues the Statement of Objections (European Commission - Commission Notice on Immunity from fines and reduction of fines in cartel cases, 2006, p. 3; Office of Fair Trading, 2013, p. 11); under the U.S. system, a leniency application can be accepted until the time that sufficient evidence is collected (U.S. Department of Justice, 2022).

Despite some variations, there are main characteristics of a leniency programme design. Importantly, it should always reflect vital principles, such as clarity, commitment from both sides, credibility, confidentiality, cooperation and coordination between authorities, and context and culture (OECD, 2023, p. 6). Consequently, the right design of the programme is likely to increase anti-cartel enforcement efficiency by raising the detection level,

reaching the main aim of suspension of cartels, and facilitating compensation for victims (Office of Fair Trading, 2013, p. 6).

2.3. The possible reasons behind reliance on the leniency policy and following shortcomings

The leniency policy is one of the CAs' ways to define and punish cartels. To be an efficient tool, it clearly must be designed to reflect the problems it should solve. As leniency should make cartel participants willing to use this mechanism, legislators must convince them that it is more beneficial for that member than staying in a cartel. Offering incentives for cartel participants to provide CAs with a confession created internal distrust among cartel participants, leading to a potential breakup of the cartel (Korsten, 2023, p. 61). This created specific and general deterrence. The members of caught cartels will be less willing to participate in collusions in the future, and disruption of trust between cartel members makes participation in the cartel less attractive in general for all potential cartels.

Despite attempts to design leniency to bring multiple benefits to the competition law enforcement system, there is no consensus on the usefulness of the programmes, the correctness of their design, or the need to rely primarily on leniency to detect cartels. There is a crucial number of theoretical and empirical research evaluating leniency effectiveness worldwide. It is striking that they all point in different directions, some showing the effectiveness of the policy, some showing its failure, and some finding no real effect from it. Importantly, the same information and results can both support and refute the effectiveness of the policy. Referring to one of the previous examples, there was a crucial decrease in the number of leniency applications from 2015 to 2021, dropping by more than

50% (OECD, 2023, p. 6). The decline in the number of leniency applications can show the success of the programmes, meaning that there are fewer self-reporting because of fewer cartels, or show the failure of the programmes, meaning that companies adjust their behaviour and there are no incentives for them to apply for immunity or reduction (Marx, Mezzetti, Marshall, 2015, p. 207; OECD. 2023 p. 9).

CAs are usually satisfied with the existence of leniency programmes in their jurisdictions and rely on this tool for cartel detection and deterrence (Ysewyn, Kahmann, 2018; Carovano, 2020, p. 444). Possibly, there are three main reasons why CAs prefer this tool over others and even excessively rely on it.

The first possible reason is that the programme has a real effect and increases the rate of cartel detection and deterrence. For example, (Ysewyn, Kahmann, 2018) indicated that many cartels were uncovered in recent years because of the leniency applications. According to the OECD Secretariat Survey from 2017, most participants confirm that their leniency programme was the most effective cartel detection tool (OECD, 2018, p. 4). However, keeping other arguments aside, there is a danger of being captured by a sample selection bias while analysing the effectiveness of the programmes (Korsten, 2023, p. 24).

Researchers conduct statistical analysis of some data to evaluate the effectiveness of leniency policies and support or deny theoretical conclusions. It is important that all conclusions about the effectiveness of leniency policy are derived from the analysis of the discovered cartels (Klein, 2010-2011, p. 1, 5), investigations that have already been conducted, and the number of leniency applications. However, the nature of cartels is that the agreements are secret; therefore, there is no information about the number of uncovered cartels (Klein, 2010-2011, p. 1, 5; OECD, 2023, p. 9). According to the analysis by Bryant and Eckard conducted in 1991, the likelihood of cartel detection in the US varied from 13

to 17%, while the estimation proposed by Combe et al. showed that the likelihood of cartel discovery in the EU between 1969 and 2008 was up to 13.3% (Kim and Noussair, 2023, p. 187-188). This shows that the percentage of uncovered cartels can be relatively small; thus, conclusions regarding the general detection level and leniency effect made on the existing information can be erroneous.

The same is relevant for the previous example regarding the decreased number of leniency applications. There is no confidence that the number of leniency applications dropped because the number of cartels dropped; generally, it can be the opposite (Klein, 2010-2011, p. 5-6).

To summarise, it is difficult to evaluate the success of leniency programmes as information about cartels in general is unavailable. It is possible to compare the percentage of cartels detected in a country and those detected through a leniency programme; however, it is not yet possible to correlate the percentage of all cartels present in a country with the proportion of cartels punished through leniency policies.

The explanation of the CAs' reliance on leniency programmes can also be offered by public choice theory. The economic theory of bureaucracy considers state agency employees as utility-maximising actors driven by the desire for power, reputation, allocated budget, low disutility from work and other factors (Mueller, 2003, p. 359-362). Initiating a case based on a leniency application ensures a successful investigation, as leniency requires the applicant to provide evidence of the existence of a cartel (Harrington, Chang, 2015, p. 424). Accordingly, cases brought through leniency increase CA's performance and can lead to budget increases, higher income (bonuses, additional payments), and expansion of powers. Therefore, rational actors tend to prosecute cases with a higher probability of successful investigation.

One more possible reason for CAs to embrace leniency is its benefits compared to other CA tools, as referred to before. For instance, costly, time-consuming, and not always successful own-initiated investigations during the period of leniency implementation were less attractive for the CAs. However, two important elements should be considered. The first is the sample selection bias, and the second is the need for timely revision of tools used by the CAs.

Importantly, the embracement of leniency programmes by national CAs is increasing, meaning that the reliance on the programmes is also increasing. Considering CAs' limited resources, they allocate more of their capacity to follow cases brought through leniency rather than own-initiated investigations or investigations brought through other sources. Previously provided statistics prove this. The discussion paper of Michael Hellwig and Kai Hüschelrath also clarified how information about possible cartels was brought to the EC between 2001-2015. In general, there were two main types of cartel detection: EC investigation and leniency programme application, indication two the most important instruments for detection. The authors highlighted that both detection tools brought cases in 12 out of 16 examined years. However, one observed trend is that starting in 2007, the importance of leniency as a cartel detection tool increased. The authors also referred to the fact that this trend was in line with some statements from the officials about leniency effectiveness that even led to the absence of the need to use all CA's human resources. However, importantly, not only did leniency importance increase, but, more precisely, the application regarding cartels with ended activity (Hellwig, Hüschelrath, 2017, p. 424).

