4 AN EMPIRICAL ANALYSIS OF ANTITRUST FINES IN BRAZIL (2012-2020)[1]

Uma Análise Empírica das Multas Antitruste no Brasil (2012–2020)

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STRUCTURED ABSTRACT

Background: the antitrust enforcement remains a primary concern for regulatory authorities globally. A central issue within this domain is the determination of appropriate penalties for violators, as antitrust fines serve both to deter future violations and to disrupt ongoing anticompetitive behaviors.

Objective: utilizing a comprehensive, hand-collected database of antitrust cases from 2012 to 2020, this study aims to empirically examine the factors that are associated with the imposition of corporate antitrust fines in Brazil.

Method: econometric estimates based on Ordinary Least Squares and Random-Intercept Model.

Conclusions: the number of subsections within Law No. 12.529/11, the duration of the infringement, the number of corporations involved, and the type of corporation (with traditional companies facing higher fines) are all positively associated with the severity of fines. Additionally, the scope of the market at international and national levels also demonstrates a statistically significant positive relationship with the fines imposed. Cases involving the fuel sector are also associated with higher penalties, suggesting the presence of sector-specific enforcement patterns. The findings of this study provide valuable insights for both Brazilian policymakers and global stakeholders, contributing to the enhancement of deterrence mechanisms by amplifying the perceived costs of anticompetitive conduct.

Keywords: antitrust; antitrust fines; Cade; antitrust authority; random-intercept model.

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RESUMO ESTRUTURADO

Contexto: a defesa da concorrência constitui uma das principais preocupações das agências reguladoras ao redor do mundo. Uma das questões centrais neste contexto é a determinação de penalidades apropriadas para infratores, uma vez que as multas servem tanto para dissuadir futuras infrações quanto para desencorajar comportamentos já existentes.

Objetivo: utilizando uma base de dados de casos coletados entre 2012 e 2020, o presente estudo visa examinar empiricamente os fatores associados com a imposição de multas antitruste corporativas aplicadas no Brasil pelo Conselho Administrativo de Defesa Econômica.

Método: estimativas econométricas baseadas em Mínimos Quadrados Ordinários e Modelo de Intercepto Aleatório.

Conclusões: o número de incisos da Lei nº 12.529/11, a duração da infração, o número de corporações envolvidas e o tipo de corporação (empresas tradicionais apresentando multas maiores) são fatores positivamente associados com a severidade da multa aplicada. Em adição, infrações com escopo internacional e nacional também demonstraram significância estatística e sinal positivo em relação às multas. Casos envolvendo o setor de combustíveis também estão associados positivamente a maiores penalidades, sugerindo a presença de padrões de atuação em setores específicos. Os resultados do estudo fornecem informações importantes tanto para formuladores de política pública no Brasil quanto para interessados ao redor do mundo, o que contribui para ampliar o efeito dissuasivo por elevar os custos percebidos da infração.

Palavras-chave: defesa da concorrência; multas antitruste; autoridade antitruste; modelo de intercepto aleatório.

Classificação JEL: L40; C40; K21.

Summary: *1. Introduction; 2. Corporate antitrust fines in Brazil; 3. Methodology; 3.1. Data; 3.2. Empirical model; 4. Results and discussion; 5. Conclusions; References.*

1 INTRODUCTION

In certain occasions, firms may deliberately engage in practices that undermine competition within markets. Addressing these anticompetitive behaviors constitutes a primary objective of antitrust laws enacted by governments. Examples of such practices include collusive agreements, wherein competitors coordinate their actions to restrict competition (Harrington, 2017); exclusionary practices, where firms with dominant market positions take actions to stifle competition; vertical restraints, which involve agreements between parties operating at different levels of the supply chain; and coordinated actions by unions or associations to influence market behavior (Cade, 2016a). Additionally, new forms of anticompetitive conduct have emerged in digital economies and platforms. What unites these practices is their shared aim to restrict or eliminate present and future competition, thereby facilitating the generation of supracompetitive profits. These inflated profits are often achieved to the detriment of consumers, who face higher prices, diminished product quality, reduced variety, and other inefficiencies inherent in markets plagued by antitrust violations.

https://doi.org/10.52896/rdc.v14i1.1977

In Brazil, the antitrust authority (Conselho Administrativo de Defesa Econômica – Cade, in Portuguese) started to focus on antitrust issues after the Law nº 8.884/1994, which was enacted to regulate the Brazilian Competition Defense System. However, the major concern in the 90s was mergers and acquisitions due the economic openness faced by Brazil in that period. The fight against anticompetitive conducts started effectively in the 2000s and has been improving over the years, including the following actions: upgrade of the Brazilian Leniency Program adopted in the year of 2000; public fight against gas station cartels; public fight against anticompetitive conducts in healthcare systems; punishment of international hardcore cartels; improvement of the legal and economic teams; enactment of Law nº 12.529/2011, which have been regulating the Brazilian Competition Defense System since 2012.[5] From 2014 onwards, Operation Car Wash (Operação Lava Jato) also played a significant role in strengthening antitrust enforcement in Brazil. The investigations uncovered several bid-rigging cartels in public procurement, often linked to corruption schemes, and reinforced the use of Cade's leniency program as a key detection tool. This context contributed to a more intensive and coordinated fight against cartels in the country (Munhoz; Oliveira, 2020).

