

An econometric analysis of antitrust fines in Brazil

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Abstract: Fighting antitrust conducts is a major concern of antitrust authorities around the world. A key issue in this context is how punishing offenders, since antitrust penalties can help the deterrence of new cases and also interrupt already existing infringements. Based on a self-built database of antitrust cases in the period of 2012-2020, the objective of this paper is to analyze econometrically which factors are associated to corporate antitrust fines in Brazil. Estimates are obtained by a multilevel model and indicate that the number of subsections of Law nº 12.529/11 and the duration of the infringement are positively related to the level of fines, so as being an ordinary company. The market scope at national level is also statistically significant and positively related to imposed fines. Results provide useful information for interested people in Brazil and worldwide and help to increase the deterrence of antitrust cases by increasing the fear of misconducts, which tends to be the most important goal of anticrime law enforcement.

Keywords: antitrust, antitrust fines, CADE, antitrust authority, multilevel model

JEL Code: L40, C40, K21

Resumo: O combate às condutas anticompetitivas é uma prioridade das autoridades antitruste ao redor do mundo. Uma questão importante neste cenário é como punir os acusados, uma vez que as penalidades podem auxiliar na dissuasão de novos casos e também interromper infrações já existentes. Com base em uma base de dados composta por infrações antitruste no período de 2012-2020, o objetivo do presente artigo é analisar os determinantes das multas antitruste para corporações no Brasil. As estimativas são obtidas por um modelo multinível e indicam que o número de incisos da Lei nº 12.529/2011 e a duração da infração são positivamente relacionados às multas aplicadas, assim como ser uma empresa normal (em comparação a ser outro tipo de corporação). O escopo do mercado ser nacional também é significativo na explicação das multas. Os resultados fornecem informações importantes para interessados no Brasil e no exterior e auxiliam na dissuasão de infrações anticompetitivas por elevar o medo de ser condenado, o que tende a ser o objetivo mais importante da atuação anticrime.

Palavras-chave: antitruste, multas antitruste, CADE, autoridade antitruste, modelo multinível

The main author thanks FAPERJ for the support through Grant nº267685

I. Introduction

In many situations, firms may intentionally engage in practices that reduce competition in markets. Fighting these practices is a major objective of antitrust laws adopted by nations¹.

The most known antitrust infringement is possibly horizontal collusive agreements, defined by Harrington (2017) as the coordination of firms in a market to achieve supracompetitive outcomes (price-fixing, bid-rigging, market division, and so forth). Other anticompetitive conducts include exclusionary practices (actions taken by firms in dominant positions to decrease competition), vertical restraints (agreements among agents in distinct levels of the value chain), influence of uniform conduct by unions and associations, among other possible conducts, including the ones that emerged in digital economies and platforms. The commonality among these practices is the objective to restrict or eliminate current/future competition, which is related to current/future supracompetitive profits. These inflated gains occur in detriment of consumers, who face increased prices, lower quality, less variety of products, among other problems associated with market inefficiencies and antitrust violations.

Developed countries were the first to adopt antitrust laws in the contemporary world. The first modern competition laws in Canada and United States date from the end of the 19th century (Competition Act in 1889 and Sherman Act in 1890, respectively), but some anticompetitive rules and legislations in these countries can be observed even before. European countries also demonstrate anticompetitive enforcement since many centuries ago, and the emergence of European Union helped to develop an important organism to regulate antitrust issues in Europe, the European Commission. In developing countries, the fight against antitrust violations started to be effective in the 90s and 2000s, such as in BRICS nations (Brazil, Russia, India, China and South Africa), while some poor countries do not have antitrust laws and antitrust agencies until this moment.

In Brazil, the antitrust authority (Conselho Administrativo de Defesa Econômica - CADE, in Portuguese) started to focus on antitrust issues after 1994, when the Law nº 8.884/1994 was enacted to regulate the Brazilian Competition Defense System. However, in the 90s the major concern was related to 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, which includes 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 until this moment; among other improvements. Further details on the history of antitrust enforcement in Brazil can be found in Todorov and Filho (2012).

An important aspect in this scenario is the punishment of anticompetitive conducts. The effects of antitrust penalties are twofold: the deterrence of new cases and the interruption of already existing ones. As highlighted by Spagnolo (2008), the *ex-ante* deterrence with the threat of sufficiently heavy expected sanctions is the most important objective, since it affects a large number of potential infringements at a lower social and individual cost. In sequence, penalizing the discovered infringements is also important in the sense of encouraging offenders to interrupt the misconduct.

Strictly speaking of monetary penalties, the literature on optimal criminal fines highlights some important aspects that must be considered. Regarding the deterrence effect, the literature on the economics of crime initiated by Becker (1968) points that criminals compare marginal

¹ It is worth noting that little competition in a market is not an infringement *per se*.

benefits to the marginal costs when maximizing the utility function of committing a crime, while the probability of being detected and the expected penalties are important parts of the costs of the misconduct. In this sense, to avoid a great number of infringements the optimal fines should be somehow related to this maximization process. Regarding the punishment of infringements that end-up occurring, Wils (2006) lists some issues that antitrust agencies should consider: the inability of offenders to pay; the social and economic costs of fines, that is, the consequences on the corporation structure (employees, stock market, investments, and so forth); the proportionality of fines to the illegal gains. It is worth noting that the objective is to punish offenders to discourage the infringement continuity, and not to bankrupt the corporation, which would cause a market concentration that could be even worst in the future. For instance, in a market with two firms that collude if one goes bankrupt the other becomes a monopolist (everything else constant), which is the worst scenario for market concentration.