Therefore, the reliance on leniency is increasing over time. This means that the proportion of investigations triggered by leniency applications is growing compared to own-initiated

investigations. One of the main limitations faced by any state agency is the limitation of resources, the smaller proportion of resources allocated to own-initiated investigations.

2.4. Disadvantages of leniency programmes and reasons for concerns

Besides the impossibility of providing clear evidence of leniency effectiveness, there are also some discovered shortcomings that the policy creates. It is important that we do not deny the possible positive effects of the leniency programmes; however, we are focusing on modifying the tool's ratio used for cartel detection and deterrence. Therefore, to discover the danger of overreliance on self-reporting, possible disadvantages of the leniency design should be discussed. At the same time, it is important to highlight that the level of danger related to design imperfections increases with reliance on this tool.

At this stage, cartels can be divided into domestic, concerning only one jurisdiction, and international, which involves more than one jurisdiction. (Korsten, 2022, p. 195) analyzed the risks related to the spread of leniency policies and lack of international cooperation while prosecuting international cartels. It was shown that a leniency application can lose its attractiveness for the cartel members when the application for immunity or reduction of the fine in one jurisdiction can lead to prosecution in another. As it was illustrated before, the number of countries that implemented leniency has increased over the last few years; thus, when it comes to international cartels, it is more complicated for companies to be the first ones to apply for immunity or fine reduction in all concerned jurisdictions (Korsten, 2022, p. 195). Therefore, it can be identified as the first factor decreasing the attractiveness of the leniency application for international cartels and making them more stable.

Another issue that can trigger multiple prosecutions and potentially make leniency applications less appealing is the information-sharing policies (Obersteiner, 2013, p. 20; Korsten, 2022, p. 196). To effectively enforce competition regulation, including fighting against international cartels, CAs are trying to deepen their cooperation and information exchange practices worldwide. For instance, besides assuring cooperation between member states, the EC also collaborates with the CAs of countries that are not members of the EU on bilateral and multilateral levels (EC, accessed 2024). Other communities, such as the COMESA Competition Commission (COMESA Competition Authority, 2023), and jurisdictions follow the same path. While many jurisdictions that offer leniency provide confidentiality for the application, the risk of information leakage should always be considered. As in some relatively less experienced jurisdictions, there is a possibility that after receipt of a leniency application by one CA, some of the information will become available to others (Obersteiner, 2013, p. 22). This may result in prosecution of the applicant in other jurisdictions.

It is important to note that in addition to fines in different jurisdictions, the firm applying for leniency can also be exposed to private damages and criminal sanctions. Consequently, risks and difficulties related to multijurisdictional leniency may decrease the potential benefits of the application. That is why the decision to apply for leniency is a complicated trade-off between possible benefits and costs.

The decision of the international cartel participants on whether to apply for immunity is also based on some technical differences between leniency designs in concerned countries. Potentially, there are situations where the fulfilment of conditions required by one jurisdiction can make it difficult or impossible to apply for leniency in another country. These differences can be in terms of the standard of the required information and in terms

of termination of participation in the cartel (Korsten, 2022, p. 196). The latter condition is the most difficult, as in some jurisdictions, cartel participation must be terminated immediately, while in others, applicants must remain in the cartel for some time to gather more evidence (Obersteiner, 2013, p. 22-23).

Importantly, all the listed factors decrease the attractiveness of deviation from a cartel. Further, it is difficult to find balance and provide incentives for cartel members to deviate from a cartel as the problem is both the lack of international cooperation and the attempt to deepen it. Even though the legal literature provides some offers to overcome the problem of international cartel prosecution, it does not seem to be reachable. The offers described by (Obersteiner, 2013, p. 28-30) include increasing international cooperation through the harmonisation of leniency policies worldwide, mutual recognition of immunity grants, and creating a one-stop-shop for leniency applications that concern some number of jurisdictions and others. As (Obersteiner, 2013, p. 28-30) highlighted, the problem of loss of sovereignty will occur; additionally, regarding the one-stop-shop proposal, we can predict that it will be extremely costly to organise such cooperation. Therefore, this question requires cautious consideration.

Referring to domestic cartels, some risks relevant to international cartels are also applicable to domestic ones, such as the risk of private damages. In practice, leniency application provides cartel victims with the information and evidence needed to build a successful case and ensure that the private damages will be recovered. Another factor that increases the success of a private lawsuit is that the applicant for leniency does not challenge the CA's decision to grant immunity. This makes it even easier to recover damages from the applicant (Buccirossi, Marvao, and Spagnolo, 2020, p. 336).

Cartels can also exploit leniency programmes (Stephan, 2009, p. 560; Korsten, 2023, p. 26). After the cartel ends for natural reasons or when it is threatened with discovery, cartel members can agree to apply for leniency and fine reduction one by one. This strategy can reduce the overall size of the fine that can be applied to the cartel participants in general and eliminate future prosecutions. In this regard, it is important to refer to Michael Hellwig's and Kai Hüschelrath's finding that leniency applications regarding cartels that had already stopped their operations triggered a lot of cartel cases (Hellwig, Hüschelrath, 2017, p. 425). Further, this phenomenon was not evaluated; however, it is also possible to suppose that the cartel participants could use leniency in their favour. (Korsten, 2023, p. 26) also refers to the risk of prosecutions of dying cartels. Overall, there is a risk that by relying mostly on leniency applications while opening cases, CAs can shift all their attention and resources to prosecuting cartels that can be less important.