An important element in this context is the imposition of penalties for anticompetitive conduct. Antitrust sanctions have two primary effects: deterrence of future violations and cessation of ongoing infringements. As noted by Spagnolo (2008), ex-ante deterrence, achieved through the threat of sufficiently severe sanctions, is the most critical objective, as it has the potential to prevent a wide range of potential violations at relatively lower social and individual costs. Additionally, penalizing detected infringements plays a vital role in prompting offenders to cease their anticompetitive behavior, thereby contributing to the overall efficacy of antitrust enforcement.

When discussing monetary penalties, the literature on optimal criminal fines emphasizes some crucial considerations. Regarding the deterrence effect, Becker's (1968) foundational work in the economics of crime suggests that offenders weigh the marginal benefits of committing a crime against the marginal costs, with the probability of detection and the anticipated penalties forming key components of those costs. In this context, to effectively deter infringements, optimal fines should be calibrated to align with this decision-making process, ensuring that the costs of committing an antitrust violation exceed the potential benefits. On the other hand, when addressing the punishment of actual infringements, Wils (2006) outlines several factors that antitrust authorities should take into account: the financial capacity of offenders to pay the fines, the broader social and economic costs associated with the imposition of penalties (such as the impact on corporate structure, employees, stock market performance, and investments), and the proportionality of fines relative to the illegal gains derived from the infringement. It is important to note that the objective of imposing fines is not to bankrupt the offending corporation but rather to encourage the cessation of anticompetitive conduct. Bankrupting a firm could result in undesirable market concentration. For instance, in a duopoly where two firms are engaged in collusion, if one firm goes bankrupt, the surviving firm may become a monopolist, which would lead to a worse market concentration scenario in the future, further exacerbating competitive harm.

In this context, it is essential to understand which factors are associated to the level of fines imposed to antitrust offenders. Despite the guidelines provided by antitrust agencies, such as European Comission (2011) and United States Sentencing Commission (2020), penalizing antitrust conducts is

5 Further details on the history of antitrust enforcement in Brazil can be found in Todorov and Torres Filho (2012).

not an exact science. In the United States, for example, the prevalence of plea agreements introduces a subjective element into the penalty-setting process. According to Law nº 12.529/2011 (Brasil, 2011), in Brazil fines are supposed to be proportional to the revenue obtained and the aggravating factors, but the necessary data on revenue and aggravating circumstances is not always readily available (or it is not available to Cade, or it is restricted to the public). Considering these challenges, conducting an empirical analysis to identify the primary factors influencing antitrust fines becomes an essential task. Such an analysis can provide a deeper understanding of the rationale behind penalty decisions and enhance the transparency and effectiveness of antitrust enforcement.

The objective of this paper is to empirically analyze which factors are associated to corporate antitrust fines in Brazil. Since the rules for individuals are distinct, the focus is on corporations that participated in anticompetitive conducts. We rely on a hand-collected database that contains all antitrust cases after the implementation of Law nº 12.529/2011 where at least one corporation was punished regularly with monetary penalties.

This paper makes a threefold contribution to the existing literature. First, from an international perspective, it is among the first studies to focus on an emerging economy – Brazil – where effective antitrust enforcement only began in the last decade of the twentieth century. With the exception of Jing, Gong and Yi. (2020), who focused on China, there is a limited body of work exploring antitrust fines in emerging countries (and China and Brazil differ greatly regarding the economy, institutions, politics, industrialization, among many other aspects). Second, in Brazil, the findings offer valuable insights for Cade's team, researchers, legal professionals, and other interested parties by informing discussions on deterrence and the setting of antitrust fines, that is, which factors judges tend to consider most relevant when defining sentences. Third, from a methodological standpoint, while much of the existing literature employs statistical techniques and regressions that do not account for group similarities, this study applies a random-intercept model, a more robust method that controls for group-level variations through random coefficients, providing a more nuanced understanding of the factors influencing antitrust penalties.

From the perspective of enforcement efficiency, the identification of statistically significant drivers of fines also contributes to improving Cade's transparency and predictability. If economic agents can anticipate how fines are likely to be calculated, deterrence is strengthened ex ante, thereby increasing the authority's efficiency in reducing cartel activity (Spagnolo, 2008). Furthermore, the divergence of results regarding cartel duration compared to studies of U.S. and EU fines (Connor & Miller, 2009, 2013) highlights a contextual difference in Brazil's enforcement, which can inform the comparative literature on whether emerging economies converge or diverge from the "optimal fines" benchmark.

This paper contributes to the existing body of literature on the statistical and econometric analysis of antitrust sanctions. Notable foundational works in this field include Posner (1970) and Gallo, Craycraft and Dutta (1986) for the United States, while more recent studies include Bolotova and Connor (2008), Connor and Miller (2009), and Connor and Miller (2013), which examine international cartels penalized in the United States and the European Union. Additionally, two significant studies—Allain *et al.* (2015) and Jing, Gong and Yi (2020)—investigate whether actual antitrust fines in the European Union and China, respectively, align with the theoretical framework of optimal sanctions.

https://doi.org/10.52896/rdc.v14i1.1977

The remainder of the paper is organized as follows. Section 2 discusses the law governing corporate antitrust fines in Brazil, while Section 3 contains the methodology used in the paper. Section 4 presents the results and discussion. Conclusions are provided in Section 5, followed by the references.