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 Commission (2011) and United States Sentencing Commission (2020), penalizing antitrust conducts is not an exact science. In United States, for example, plea deals are very common, which brings subjective aspects to the penalty. In Brazil, fines are supposed to be proportional to the revenue obtained, but this information is not always available to CADE (further details on the antitrust fines in Brazil are presented in the next Section). An econometric analysis of the main factors that explain anticompetitive fines becomes a fundamental task in this context.

The objective of this paper is to analyze econometrically 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 self-built 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.

The contribution of this paper to the literature is threefold: regarding the international interest, as far as we know, with exceptions to Jing *et al.* (2020), our paper is the first focusing on an emerging country, where antitrust enforcement became effective in the last decade of twentieth century (also, China and Brazil differ greatly regarding the economy, institutions, politics, industrialization, among many other aspects); for Brazilians, results provide useful information for CADE's team, researchers, lawyers and interested people regarding deterrence and antitrust fine setting; methodologically, literature makes use of statistics and regressions that do not control for group similarities, while we apply a multilevel model, a robust technique that allows firms to present similar characteristics that are controlled by random coefficients.

This paper is in the line with the literature on statistical and econometric papers focused on antitrust sanctions. Seminal papers include Posner (1970) and Gallo *et al.* (1986) for United States, while more recent articles are Bolotova and Connor (2008), Connor and Miller (2009) and Connor and Miller (2013) for international cartels punished in United States and European Union. Two papers worth mentioning are Allain *et al.* (2015) and Jing *et al.* (2020), where authors analyze if actual fines in antitrust cases fit the theory of optimal sanctions in European Union and China, respectively.

The remainder of the paper is organized as follows. Section 2 talks briefly about the legislation of corporate antitrust fines in Brazil. Section 3 contains the methodology used in the paper, while Section 4 presents the results and discussion. Conclusions are provided in Section 5 and the paper ends after references.

II. Corporate antitrust fines in Brazil

As previously mentioned, despite of former antitrust laws, the Law n° 8.884/94 in 1994 was the first one to establish the Brazilian System of Competition Policy, which was replaced by Law n° 12.529/11 that is in force from 2012 until now². Article 36 and the subsequent subsections of Law n° 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;
- 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;

² The changes from Law n° 8.884/94 to Law n° 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.

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”.

As will be detailed later, based on the subsections above the antitrust cases contained in the sample can be divided in four 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.

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.”

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.”

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 disclosure 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 subjective³. 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 both⁴.

Despite the criteria above, the subjectivity of antitrust fines in Brazil reinforces the importance of an econometric analysis to understand which factors are associated to 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

³ CADE recently released a preliminary version of 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 (2020).

⁴ Unfortunately, aggravating factors are not always listed, and we could not access firms’ revenues due legal aspects.

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.

III. Methodology

A. The 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 factors⁵. For other types of corporations (public and private legal entities) and when company's sales are not available, fines must respect the range of fifty thousand reais up to two billion reais, considering the aggravating factors. A challenge in our paper is that CADE do 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 de Informações – SEI)⁶. As aforementioned, our sample consists of a self-built database that contains all antitrust cases judged after the implementation of Law n° 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. Table 1 below presents the variables information:

Table 1. Variables names and description

Name	Description
<i>Fines</i> (corporation-level)	Fines set by CADE to each corporation, in Reais and in values of December 2020*.
<i>Subsections</i> (corporation-level)	Number of subsections of Law n° 12.529/2011, or equivalent if the corporation was judged by Law n° 8.884/1994**.
<i>Company</i> (corporation-level)	Dummy variable with value one if the corporation is an ordinary company, zero otherwise (union, association, or another legal entity).
<i>Collusive agreement</i> (corporation-level)	Dummy variable with value one if the corporation was punished for collusive agreement (Art. 36, §3, subsection I of Law n° 12.529/2011), zero otherwise (influence of uniform conduct or abuse of dominant position)
<i>Corporations</i> (case-level)	Number of corporations involved in the infringement.
<i>Duration</i> (case-level)	Duration of the infringement, in years.
<i>Leniency</i> (case-level)	Dummy variable with value one if there was at least one leniency agreement in the case, zero otherwise

⁵ 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.