Although much research exists regarding the benefits and effectiveness of the leniency programme, the literature on detected shortcomings is growing. As stated before, this work aims not to deny the possible positive effects of the leniency policy but to highlight the need to find the point where benefits from the programme can be maximised. Therefore, it is crucial to evaluate the disadvantages of the programmes and potentially work on solving them and enhance enforcement. Competition law enforcement can be strengthened by improving the usage of other available tools that will work independently and, additionally, balance the leniency programme by increasing the credible threat of being caught.

3. The need for a balanced approach to cartel detection and deterrence tools

As demonstrated earlier, a leniency application can be a strategic move for cartel participants, but this is true only when the decision brings them more advantages than remaining in the cartel. Therefore, immunity or fine reduction filings will be made only after a careful cost-benefit analysis.

This notion can be considered from the rational criminal perspective according to Becker's model (Gary Becker, 1968). Rational cartel members are interested in staying in the cartel until the benefits of participating exceed the costs, meaning the profit gained from cartel activities is higher than the threat and imposition of punishment. Thus, to incentivise cartelists to deviate from cartel participation, benefits associated with cartel participation should be decreased, or costs should be increased. It can be assumed that CAs cannot directly lower the benefits from cartel participation as it is not in their area of control. However, the costs, consisting of the cumulative probability of detection and punishment and the fine size, can be adjusted by correct regulation and more active enforcement. Thus, severe penalties and active law enforcement by the CAs can incentivise the self-reporting of cartel participants (ICN, 2014, p. 5). One of the elements that can change the cost-and-benefit ratio is the probability of being caught and punished. This can lead to two main effects: increasing the detection and deterrence level and making leniency programmes more attractive.

The change in the fine size is not part of this research, this work focuses on the change in the probability of being caught through improving enforcement activities. One of the main ideas that underline the Anti-cartel enforcement manual prepared by the ICN is that no unique method or tool can address all situations related to competition law enforcement (ICN, 2010 (updated in 2021), p. 6). An important task that CAs face is the determination of a balanced mix of proactive and reactive approaches that will lead to productive work in

terms of cartel detection and additionally will show the enforcement capacity of the CAs. Moreover, each agency should define this mix considering its legal environment (ICN, 2010 (updated in 2021), p. 6). Therefore, evaluating the main proactive tool – own-initiated investigations is important.

3.1 Anti-cartel enforcement: main features

Regarding anti-cartel enforcement, private litigation is much more common than public in jurisdictions such as the U.S. to the highest degree, the UK and other jurisdictions with common law systems. For example, only 10% of antitrust cases in the U.S. are public actions (Bergh, Camesasca, Giannaccari, 2017, p. 408). Private enforcement facilitates full compensation for victims and additionally increases the deterrence level (Hausfeld, accessed in 2024). The situation in the EU is the opposite, and public enforcement is dominant (Bergh, Camesasca, Giannaccari, 2017, p. 408), meaning that the public enforcement system of competition law is much more commonly used in the EU and EU member states. This work is focused on public anti-cartel enforcement.

In the EU, public anti-cartel enforcement is regulated by Council Regulation (EC) No 1/2003 of 16 December 2004. Competition rules are enforced through the EC at the European level, the network of CAs of member states. An important notion is that there are no unique litigation rules that are the same for all member states; thus, each jurisdiction has its own litigation rules (Bergh, Camesasca, Giannaccari, 2017, p. 409).

The most important regulation of anti-cartel enforcement in the US is the Sherman Act (1890), which prohibits all anti-competitive agreements among competitors. The Antitrust Division of the U.S. Department of Justice is responsible for its enforcement (U.S.

Department of Justice, updated in 2021). The Federal Trade Commission Act (1914) prohibits “unfair methods of competition” and “unfair or deceptive acts or practices” and established the Federal Trade Commission, which is also responsible for fighting competition law violations, but mainly through civil enforcement actions (FTC, accessed 2024). Decisions of Federal court serve as the basis for evaluating cartel conduct under the Sherman Act. In the U.S., cartel investigations can follow civil or criminal procedures (Lexology GTDT, 2021, p. 5, 9).

3.2. Pre-investigation phase and its significance

An investigation has main characteristics and steps that usually do not differ much in different jurisdictions. Some elements, such as the extent of investigative powers and technical differences, exist; however, any investigation starts with an initial information gathering. This can lead to a preliminary investigation that in different jurisdictions can be referred to as screening, preliminary inquiry or examination (ICN, 2010 (updated in 2021), p. 10). Information gathering is one of the most difficult and crucial steps as the cartels are secret agreements; thus, it is difficult to collect information that can lead to opening an investigation (Hellwig, Hüschelrath, 2017, p. 403).

There are different ways in which CAs can start an investigation. One of them is a leniency application that was evaluated in Chapter 2 of this thesis; however, the focus of this Chapter is on own-initiated investigations that can be started through other mechanisms. Information about cartels that can trigger an investigation can also be delivered to CAs through other retroactive channels, such as complaints, whistleblowers and informants or

proactive tools, such as monitoring of industry activity, media and internet, and reports of different organisations (ICN, 2010 (updated in 2021), p. 12-28; Regulation 1/2003).

ICN indicates that complaints are still the most common method of cartel detection worldwide. However, as they refer to some of the survey participants, this can be questioned because of the number of complaints that CAs dismiss; thus, the percentage of complaints that really lead to cartel prosecution cannot be that high. However, it is also questionable due to the above-mentioned analysis of M. Hellwig and K. Hüschelrath (Hellwig, Hüschelrath, 2017, p. 424) and the OECD (OECD, 2018, p. 4).

Anyone aware of this illegal behaviour, including anonymous informants in some jurisdictions, can submit complaints (OECD, 2024, p. 4). Interestingly, it is not common practice to receive a complaint from customers because they usually cannot detect the existence of the cartel or have any evidence regarding this (ICN, 2010 (updated in 2021), pp. 12-28).

The pre-investigation phase begins after the CAs receive information regarding the possible cartel's existence. During this step, the CAs' first task is to assess the source that brought information about the possible offence. After that, the agency needs to decide whether the matter requires no action from the agency, the need for the actions has to be evaluated further (possibly the case should be directed to another agency), or the actions are required because plausible assumptions of cartel existence should be assessed further (ICN, 2010 (updated in 2021), p. 28).