2 CORPORATE ANTITRUST FINES IN BRAZIL

As previously mentioned, despite former antitrust laws, the Law nº 8.884/94 in 1994 was the first one to establish the Brazilian System of Competition Policy, which was replaced by Law nº 12.529/11 that is in force from 2012 until now[6]. Article 36 and the subsequent subsections of Law nº 12.529/11 establish the following conducts as subject to punishment:

> *Art. 36. The acts under any circumstance, which have as object or may have the following effects shall be considered violations to the economic order, regardless of fault, even if not achieved:*
>
> *I – to limit, restrain or in any way injure free competition or free initiative;*
>
> *II – to control the relevant market of goods or services;*
>
> *III – to arbitrarily increase profits, and*
>
> *IV – to abusively exercise a dominant position.*
>
> *§ 1 The conquest of the market resulting from the natural process of the most efficient economic agent in relation to its competitors does not characterize the tort set forth in item II of the caput of this article.*
>
> *§ 2 A dominance position is assumed when a company or group of companies is able to unilaterally or jointly change market conditions or when it controls 20% (twenty percent) or more of the relevant market, provided that such percentage may be modified by Cade for specific sectors of the economy.*
>
> *§ 3 The following acts, among others, to the extent in which they configure the hypothesis set forth in the caput of this article and items thereof, shall characterize violation of the economic order:*
>
> *I – to agree, join, manipulate or adjust with competitors, in any way:*
>
> *a) the prices of goods or services individually offered;*
>
> *b) the production or sale of a restricted or limited amount of goods or the provision of a limited or restricted number, volume or frequency of services;*
>
> *c) the division of parts or segments of a potential or current market of goods or services by means of, among others, the distribution of customers, suppliers, regions or time periods;*
>
> *d) prices, conditions, privileges or refusal to participate in public bidding;*
>
> *II – to promote, obtain or influence the adoption of uniform or agreed business practices among competitors;*
>
> *III – to limit or prevent the access of new companies to the market;*

6 The changes from Law nº 8.884/94 to Law nº 12.529/11 related to antitrust infringements are in the sense of reorganizing subsections, changing penalties ranges and establishing self-report policies that were already adopted (Brazilian Leniency Program and Cease and Desist Agreements). For this reason, we focus this Section on the current Law in Brazil.

IV – to create difficulties for the establishment, operation or development of a competitor company or supplier, acquirer or financier of goods or services;

V – to prevent the access of competitors to sources of input, raw material, equipment or technology, and distribution channels;

VI – to require or grant exclusivity for the dissemination of advertisement in mass media;

VII – to use deceitful means to cause oscillation of the prices practiced by third parties;

VIII – to regulate markets of goods or services by establishing agreements to limit or control the research and technological development, the production of goods or services, or to impair investments for the production of goods or services or their distribution;

IX – to impose, on the trade of goods or services, to distributors, retailers and representatives, resale prices, discounts, payment terms, minimum or maximum quantities, profit margin or any other market conditions related to their business with third parties;

X – to discriminate against purchasers or suppliers of goods or services by establishing price differentials, or operating conditions of sale or provision of services;

XI – to refuse the sale of goods or provision of services, within regular payment conditions to the business practices and customs;

XII – to hinder or disrupt the continuity or development of business relationships of undetermined term, because the other party refuses to abide by unjustifiable or anticompetitive terms and conditions;

XIII – to destroy, render useless or monopolize the raw materials, intermediate or finished products, as well as to destroy, disable or impair the operation of equipment to produce, distribute or transport them;

XIV – to monopolize or prevent the exploitation of industrial or intellectual property rights or technology;

XV – to sell goods or services unreasonably below the cost price;

XVI – to retain production or consumption goods, except for ensuring recovery of production costs;

XVII – to partially or totally cease the activities of the company without proven just cause;

XVIII – to condition the sale of goods to the acquisition of another or use of a service, or to condition the provision of a service to another or to the acquisition of goods.

XIX – to abusively exercise or exploit intellectual or industrial property rights, technology or trademark (Brasil, 2011).

As will be detailed later, based on the subsections above the antitrust cases contained in the sample can be divided in some big groups: collusive agreements between competitors in ordinary markets and/or procurements; influence of uniform conducts by unions, associations and/or cooperatives; collusive agreements between competitors with influence of uniform conducts; and abuse of dominant position.

https://doi.org/10.52896/rdc.v14i1.1977

Article 37 of Law nº 12.529/11 establishes the following penalties for antitrust offenders in Brazil:

> *Art. 37. A violation of the economic order subjects the ones responsible to the following penalties:*
>
> *I – in the case of a company, a fine of one tenth percent (0.1%) to twenty percent (20%) of the gross sales of the company, group or conglomerate, in the last fiscal year before the establishment of the administrative proceeding, in the field of the business activity in which the violation occurred, which will never be less than the advantage obtained, when possible the estimation thereof;*
>
> *II – in the case of other individuals or public or private legal entities, as well as any association of persons or de facto or de jure legal entities, even if temporary, incorporated or unincorporated, which do not perform business activity, not being possible to use the gross sales criteria, the fine will be between fifty thousand reais (R$ 50,000.00) to two billion reais (R$ 2,000,000,000.00);*
>
> *III – if the administrator is directly or indirectly responsible for the violation, when negligence or willful misconduct is proven, a fine of one percent (1%) to twenty percent (20%) of that applied to the company, in the case set forth in Item I of the caput of this article, or to legal entities, in the cases set forth in item II of the caput of this article.*
>
> *§ 1 – In case of recurrence, the fines shall be doubled;*
>
> *§ 2 – In the calculation of the value of the fine referred to in item I of the caput of this article, Cade may consider the total turnover of the company or group of companies, when the value of sales in the field of business activity in which the violation occurred is not available, defined by Cade, or when it is incompletely presented and/or not clearly and credibly demonstrated (Brasil, 2011).*