After screening the source of information about possible cartel conduct and establishing that there is enough base to move to the next step, the CA need to evaluate some specific aspects. These factors include the accuracy of the complaint and complainant, identification of other people who can know something related to the question of matter, the

identification of witnesses if possible, and the evaluation of other complaints in the same sector submitted before or regarding similar questions further (ICN, 2010 (updated in 2021), p. 33-34). The pre-investigation phase plays an important role because it is crucial to receive as many details from the preliminary sources of the information as possible (Hellwig, Hüschelrath, 2017, p. 403).

The collected information should also include possible evidence that is in the complainant's possession. The CAs should also verify the allegations and provide confidentiality during this period to avoid early disclosure of the information. Media reports and internet research can provide useful information for verifying the facts of the potential case and be a quick and cheap resource (ICN, 2010 (updated in 2021), p. 33-35; OECD, 2024, p. 4). Reports and other publications of professional and trade associations and journals can also be useful sources of information regarding industries' activities (ICN, 2010 (updated in 2021), p. 36; OECD, 2024, p. 4).

This stage also includes evaluating the need for other agencies' cooperation, meaning whether the violation includes other offences such as tax evasion, bribery, and others (ICN, 2010 (updated in 2021), p. 37).

While this stage is extremely important, the CAs' rights and possibilities to collect information and evidence are limited. EC, for example, does not have formal investigative powers during this phase and can only request information from companies on a voluntary basis (EC, Regulation 1/2003). In the U.S., the Department of Justice and the Federal Trade Commission also cannot use full investigative powers and are limited by informal discussions with the parties involved (Lexology GTDT, 2021, p. 10). The case is true for the UK, where the agency must rely on information from open resources (CMA, 2021).

The pre-investigation phase is a crucial step in processing cartel cases. Information collected during this step will be used to decide whether a full-scale investigation is necessary (ICN, 2010 (updated in 2021), pp. 33-37). This phase can be identified as the next phase of the investigation associated with evidence-gathering (Urmonaitė, accessed in 2024), official actions by an agency, and disclosure of information about the investigation (ICN, 2010 (updated in 2021), p. 10).

3.3. Full-scale investigations: resources constrain, case prioritizations, and investigation plan

The decision to move from the pre-investigation stage to a full-scale investigation (in-depth) varies from jurisdiction to jurisdiction. In some, it is decided on a case-by-case basis according to the priorities and capacity; in others, some thresholds must be met. What also varies is the way the CAs prioritise cases. It can be done via formal guidance with transparent criteria or informal criteria. Prioritising cases is important as agencies usually have information about more cartels than they can investigate (ICN, 2010 (updated in 2021), p. 40-41; CMA - Prioritisation Principles, 2023, p. 3). Therefore, facing budget and resource constraints, it is crucial how the selection of cases for prosecution is organised and whether there is a justified disbalance in favour of some canal that brings cases or not.

In the EU, the EC needs to prioritise potential cases (EC, accessed in 2024), considering their impact on the Internal Market, deterrence, consumer harm, and strategic importance. Similar considerations are relevant for the U.S. (U.S. Department of Justice, 2022) with the strong reliance on the leniency canal. Notably, both agencies do not have clear guidelines for prioritization; they are more flexible and general for their work. The UK provide clear

principles for case selection, including the strategic significance of potential actions, whether there will be a positive impact in the case of actions, whether there are enough resources to act, possible risks associated with actions, and whether the agency is the best place to take actions (CMA - Prioritisation Principles, 2023, p. 3).

As the prioritisation process that leaves some cases aside also relies on resource considerations, a resource plan is a crucial part of any investigation. Despite some jurisdictional differences, there are common elements that should be included in any resource plan. This plan determines the allocation of resources needed to conduct successful cartel investigations, including the time, preliminary budget evaluation (operational, legal costs and costs for the usage of technologies and tools), personnel (investigators, legal team, economists and data analytics, specialists and experts), and tools that will be used (ICN, 2021, p. 43). Besides allocating resources, this plan also serves as one of the starting points for deciding whether it is still possible to proceed with a full-scale investigation, as the resources can be considerable and should be quickly allocated. In the UK, the CMA clarifies that required resources should be proportionate to the expected benefits from proceeding with a case (CMA - Prioritisation Principles, 2023, 8). Even though it can be extremely difficult to prepare such a plan in the initial stage of the full-scale investigation, it should be prepared and adjusted during the investigation (ICN, 2021, p. 43).

After the prioritising procedure and creating a resource plan, the decision regarding the full-scale (in-depth) investigation can be made. Collecting as much information about suspected cartel as possible before moving to the full-scale investigation is important because this information is used to decide on the investigation strategy. Any strategy aims to successfully conduct an investigation and increase general enforcement of the competition

law while allocating limited resources of the CA in the most beneficial way (ICN, 2008 (updated in 2021), p. 7).

The strategy is built with an investigation plan. There is no unique form of this plan; however, it is crucial to include characteristics of the suspected cartel, meaning the industry, products or services involved, subject of the investigation, geographic area, type of involved agreement, explanation of cartel operation, establishment and others[1]. Another aspect of the investigation plan is a strategy of collecting evidence with a focus on determining and proving guilt, determining gaps in the evidence, finding sources of potential evidence and others. The administrative tasks related to the investigation should be included as well (ICN, 2008 (updated in 2021), p. 1-17). This plan should be regularly updated and to be the basis for interim reports reflecting the investigation process and its findings.

Information that was not collected on previous stage should be collected during full-scale investigation phase, using investigative powers available for agencies. Investigation powers can be divided into three main categories: tools for covert investigative actions, tools for public investigative actions, and tools for corroboration of evidence (ICN, 2008 (updated in 2021), p. 17-20). Tools for covert investigative activities are used in order to collect some information and be prepared for public investigative actions, ensuring that the cartel members are not aware of the investigation and do not destroy the evidence. Investigative tools for public actions include raids or inspections, searches, and ensuring evidence collection. The last group of tools includes compulsory interviews and collecting

[1] As technologies develop, it can also be relevant to analyse the level of sector digitalization, usage of dynamic pricing systems and algorithms, and availability of some databases regarding the relevant market.

information from third parties not associated with the cartel (ICN, 2008 (updated in 2021), p. 17-20).

For instance, the EC is empowered to send information requests to companies and conduct inspections. During an inspection, the EC has the right to enter the premises of companies, examine the records related to the business and take copies of those records, seal the business premises and records during an inspection, and ask staff and company representatives questions related to the inspection and record received answers (EC; Regulation 1/2003). The CMA's formal powers of investigation share a lot of similarities with the one relevant to EC; however, the differences, such as the need for a warrant to enter premises under most circumstances[2], are also present (CMA, 2022). Other investigative powers may include continuing prohibited conduct undercover, electronic surveillance, obtaining communications data from providers, and even deterring or arresting suspected persons from answering questions (ICN, accessed in 2024).

In order to maximise an investigation capacity with the involvement of limited resources, the investigation strategy should also include the evaluation of cooperation opportunities and investigation powers that can be used. Cooperation opportunities include collaboration with other state bodies within the country and international cooperation with other CAs (ICN, 2008 (updated in 2021), p. 14).

After an investigation is completed, the agency prepares a report with recommendations for future actions, such as administrative measures or civil or criminal proceedings, according to the jurisdiction. In the EU, for example, if collected evidence proves the Commission's concert, the latter must issue a Statement of Objection. The suspected cartel participants

[2] The CMA can enter business premises without a warrant under specific circumstances (prior notification of the company's premises or without in some circumstances); however, the general rule is that a warrant must be obtained to enter business and domestic premises, and it is usually obtained if there is a threat that evidence can be destroyed (CMA, 2022).

have the right to defence and, therefore, to access non-confidential evidence collected by the EC. They also have the right to reply to the Statement of Objections or request an oral hearing with an independent Hearing Officer. After evidence and arguments from both sides are collected, the EC, who decide on their own, may abandon partially or entirely its objections or prepare a prohibiting decision that should be checked by the Advisory Committee and adopted by the College of Commissioners (Hellwig, Hüschelrath, 2017, p. 403; Regulation 1/2003). The CMA follows a relatively close procedure (CMA, 2022). The situation is different in the US, where collected evidence must be presented in a court, and the court needs to decide whether the violation exists (Bergh, Camesasca, Giannaccari, 2017, p. 383-384).

An own-initiated investigation is an important part of the enforcement system. This type of investigation increases detection and deterrence rates, complementing other tools used by CAs. It is a separate tool used in order to detect and punish cartels; thus, it works on its own. Additionally, this tool directly affects the effectiveness of the leniency programme because it creates a credible threat that forces cartel participants to reconsider their participation in a cartel. However, it is important that investigations have their own advantages and disadvantages, and one of the disadvantages leads to leniency implementation. To be more precise, investigations are usually time-consuming and require a lot of human resources and a lot of budget allocation. Thus, it is important to keep the most suitable and balanced system of tools for cartel detection. Additionally, it is crucial to look for solutions that can help to overcome problems associated with own-initiated investigations.

4. Technical development as a method to overcome issues associated with own-initiated investigations

Over time, technological development offers many different ways to increase the effectiveness of employees' performance, business processes and business in general. It affects the structure of existing markets, facilitates the emergence of new markets, and creates new business models and strategies used by economic agents. As for now, there are plenty of discussions regarding the usage of technologies by business players; however, the implementation of the same tools by state agencies to increase their efficiency is not discussed that actively (Schrepel, 2021, p. 2, 4).

Incorporation of new tools and models by state employees is an important step that allows increasing their productivity during the performance of regular tasks, for example, by speeding up information processing; and, at the same time, it provides them with effective tools to process new tasks related to the digital economy (Schrepel, 2021, p. 3-4). The application of technological tools and methods to analyse the business activities of digital players is a logical response of CAs, as it is impossible to make an effective analysis without these methods and tools in terms of capacity and pure understanding. Technologies also provide ways to overcome disadvantages associated with own-initiated investigations, such as reducing task performance time, allowing automation of some work areas, and redistributing human resources more efficiently.

One of the new emerging fields of legal informatics that intended to create and develop computational tools and methods in order to improve competition law enforcement procedures is computational antitrust (Schrepel, 2021, p. 1). Computation antitrust is one of the elements of computational legal science that explores how approaches and methods

developed by computer science can be used by professionals in the legal area (Lettieri, Antonio, Giugno, 2018, p. 7).

Stanford University Codex Center (the Stanford Center for Legal Informatics) launched the "Computational Antitrust" project in January 2021 with the aim of exploring how legal informatics can contribute to the enhancement of antitrust analysis. This project allows academics in different fields, regulators and policymakers to work together on the established goal. Importantly, that project brings together sixty-seven CAs who prepare short reports about incorporating computational tools into their day-to-day work. The network of CAs includes agencies from all over the world, including Australian, Brazilian, Canadian, French, Albanian, Finnish, Indonesian, Dutch, UK, US and others. It also unites more than thirty-six academics from antitrust and computational sides. This allows tracking the dynamic of tools' acceptance internationally with regional divisions (Stanford University Codex Center website, accessed in 2024).

The research agenda provided by the project creator and director Thibault Schrepel at the beginning of the project (2021) indicated that some computational tools such as machine learning, data mining, document management, legal text analysis, deep learning simulations, network analysis, natural language techniques, computational game theory and information visualisation are already utilised in the legal area in general. However, most of CAs rarely used these instruments and just started familiarising themselves and implementing the simplest tools (Schrepel, 2021, p. 5). Therefore, evaluating the state of computational tool implementation among CAs worldwide is important. The possibility to assess the progress reached during the project implementation also brings additional value.