Observe that Art. 37 establishes the range of penalties, but the proportion and the fine depend on the following criteria contained in Art. 45:

> *Art. 45. In the application of the penalties set forth in this Law, the following shall be taken into consideration:*
>
> *I – the seriousness of the violation;*
>
> *II – the good faith of the transgressor;*
>
> *III – the advantage obtained or envisaged by the violator;*
>
> *IV – whether the violation was consummated or not;*
>
> *V – the degree of injury or threatened injury to free competition, the national economy, consumers, or third parties;*
>
> *VI – the negative economic effects produced in the market;*
>
> *VII – the economic status of the transgressor;*
>
> *VIII – any recurrence (Brasil, 2011).*

In this context, we can conclude that penalties setting vary case-by-case and offender-by-offender. First, because the outcome that the fine proportion will affect (defined in Art. 37, paragraph

I) can be distinct, and in some cases companies do not disclose outcomes, which require another type of criteria used by Cade, such as a similar company, a similar case, or a penalty based on the reasonability. Second, because the aggravating factors listed in Art. 45 are subjective[7]. As better explained later in the paper, our dependent variable is the value of the penalty set for each firm, and covariates are related to this penalty or by influencing the firm revenue or by interfering on the aggravating factors, or both[8].

Despite the criteria above, the subjectivity of antitrust fines in Brazil reinforces the importance of an econometric analysis to understand which factors are associated with penalties, which may contribute to the literature and may increase the deterrence of anticompetitive conducts. Regarding other jurisdictions, Connor and Miller (2009) found that fines imposed on international cartels by the Department of Justice (DOJ) in United States are positively related to the economic injuries of collusion, at the same time that fines complement other antitrust penalties: prison sentences and private damages paid. The rest of coefficients were non-significant and/or showed a sign contrary to the expected, as the ones related to leadership, bid-rigging cartels, and the duration of the infringement (which may indicate that long-lasting cartels receive higher fines through the harm caused). Similarly, Connor and Miller (2013) analyzed the European Commission fines for global price-fixing and found that monetary penalties are directly related to economic injuries, recidivism, and having a whistleblower with immunity in the case, while inversely related factors that increase the probability of detection and conviction. Even though many of our variables differ from the mentioned papers due to available information, our results increase the comprehension of the subjective criteria of Cade in Brazil and allow the comparison with other jurisdictions in which is comparable.

3 METHODOLOGY

3.1 Data

As mentioned in the previous Section, antitrust fines for companies in Brazil are primarily set based on the company's sales and the aggravating factors[9]. For other types of corporations (public and private legal entities) and when company's sales are not available, fines must respect the maximum of fifty thousand Reais up to two billion Reais, considering the aggravating factors. A challenge in our paper is that Cade does not disclosure market information when lawyers require for secrecy, which prevents access to important control variables of corporations. It occurred many times in the sample, thus we needed to find other ways to control for factors that influence monetary penalties imposed by Cade.

The dependent variable in our paper is the fine applied by Cade to each corporation. Control variables comprise corporation-level covariates and case-level covariates, all collected in the antitrust cases judge by Cade through the electronic system of information (in Portuguese, Sistema Eletrônico

7 Cade recently released a guideline for cartel fines setting that suggests objective criteria for calculating penalties based on Cade previous decisions. However, this document is focused on cartels and has a suggestive character. Even with the goal of turning the fine setting more objective, possibly this guideline will not remove completely the subjectivity of decisions. The document in Portuguese can be accessed in Cade (2023).

8 Unfortunately, aggravating factors are not always listed, and we could not access firms' revenues due legal aspects.

9 When gross sales are not available, Cade may use another criterium, such as the percentage of fine for a similar company in the same case.

https://doi.org/10.52896/rdc.v14i1.1977

de Informações – SEI)[10]. As aforementioned, our sample consists of a hand-collected database that contains all antitrust cases judged after the implementation of Law nº 12.529/2011 where at least one corporation was punished regularly with monetary penalties, totalizing 597 corporations judged in 146 antitrust cases. The final date considered in the paper is December 2020. The Table 1 below presents the variables information:

Table 1 - Variables names and description

Name	Description
Fines (corporation-level)	Fines set by Cade to each corporation, in Reais and in values of December 2020*.
Subsections (corporation-level)	Number of subsections of Law n° 12.529/2011, or equivalent if the corporation was judged by Law n° 8.884/1994**.
Company (corporation-level)	Dummy variable with value one if the corporation is an ordinary company, zero otherwise (union, association, or another legal entity).
Corporations (case-level)	Number of corporations involved in the infringement.
Duration (case-level)	Duration of the infringement, in years.
Leniency (case-level)	Dummy variable with value one if there was at least one leniency agreement in the case, zero otherwise
TCC (case-level)	Dummy variable with value one if there was at least one Cease and Desist Agreements (in Portuguese, Termo de Compromisso de Cessação – TCC) in the case, zero otherwise.
International (case-level)	Dummy variable with value one if the market affected by the infringement is international, zero otherwise***.
National (case-level)	Dummy variable with value one if the market affected by the infringement is national, zero otherwise. Zero value means an infringement with a scope of operation smaller than the state level***.
State (case-level)	Dummy variable with value one if the market affected by the infringement is state-level, zero otherwise***.
Health (case-level)	Dummy variable with value one for cases in the health sector, zero otherwise****.
Fuel (case-level)	Dummy variable with value one for cases in the fuel sector, zero otherwise****.
Year dummies (case-level)	Dummy variable with value one if the case was judged in the respective year, zero otherwise.