4.1. The state-of-the-art computational tools implementation by CAs

To evaluate steps that can be taken to increase CAs' effectiveness in own-initiated cartel investigations, it is crucial to find a starting point for analysis. As it was referred to, the "Computational Antitrust" project collaborates with numerous CAs worldwide, collecting their experience in implementing computational tools into their work. During the project's progress, CAs participated in surveys on the computational antitrust implementation, providing once-a-year information regarding their progress in this area between 2021 and 2023. The Stanford University Codex Center used submitted information to prepare reports for the respective years. Since the information provided by CAs illustrates their position regarding the level of implementation and reflects previously published press releases, official statements, news, and articles, this information is used to analyse the state-of-the-art in the field of computational tool implementation. The variety of project participants allowed us to prepare a comprehensive analysis, which is reflected below. Importantly, provided information is presented in a more general way, without specific details, that reflects CAs' concerns regarding attempts of market participants to adjust their behaviour to the implemented tools (OECD - Screening Tools, 2022, p. 6).

Starting with the project, the information was provided by thirty-one participants, including twenty-nine jurisdictions (Argentina, Armenia, Australia, Brazil, Bulgaria, Canada, Chile, Colombia, Cyprus, Czech Republic, Denmark, Finland, El Salvador, France, the Netherlands, Greece, Kenya, Luxembourg, Mexico, Poland, Romania, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Taiwan, Turkey, the United Kingdom), one an independent and autonomous administrative body (Catalan Competition Authority, Spain) and one community (Caribbean Community). Overall, there are 56 contributions. Some of the participants provided their reports each year from the beginning of the project (Brazil,

Colombia, Czech Republic, France, Singapore, Catalan Competition Authority), giving the opportunity to track the dynamics. Some of the participants joined only once (Caribbean Community, Chile, Cyprus, Denmark, El Salvador, the Netherlands, Kenya, Luxembourg, Saudi Arabia, Slovenia, Taiwan, and Turkey), mostly in the survey in 2022. All other participants provided their contributions twice.

The created reports include information regarding different aspects of computational antitrust implementation; however, as this work focuses on cartels and related investigations, only patterns related to this part will be analysed. Importantly, CAs shared their experience using computational tools to tackle cartels and their plans. The provided information allows for highlighting trends that emerged in 2021 and continue developing now.

According to the reports, many CAs, such as the UK, Spain, Singapore, the Netherlands, Canada, Chile, and France, extended their capability by creating digital units in their agencies. This approach means that not only lawyers and economists but also data scientists are now part of the team. Their expertise supports daily work and developing new tools for the agency. This trend shows the beginning of acceptance by CAs of newly emerged challenges and their readiness to start transformation. However, this should be critically evaluated as a relatively small number of countries have already done this step, all listed jurisdictions are developed countries, and information was provided only by 30 out of around 200 countries.[3].

Analysis of provided contributions allows us to distinguish two main ways the CAs are improving the performance of cartel enforcement policy by implementing computational

[3] According to different resources the number of countries varies between 195 according to the United Nations (193 of these are member states of the UN, while two countries are non-member observer states: Vatican City and the State of Palestine) and 237 according to US intelligence agency the CIA.

techniques. The first group includes tools that are not specifically related to the cartel detection policy but still increase performance in this area. The second group consists of tools developed directly for cartel detection and deterrence.

Starting with the first group, CAs understand that some processes in their work are largely time-consuming and subject to human errors; this, in turn, requires the allocation of a large proportion of available human resources that could be used more efficiently. Therefore, most of the jurisdictions implemented into their work electronic document systems (Argentina, Armenia, Cyprus, Kenya and others) that allow shorter timeframes of primary document processing. These systems usually include both internal document flow management and external one. However, we offer to separate this tool into groups that do not directly influence the level of cartel detection; the ICN includes a formal complaint system in the list of methods for cartel detection (ICN, 2010 (updated in 2021), p. 5); this can be implemented through document management services.

More sophisticated tools that are used for different purposes, including cartel detection, consist of technologies such as data collection tools (mainly web scraping and data mining), compare tools, automated audio and video transcription tools, concept clustering to group documents, pattern-matching tools, topic modelling tools, screening tools, and, importantly, predictive coding and natural language processing techniques. All these techniques are used in different areas; however, they increase the effectiveness of investigations related to cartel detection, transforming the evidence collection and analysing process, providing the opportunity to speed up investigations with the limited involvement of employees and limiting the possibilities of human errors.

Australia, for example, actively uses web scraping tools to collect evidence, including a more specific toolkit to mimic consumer behaviour on websites (Schrepel, Groza, 2022, p.

82). Finland usually relies on web scraping when there are no alternative sources of information (Schrepel, Groza, 2024, p. 84).

Almost all survey participants shared that they use tools that allow automatically grouping documents according to different themes, finding connections between different documents, and prioritising documents. These techniques also reduce the time for evidence review and analysis and minimise the possibility that some documents will not be reviewed because of human error (Schrepel, Groza, 2024, p. 84). To develop new investigation capabilities, Denmark uses a tool that allows grouping and understanding patterns of using specific wordings. Companies can use some terminology that can be difficult to understand for people without special education or use codding in order to make some communication ambiguous; thus, this tool allows translating the meaning of the communication into understandable text (Schrepel, Groza, 2024, p. 80).

The second group of tools is the one created specifically to detect cartels, improving CA's efficiency in terms of timeframe and engaging resources. Almost all survey participants referred to the screening techniques for cartel detection, mainly bid-rigging practices. However, as was referred to earlier, many CAs do not publish or reveal details of their screening developments to avoid some activities from market participants that can decrease the effectiveness of those tools (OECD - Screening Tools, 2022, p. 6). Despite the unwillingness to reveal the details, some of the participants have already implemented and utilised screening tools, such as Australia, Brazil (Cérebro project), Colombia (Sherlock tool), Canada (Collusion Risk Assessment Tool), Denmark (Bid Viewer cartel screening too), Finland, Saudi Arabia, Singapore (Bid Rigging Detection Tool), the Catalan competition authority in Spain (Smart Administrative Procurement Collusion Research Tool) and a few others. Other participants, namely Bulgaria, Chile, Colombia, Kenya, the

Czech Republic, and others, are in the process of developing and introducing such techniques[4].