Source: data collected by the authors (2021).

* Note: Values are adjusted by the Brazilian basic interest rate, SELIC. This is the same procedure done by Cade to adjust monetary values.

** Note: Corporations may be judged under the previous law if the case was initiated prior to the enactment of the new law, and if Cade deems it more advantageous to the defendant.

*** The reference category (zero value) means an infringement with a scope of operation smaller than the state level, for example, at the municipal level or lower.

**** Both categories were selected given their importance in the sample, as will be discussed later.

10 The system can be accessed in the following link: https://sei.cade.gov.br/sei//controlador_externo.php?acao=usuario_externo_logar&id_orgao_acesso_externo=0

Some further details on the data are worth noting. Regarding "subsections", Article 36 and the subsequent subsections of Law No. 12.529/11 define the conducts that are subject to penalties, including practices associated to collusive practices, influence of uniform conduct and abuse of dominant position. Corporations that applied for leniency or TCC agreements were excluded from the sample, since the logic of fines are distinct[11], but they are included in the number of the variable "corporations". Regarding the variable "duration", the number of years was defined based on Cade definition and/or case information. Lastly, our database consists of a cross-section of 597 corporations judged in distinct periods, where specific factors of time are controlled by year dummy variables. The empirical model described below allows for the identification of correlations between covariates and the dependent variable[12].

3.2 Empirical model

In this paper, each convicted corporation represents a unit of observation, with these convictions being associated with distinct antitrust cases. It is plausible that corporations convicted within the same case share common characteristics, suggesting the presence of factors within each group that may influence the determination of fines and, consequently, should be accounted for in the estimation process. While one might consider the inclusion of group-specific dummies to capture these effects, the sample consists of 146 antitrust cases, and such an approach could compromise the quality of the estimates. To address this concern, we employ a multilevel model in our analysis.

Multilevel models (also referred to as hierarchical models) are particularly appropriate when data is structured hierarchically, meaning that observations represent units clustered at different levels (Goldstein, 2011). According to Steenbergen and Jones (2002), the primary advantage of multilevel models over traditional regression methods lies in their ability to account for the natural nesting of data. In these models, the variability among individual units is explained not only by factors at the individual level, as in standard regression, but also by characteristics at the group level. A classic example of this is the analysis of student grades: while individual factors such as parents' education, family wealth, and personal dedication influence grades, school-level characteristics such as teacher quality and institutional resources also contribute significantly. In the context of our study, each convicted corporation is treated as a unit nested within its respective antitrust case.

Multilevel models account for both unit-level and group-level factors through random coefficients (intercepts and/or slopes). In a random-intercept model, a random component is added to the unit-level error term to capture the variation in the intercept across groups. This means that while the overall regression intercept is fixed, the intercept for each group can vary according to a random component. In contrast, random slopes allow for random components at the group level that are associated with the coefficients of the predictor variables. The decision regarding which coefficients should be treated as random depends on the research question, the statistical significance of the random components, the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and other case-specific considerations.

11 The Brazilian Leniency Program may provide full or partial amnesty of fines according to certain criteria, while TCC may provide partial amnesty. Further details on these programs can be accessed in Cade (2016a) and Cade (2016b), respectively.

12 In simple terms, correlation (or association) measures the extent to which two variables move together. This type of study does not account for causality.

https://doi.org/10.52896/rdc.v14i1.1977

In line with the previous discussion, we estimate two models: an Ordinary Least Squares (OLS) model and a random-intercept model. We chose to include both models to highlight their differences and to provide robustness to our results; however, the primary focus of our analysis is on the random-intercept model. Moreover, models are estimated in a log-linear form, meaning that the variable *Fines* is in its natural logarithm and all other variables are in their natural form. This functional form was chosen because it provides percentage variations, which is more interesting than analyzing absolute variations in Brazilian currency. Coefficients in log-linear models express an approximated percentage variation on the dependent variable in its natural form in consequence of a unit variation in regressors, but the exact percentage variation is expressed by $100*(e^{\beta i}-1), i=1,2,...$. We provide both information on the results and discussion section. The OLS specification can be expressed as the following:

$$ln(Fines)_i=\beta_0+\beta_1 Subsections_i+\beta_2 Company_i+\beta_3 Corporations_i+\beta_4 Duration_i+\beta_5 Leniency_i+\beta_6 TCC_i+\beta_7 International_i+\beta_8 National_i+\beta_9 State_i+\beta_{10} Health_i+\beta_{11} Fuel_i+\beta_{12} Year2020_i+\beta_{13} Year2019_i+\beta_{14} Year2018_i+\beta_{15} Year2017_i+\beta_{16} Year16_i+\beta_{17} Year2015_i+\beta_{18} Year2014_i+\varepsilon_i$$

(1)

Where β_0 is the intercept, $\beta_1, \beta_2, ...$ are variables coefficients and ε_i is the error term for each condemned corporation of the sample, represented by *i*.