Although the tool's main idea is the same, the detail and advancement level can differ. Starting with the less sophisticated version, there is a list of the most common features that suggest that the collusive tendency may occur during a tender, usually called red flags. These common features exist and are used by CAs regardless of computational tools and, in practice, can be described in some guidance, as it exists in Bulgaria (Schrepel, Groza, 2023, p. 69). With the use of economic and statistical analysis, it is possible to customise the algorithm to recognise red flags automatically. With the more complex approach, it is possible to train an algorithm with already existing (historical) data about previous tenders to recognise not only indicated red flags but also patterns learned from the past. In both scenarios, in the first stage, the algorithm constantly monitors procurements and highlights captured tenders after recognising collusive patterns. In the second stage, CAs manually analyse the patterns that may indicate bid-rigging.

A less widespread but also important technique is a tool that recognises price signalling in the news. The CA in the Netherlands developed such a tool to detect signalling regarding prices in news articles using complex natural language processing (Schrepel, Groza, 2024, p. 89).

For now, CAs have started implementing computational tools into their work. Some tools are more specific for cartel detection and deterrence, while others increase the general efficiency of agencies. The biggest progress in implementing computational tools into cartel enforcement is associated with procurements. This can be explained by the fact that

[4] The level of development and implementation is changing overtime. This analysis is based on the reports for which information was collected until the end of 2023.

public procurements are transformed into electronic processes, which allow algorithms to track participants' behaviour constantly. It is also possible to train algorithms for checking public tenders because historical data about previously conducted tenders enable the algorithm to recognise some patterns regarding collusive behaviour.

4.1.1. The critical point of view on computational tools implementation

Although most CAs accept the need to implement new tools, some share concerns. While implementing the Cerebro Project, aiming to develop screening and data mining techniques for investigation cartels (OECD - Note by Brazil, 2022, p. 3), Brazilian CA criticised using computational tools. One concern relates to the possible biases in data that will be deepening because of the feedback loop (Schrepel, Groza, 2022, p. 83). Another concern is the race to create these new tools. On the one hand, it can lead to quick but inefficient results and, on the other hand, create additional pressure on the state budget because different authorities can work separately on the tools that, in essence, can be used by different agencies after some adjustments (Schrepel, Groza, 2023, p. 66).

Importantly, despite different concerns, the Brazilian computation tools developed within the Cerebro project are already showing their results. With the help of screening and data mining tools, Brazilian CA found information about possible cartel participants that were unknown and indicated in the initial complaint; these results were confirmed by collected evidence (CADE, 2022).

Slovakia also shared its unsuccessful attempt to use one of the machine's reading tools for collecting data and detecting suspicious anticompetitive patterns. The main problem that leads to the failure is that Slovakian CA is relatively small, and the number of objects that

can be processed by some tools (such as the number of decisions prepared by CA) is also relatively small. Thus, the development or implementation of such tools can be more costly than the manual creation of some databases (Schrepel, Groza, 2023, p. 136).

Overall, the last, as for now, the 3rd Annual Report on Computational Antitrust within agencies (implementation survey) highlighted the main trends for 2023 as the focus on detecting bid rigging and harmful for the end consumers practices. The CA highlighted that they started implementing into their daily activities large language models (LLMs), relying more on machine learning (ML) tools designed for the analysis of big volumes of text and the Proof-of-Concept Application Programming Interfaces (APIs) development (Schrepel, Groza, 2024, p. 1).

4.2. Advantages of computational tools usage and identified gaps

Recognising that the already implemented screening tool has some limitations is important. One of the limitations is that the bid-rigging detection process does not completely automate; only the algorithm does the first stage. Another limitation is that algorithms should be trained with some data that allows them to recognise collusive patterns; thus, the data should be reliable, not biased, and in large quantity (OECD - Screening Tools, 2022, p. 9-10). One more limitation is that not all flagged patterns represent cartels; therefore, algorithms should be trained and further developed.

Despite all the described limitations, there are numerous advantages associated with these screening tools. These tools are proactive, meaning that CAs actively check whether there are collusions in different markets. Thus, there are more chances for market players who violate the law to be caught and punished. As those tools allow constant monitoring without

human intervention in the first stage, they allow monitoring of the behaviour of an unlimited number of market players in different markets. This increases both specific and general deterrence. Implementing these tools increases the efficiency of CAs in terms of investigations and the attractiveness of the leniency programme as the probability of being caught by CAs is higher. All these processes are deepening over time because of algorithms' ability to learn and improve their efficiency. Additionally, the volume of data that can be used by the algorithms to learn increases constantly, also leading to the constant improvement of the tool's effectiveness.

Overall, the main advantages brought by these screening tools are the possibility to reallocate human resources from manual monitoring activity to directly analysing cases with collusive patterns and investigations; expand the monitoring activity from the volume that can be covered manually to an unlimited number of market players and their interactions with others; eliminate human factors in form of possible errors and possible corruption risks.

4.3. The new possibilities for increasing the effectiveness of own-initiated investigations: computational antitrust findings

Despite the progress, the shortcomings of these tools and existing gaps also require further developments and implementations. One of the techniques that can improve CAs' performance is machine learning technologies, which CAs slowly accept. In the legal area, these types of approaches are used to study the context of legal documents, automatised analysis of legal documents, and predict outcomes. It is possible to reach these results because machine learning implies that algorithms trained to recognise complex patterns

from a sizable amount of data without instructions from people and learned patterns can be used to automate tasks (Zeleznikow, 2023, p. 2). Important features of Machine learning approaches: these types of models use statistical techniques to recognise trends in the data; they are trained on existing data that allows them to make predictions based on learned patterns; these algorithms are self-learning, meaning that they adapt to changes in data and improve their performance on continuous bases (Brown, Cajueiro, Eckert, and Silveira, 2023, p. 201).