For the random intercept model, suppose that the intercept in (1) is specified as $\beta_0=\gamma_{00}+\mu_{0j}$, where γ_{00} is the fixed overall intercept and μ_{0j} is the random component at the antitrust case level j , assumed independent, normally distributed with zero mean and constant variance. The random intercept model can be expressed as the following:

$$ln(Fines)_{ij}=\gamma_{00}+\beta_1 Subsections_{ij}+\beta_2 Company_{ij}+\beta_3 Corporations_{ij}+\beta_4 Duration_{ij}+\beta_5 Leniency_{ij}+\beta_6 TCC_{ij}+\beta_7 International_{ij}+\beta_8 National_{ij}+\beta_9 State_{ij}+\beta_{10} Health_i+\beta_{11} Fuel_i+\beta_{12} Year2020_{ij}+\beta_{13} Year2019_{ij}+\beta_{14} Year2018_{ij}+\beta_{15} Year2017_{ij}+\beta_{16} Year16_{ij}+\beta_{17} Year2015_{ij}+\beta_{18} Year2014_{ij}+\mu_{0j}+\varepsilon_{ij}$$

(2)

In this model, intercepts are the same for corporations in the same antitrust cases but are distinct between different cases according to μ_{0j}. Defining the variance of μ_{0j} by τ^2 (between-group variance) and the variance of ε_{ij} by σ^2 (within-group variance), the proportion of total variance that is between-group can be expressed by the intraclass correlation coefficient (ρ), defined by the following:

$$\rho = \frac{\tau^2}{\tau^2+\sigma^2}$$

(3)

This index is an important argument in favor (or not) of estimating a random-intercept model, since a high value of ρ indicates that a great amount of the variance of corporations' fines is related to antitrust cases characteristics, which is neglected in the OLS regression.

We estimate the random intercept model using maximum likelihood, which Snijders and Bosker (2012) identify as a primary method for estimating statistical parameters in random coefficients models. Following a Breusch-Pagan test for heteroscedasticity on the OLS regression, we found strong evidence of heteroscedastic residuals. Consequently, both the OLS and random intercept models

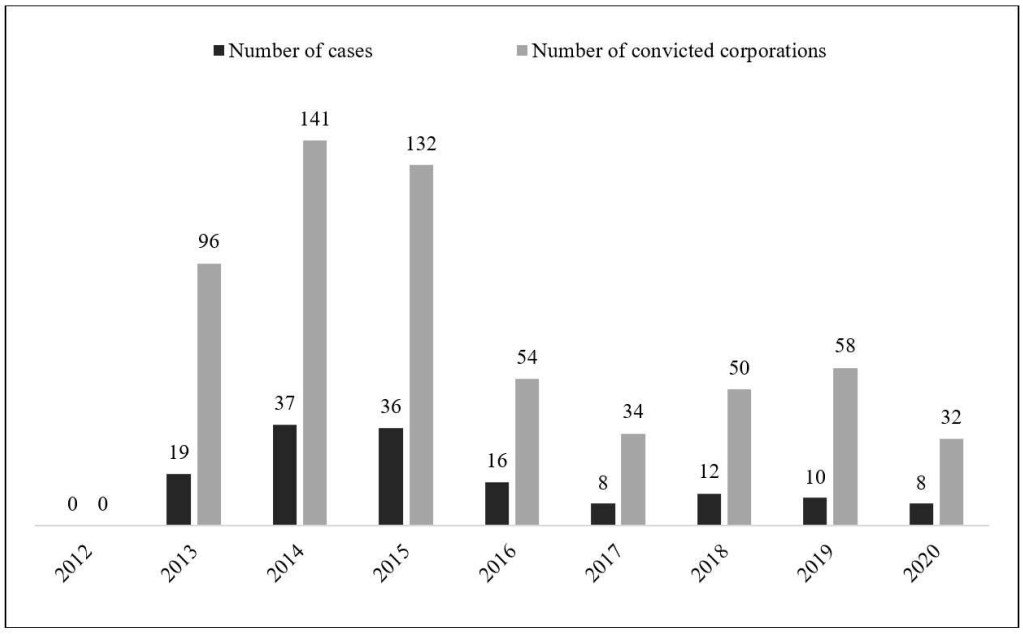
are estimated with robust variance-covariance matrix estimations.[13] The estimates presented in the following section indicate that the selection of variables is appropriate in terms of model fit.

4 RESULTS AND DISCUSSION

Starting with a description of the sample, approximately 36% of the cases (53 antitrust cases) involve collusive agreements between competitors in traditional markets and/or procurement sectors. Around 39% of the cases (57 antitrust cases) pertain to the influence of uniform conduct by unions, associations, and/or cooperatives. Approximately 12% of the cases (17 antitrust cases) represent a combination of collusive agreements and the influence of uniform conduct, while the remaining 13% (19 antitrust cases) involve abuse of dominant position.

Figure 1 below illustrates the number of cases and the number of convicted corporations for each year within the period covered by this paper.

Figure 1 - Number of cases and number of convictions of antitrust cases in Brazil, by year



Source: own elaboration. (2021)

Law No. 12.529/2011 has been in force in Brazil since July 2012. Notably, no antitrust cases were condemned in 2012, but the number of condemnations increased significantly in the subsequent three years, before stabilizing at a lower level between 2016 and 2020. This suggests that the enforcement of antitrust violations became more rigorous and effective following the implementation of the law. Regarding the observed stability since 2016, Harrington and Chang (2009) point out a key challenge in addressing cartels (and, more broadly, antitrust infringements): only discovered cases are observable, meaning that the true extent of violations remains unknown. Therefore, a low rate of condemnations could indicate either ineffective enforcement or a reduced number of infringements. The latter

13 Further details are available in the Stata User's Guide (Stata Corp, 2021).

https://doi.org/10.52896/rdc.v14i1.1977

interpretation appears more likely, implying that Law No. 12.529/2011 has strengthened enforcement, leading to fewer violations over time. This deterrence effect is further corroborated by Miller (2009), who demonstrates that effective anti-cartel measures can reduce the incidence of detected and condemned cases in the long run.

Table 2 below presents descriptive statistics for the non-dummy variables.

Table 2 - Descriptive statistics of ordinary (non-dummy) variables

	Variables	Mean	Standard deviation	Min.	Max.
Corporation - level	*Fines (in Reais)*	14.327.437,48	122.063.099,03	5.866,28	2.745.929.130,14
	Subsections	3,94	1,75	2	10
Case-level	*Duration (in years)*	5,24	5,69	1	33
	Corporations	5,10	5,82	1	46

Source: own elaboration (2021).

For the corporation-level variables (597 condemnations), the table above indicates that, on average, corporations' activities were classified under approximately four subsections of Law No. 12.529/11, with a relatively modest standard deviation. The fines, however, exhibit a high standard deviation, reflecting the considerable variability across both corporations and cases. These values should be interpreted with caution, as fines were determined at different points in time. Despite adjustments to December 2020, unobserved factors not captured by simple descriptive statistics may influence these values, though they are addressed in the main model. Regarding the case-level variables (146 antitrust cases), the average duration of cases was five years, and each case involved, on average, five corporations.

For the corporation-level dummy variable "*Company*," nearly 75% represent traditional companies (value one), while the remaining 25% are unions, associations, and other legal entities (value zero). For the case-level dummy variables, about 20% of the cases involved at least one Cease and Desist Agreement (coded as one in "*TCC*"), while nearly 12% of cases involved at least one leniency agreement (coded as one in "*Leniency*"). Concerning the affected market, approximately 8% of the cases were international (coded as one in "*International*"), around 20% impacted the national market (coded as one in "*National*"), and about 31% affected the state level (coded as one in "*State*"), with the remainder of cases affecting the municipal level. Approximately 19% of the cases occurred in the health sector (28 cases and 157 condemned corporations), while 11% occurred in the fuel sector (16 cases and 145 corporations). Lastly, with respect to the year of condemnation, as shown in Figure 1 in absolute terms, approximately 16% of corporations were condemned in 2013, 24% in 2014, 22% in 2015, 9% in 2016, 6% in 2017, 8% in 2018, 10% in 2019, and 5% in 2020.

Estimates are presented in Table 3 below.

Table 3 - OLS and random-intercept model estimates

Dependent variable: ln(Fines)	**OLS**		**Random-intercept model**	
	Coefficient	**% change**	**Coefficient**	**% change**
Intercept	10.62*** (0,30)	-	11,39*** (0,65)	-
Subsections	0.25*** (0.05)	28,39%	0,27** (0,11)	31,31%
Duration	0.06*** (0.01)	6,71%	0,06** (0,02)	6,67%
Corporations	-0,04*** (0,01)	-3,53%	-0,05** (0,02)	-4,94%
Company	0,80*** (0,20)	123,10%	0,76*** (0,24)	113,75%
Leniency	0,32 (0,47)	37,92%	0,31 (0,69)	36,75%
TCC	0,47* (0,25)	60,43%	0,53 (0,44)	69,48%
International	2,14*** (0,64)	746,08%	1,73** (0,88)	462,97%
National	2,16*** (0,25)	770,31%	1,55*** (0,42)	372,42%
State	0,09 (0,17)	9,64%	0,13 (0,25)	13,98%
Health	0,41 (0,20)	50,01%	0,13 (0,26)	13,36%
Fuel	2,53*** (0,21)	1158,17%	2,16*** (0,47)	768,24%
Year2020	0,63 (0,40)	86,92%	0,17 (0,60)	19,10%
Year2019	0,36 (0,38)	43,28%	-0,04 (0,79)	3,69%
Year2018	0,55 (0,38)	72,84%	-0,11 (0,75)	-10,30%
Year2017	-0,43* (0,35)	-34,98%	-0,84 (0,55)	-56,68%
Year2016	-0,62* (0,34)	-46,46%	-0,55 (0,66)	-42,09%
Year2015	0,21 (0,23)	22,85%	-0,34 (0,50)	-28,95%
Year2014	0,27 (0,23)	30,69%	-0,15 (0,47)	-13,72%
Random intercept variance	-	-	1,29*** (0,24)	-
R^2	51%	-	-	-
F-test	34.75***	-	-	-
Likelihood ratio test	-	-	196,37***	-
Intraclass correlation	-	-	0,54	-

Source: Own elaboration (2021).

https://doi.org/10.52896/rdc.v14i1.1977

Note: Standard errors were clustered at the case level to account for potential correlation of residuals among firms judged within the same antitrust case. Number of observations - 597 corporations condemned in 146 antitrust cases.

*** Statistically significant at 1%; ** Statistically significant at 5%; * Statistically significant at 10%.

First, for the OLS model, nearly 51% of the variance in is explained by the regressors, and the F-test rejects the null hypothesis that all coefficients are jointly equal to zero. For the random-intercept model, the Likelihood-Ratio test rejects the null hypothesis that both models provide similar fits, suggesting that a random coefficient model is more appropriate. The random-intercept variance is statistically significant at the 1% level, further supporting the use of a random-intercept model. Additionally, the intra-class correlation indicates that 54% of the variance in *ln(Fines)* can be explained by group-level factors (i.e., antitrust cases in this study).