Different types of Machine learning technologies exist, such as Supervised learning, Unsupervised learning, and Reinforcement learning (OECD - Screening Tools, 2022, p. 16-17). Supervised learning means that an algorithm is trained with labelled data. Thus, the input with an example of how the output must look must be provided to estimate output. This type of algorithm is used for predicting outcomes and classifying data (Competition Bureau Canada, 2024, p. 6). Unsupervised learning also requires input to generate output; however, the difference with the previous type of learning is that the data provided is unlabeled. Thus, there is no need to provide associated output values (OECD - Screening Tools, 2022, p. 17). This learning method is useful for grouping data and recognising hidden patterns (Competition Bureau Canada, 2024, p. 6). Reinforcement learning works in the same way as Unsupervised learning, with the main difference in punishing negative outcomes and rewarding a positive one (OECD - Screening Tools, 2022, p. 16-17).

For now, the most crucial example of machine learning usage in the legal domain is discovery document review. In this process, the algorithms do not replace crucial tasks of legal professionals, such as making decisions or deciding on strategies; the algorithm is used for reviewing large amounts of documents and filtering irrelevant documents (Zeleznikow, 2023, p. 2). Implementing such Machine-learning technologies can be

extremely useful for CAs as it allows reallocating human resources that always curtail questions for state agencies, economises CAs' budgets in the long run, and reduces the timeframe of investigations. (Hellwig, Hüschelrath, 2017, p. 421) after analysing cartel cases and cartel enforcement processes in the EU between 2001 and 2015, it was highlighted that the shortest EC investigation took below 20 months, while the longest was more than 100, with the average investigation duration between 46 to 57 months. One of the possible reasons is the involvement of many firms. Potentially, the involvement of many companies in the same infringement requires analysis of big-volume data with similar patterns; thus, ML technologies can speed up information processing.

Going further, (Brown, Cajueiro, Eckert, and Silveira, 2023) used Machine learning techniques to evaluate the level to which bid participants can identify their competitors' offers using publicly available data to coordinate their behaviour. For this study, the authors focused on the Alberta wholesale electricity market, where firms signal their identity to other companies via specific patterns in their offers, aiming to coordinate their behaviour and increase prices. The result of the study suggested that it is possible to implement Machine learning and data mining approaches to check whether companies can identify the behaviour of their competitors via de-identified data. The authors suggest that policymakers can employ the offered method and CAs to create ex-ante screens to monitor firms' behaviour continuously by marking firms whose behaviour should be checked additionally. With additional data received over time and self-learning techniques, it is possible to also work on minimising Type I and Type II errors. Overall, implementing such approaches can be one of the steps to balance between allocation of resources on continuous monitoring of the behaviour on the market and enforcement efforts. CA can use the offered techniques as one of the algorithmic screens to examine if public data can facilitate coordination without

reliance on monitoring, which can be time-consuming and visual inspections (Brown, Cajueiro, Eckert, and Silveira, 2023).

However, it is important that the implementation of Machine learning approaches into different aspects of the legal area is an ongoing process, and some limitations should be considered during adjusting according to the CAs' needs. Therefore, limitations such as an absence of sufficient suitable data, biases in the data or the algorithms themselves, issues connected to the choice of data and ethical considerations should be considered (Zeleznikow, 2023, p. 2).

One of the Machine learning extensions is Deep learning. (Huber and Imhof, 2023, p. 17) offered a new method for the detection of bid-rigging cartels, which is based on "*a deep learning architecture involving a convolutional neural network (CNN) for image recognition*". CNN is a deep learning method that, like Machine learning, learns from data to recognise some patterns; however, the big advantage of this method is that it does not require some variables as predictors but learns independently from graphs. For the first time, the authors propose implementing the CNN method to develop a cartel detection tool based on graphs showing the interaction between competitors. More precisely, the author believes that after learning from bid plots showing competitors' interactions during bids, CNN can classify whether it was competitive or collusive. The obtained result shows that the offered method correctly classifies nineteen companies out of twenty as competitors or cartel participants (Huber and Imhof, 2023, p. 2).

The last tool offered by David P. Brown, Daniel O. Cajueiro, Andrew Eckert, and Douglas Silveira can help CAs screen bids and recognise suspicious offers and bidders' behaviour for further scrutiny. Despite the same goal of these methods, the approaches are different and can be extremely useful for work with different data types. The Machine learning

technique offered by David P. Brown, Daniel O. Cajueiro, Andrew Eckert, and Douglas Silveira requires providing an algorithm with pre-defined variables that should be constructed in advance from data that the algorithm should work with; thus, this type of tool works excellently with structured data. On the other hand, deep learning based on the CNN model offered by M. Huber and D. Imhof is suitable for pattern recognition of unstructured data such as pictures and graphs. The existence of both these tools enlarges CA's ability to process different types of data and make market and bid screening more efficient and atomised.

5. Conclusions

It is possible to conclude that the anti-cartel enforcement system works effectively when the CAs combine different cartel detection and deterrence tools – a smart mix of tools. The CAs are responsible for deciding on the most suitable ratio of these tools. CAs must find a balance between different tools, as one tool's strengths can compensate for others' weaknesses.

It is not easy to evaluate the effectiveness of the leniency policy. At the same time, this tool is widespread and claimed to be effective. Importantly that it works only when cartel participants are exposed to credible threats of being caught and punished. In order to increase this threat, CAs should start more own-initiated investigations and become more proactive. This will signal to market participants that the danger of being caught and punished is real.

Considering the limited resources of CAs, it can be extremely difficult to increase enforcement activities and start more proactive investigations. However, new technological

developments offer ways to increase enforcement capacities. As for now, some CAs already started using computational tools to automate the performance of technical and repetitive actions. Some of the new tools facilitate collecting and analysing evidence related to investigations. Other tools can help to prioritise cases selected for in-depth investigations. Those developments shorten the time of investigation and allow reallocating human resources. More sophisticated tools, such as cartel screenings, directly recognise collusive patterns.

Despite already implemented tools, there are ways to improve their effectiveness and impact on investigations and enforcement. New developments allow for improving existing methods, making them more precise, less subject to errors, and automating more processes. Additionally, implemented tools that are used to detect cartels usually recognise red flags that must be analysed by CAs. Newly created methods that are not implemented yet can also deeply analyse participants' interactions and recognise less obvious patterns, improving their performance without human intervention. Importantly, most offers are connected to bid rigging. This means that there is a wide area for work with other collusive behaviour.

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