Turning to the random-intercept model estimates, the coefficient for the subsection variable is statistically significant at the 5% level and has the expected sign, indicating that being classified under an additional subsection of Law No. 12.529/11 is associated with a 31,31% increase in the average level of fines. This finding is particularly relevant for legal teams representing defendants, as it suggests that reducing the number of subsections under which a corporation is framed could potentially lower the fines imposed by Cade. Regarding the duration variable, the coefficient is significant at the 5% level with a positive sign, suggesting that an additional year of infringement is associated with a 6,67% increase in fines. This relationship aligns with the notion that longer durations are associated with greater harm, which in turn influences the severity of penalties based on aggravating factors. This positive association is valuable in reinforcing the deterrence effect, as it underscores the financial risks of prolonged violations.

Regarding "Corporations", the negative and statistically significant coefficient at 5% indicates that cases involving a larger number of firms are associated with lower fines per corporation, suggesting a possible dilution effect in penalty setting across participants within the same infringement. For the "Company" dummy variable, being classified as a traditional company is associated with a 113.75% increase in fines, statistically significant at the 1% level. As outlined in Section 2, traditional companies are legally required to provide gross sales data to inform penalty calculations, making it easier for Cade to set fines, particularly when considering aggravating factors. Furthermore, traditional companies tend to be more profitable than unions, associations, and other legal entities, which may explain the higher fines they receive. These companies are also more likely to engage in high-profile infringements, such as horizontal collusion, while other entities are typically involved in influencing uniform conduct or abusing dominant positions. The positive and statistically significant coefficient of "Fuel" indicates that infringements in the fuel sector are associated with substantially higher fines, suggesting that Cade treats violations in this sector as particularly harmful, possibly due to their broad consumer impact and recurrent cartelization patterns.

Regarding market scope, the coefficient for "International" and "National" dummy variables are positive and statistically significant at 5% and 1%, respectively. Antitrust violations with an international (national) scope is associated with a 462.97% (372,42%) increase in fines, which is consistent with expectations: the broader the market affected, the greater the damage caused, and thus, the higher the aggravating factors considered by Cade.

The year dummies are included to control for various factors, such as changes in the political and economic environment, as well as administrative and legal shifts within Cade. Given the complexity of these factors, it is difficult to derive direct interpretations from significant coefficients. As the primary focus of this paper is on the determinants of antitrust fines, detailed analysis of these year-specific factors is omitted here.

Turning to the non-significant coefficients, the "State" market scope variables are not statistically significant, although they exhibit the expected signs. Although the coefficients for "Leniency" and "TCC" (Cease and Desist Agreements) have the expected signs, they are also statistically insignificant. These policies, which encourage cooperation with investigations in exchange for reduced penalties, were anticipated to correlate positively with higher fines for other members of the violation, but in our analysis, neither the number of corporations nor the presence of leniency or TCC agreements were significant determinants of the fines imposed by Cade. The coefficient for "Health" is positive but not statistically significant in the random-intercept model.

The findings for Brazil reveal both similarities and differences relative to the empirical literature on antitrust fines in the United States and the European Union. Consistent with the evidence for both jurisdictions (Connor and Miller, 2009; Connor and Miller, 2013), fines imposed by Cade are positively associated with indicators of infringement seriousness, including the scope of the affected market and the legal classification of the conduct, thereby reinforcing the role of monetary sanctions as a central instrument of deterrence. With respect to infringement duration, the Brazilian results are aligned with those documented for the European Union, where duration is statistically significant, indicating that longer-lasting infringements are understood as generating greater cumulative harm and thus warrant higher penalties. By contrast, in the United States, cartel duration is not statistically significant at the 10% level, suggesting that the prevalence of plea bargaining may attenuate the direct relationship between observable characteristics of the infringement and final fine levels. From a policy perspective, these findings support the continued treatment of duration as an aggravating factor in fine-setting, as it enhances deterrence while contributing to the coherence and consistency of enforcement decisions.

5 CONCLUSIONS

Given the factors that Cade considers when imposing monetary penalties on offenders, understanding which ones influence the level of fines has become a crucial task. This paper sought to analyze the determinants of corporate antitrust fines in Brazil using a random-intercept model.

Our findings suggest that the number of subsections under Law No. 12.529/11, the duration of the infringement, the number of corporations involved, and the classification as a traditional company (compared to other types of corporations) are positively correlated with the level of fines. Additionally, the scope of the market plays a significant role in explaining the penalties, particularly at the international and national levels. We also find that cases involving the fuel sector are associated with higher fines, indicating sector-specific enforcement patterns.

Our findings also contribute to the literature on optimal fines by highlighting how Brazilian enforcement practice aligns with core theoretical principles. The positive association between infringement duration and fine severity reinforces the deterrence rationale discussed by Becker (1968),

https://doi.org/10.52896/rdc.v14i1.1977

while the higher penalties applied to traditional firms reflect Wils' (2006) concern with proportionality and capacity to pay. By clarifying these mechanisms, the paper shows how Cade's sanctioning patterns can strengthen deterrence and enhance enforcement efficiency, thus connecting the empirical results to broader debates on the optimal design of antitrust fines.

These results offer valuable insights for Cade, legal professionals, researchers, and other stakeholders. Moreover, they highlight the importance of this information for corporations, as it enhances the deterrence effect by making the consequences of misconduct clearer. In other words, our findings contribute to the strengthening of the deterrent effect of antitrust laws, which is a key goal of law enforcement.

For future research, we recommend exploring additional potential determinants, including institutional factors. Investigating the underlying causes behind the year dummies in our model would also be an interesting avenue for further study.

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