⁶ 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

<i>TCC</i> (<i>case-level</i>)	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.
<i>International</i> (<i>case-level</i>)	Dummy variable with value one if the market affected by the infringement is international, zero otherwise.
<i>National</i> (<i>case-level</i>)	Dummy variable with value one if the market affected by the infringement is national, zero otherwise.
<i>State</i> (<i>case-level</i>)	Dummy variable with value one if the market affected by the infringement is state-level, zero otherwise.
<i>Year2020</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2020, zero otherwise.
<i>Year2019</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2019, zero otherwise.
<i>Year2018</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2018, zero otherwise.
<i>Year2017</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2017, zero otherwise.
<i>Year2016</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2016, zero otherwise.
<i>Year2015</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2015, zero otherwise.
<i>Year2014</i> (<i>case-level</i>)	Dummy variable with value one if the case was judged in the year of 2014, zero otherwise.

*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 by the former Law if the case was prosecuted before the new Law enactment and CADE considers more beneficial to the offender.

Source: Data collected by the authors.

Some further details on the data are worth noting. In relation to “*collusive agreement*”, it is a corporation-level variable because there are cases in the sample where companies were convicted by collusive agreements while an association/union/cooperative was framed in influence of uniform conduct and/or abuse of dominant position. In other words, this variable varies from observation to observation. Corporations that applied for leniency or TCC agreements were excluded from the sample, since the logic of fines are distinct⁷, 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.

B. Empirical model

In our paper, each condemned corporation corresponds to a unit of observation, and these convictions are comprised in distinct antitrust cases. It is presumable that corporations convicted in the same case present similarities, i.e., there are common factors within group that

⁷ 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.

probably help to explain the level of fines, and therefore must be considered in estimates. One could suggest including group dummies to capture these effects, but our sample contains 146 antitrust cases, so this strategy would harm the quality of estimates. We deal with this issue by estimating a multilevel model.

Multilevel models (or hierarchical models) are appropriated when data is organized hierarchically, that is, observations represent units that are clustered at different levels (GOLDSTEIN, 2011). According to Steenbergen & Jones (2002), the main advantage of multilevel models in comparison to ordinary regressions is precisely the possibility of considering a natural nesting of data. The variability among units is not explained only by unit level factors, as a regular regression, but also by group level characteristics. The classic example is analyzing students' grades; certainly, there exist individual factors that help to explain the grades (as parents' education, family wealth, dedication, and so forth), but it is true that schools characteristics are also important (as the teachers' quality, school quality, among others factors). In our case, each condemned corporation is a unit that is clustered in antitrust cases.

These models consider unit level and group level factors through random coefficients, say intercept and/or slopes. A random intercept model adds a random component of group level to the unit level error term, that is, the intercept for the overall regression is fixed, but for each group the intercept varies according to a random component. For random slopes, the model allows for random components of cluster level associated to variables coefficients. The choice of which coefficients are random may depend on the research problem, statistical significance of the random components, Akaike and/or Bayesian information criterion, among other possibilities specific to each case.

Considering the discussion above, we estimate two models in this paper: an Ordinary Least Square (OLS) and a random intercept model. We opted for both to show the distinction between them and for robustness, but the focus 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 $100 * (e^{\beta_i} - 1)$, $i = 1, 2, \dots$. We provide both information on the results and discussion section. The OLS specification can be expressed as the following:

$$\ln(Fines)_i = \beta_0 + \beta_1 Subsections_i + \beta_2 Company_i + \beta_3 Corporations_i + \beta_4 Duration_i + \beta_5 Leniency_i + \beta_6 TCC_i + \beta_7 Collusiveagreement_i + \beta_8 International_i + \beta_9 National_i + \beta_{10} State_i + \beta_{11} Year2020_i + \beta_{12} Year2019_i + \beta_{13} Year2018_i + \beta_{14} Year2017_i + \beta_{15} Year16_i + \beta_{16} Year2015_i + \beta_{17} Year2014_i + \varepsilon_i \quad (1)$$

Where β_0 is the intercept, β_1, β_2, \dots 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:

$$\ln(Fines)_{ij} = \gamma_{00} + \beta_1 Subsections_{ij} + \beta_2 Company_{ij} + \beta_3 Corporations_{ij} + \beta_4 Duration_{ij} + \beta_5 Leniency_{ij} + \beta_6 TCC_{ij} + \beta_7 International_{ij} +$$

$$\beta_8 \text{Collusiveagreement}_{ij} + \beta_9 \text{National}_{ij} + \beta_{10} \text{State}_{ij} + \beta_{11} \text{Year2020}_{ij} + \beta_{12} \text{Year2019}_{ij} + \beta_{13} \text{Year2018}_{ij} + \beta_{14} \text{Year2017}_{ij} + \beta_{15} \text{Year16}_{ij} + \beta_{16} \text{Year2015}_{ij} + \beta_{17} \text{Year2014}_{ij} + \mu_{0j} + \varepsilon_{ij} \quad (2)$$

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:

$$\rho = \frac{\tau^2}{\tau^2 + \sigma^2} \quad (3)$$

This index is an important argument in favor (or not) of estimating multilevel models, 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 by maximum likelihood, pointed out by Snijders and Bosker (2012) as a major estimation method for estimating statistical parameters in random coefficients models. After performing a Breusch-Pagan test for heteroscedasticity on the OLS regression we have strong evidence of heteroscedasticity of residuals, thus the OLS and random intercept model are estimated with robust estimations of variance-covariance matrix (further information is available on STATA USER'S GUIDE (2021)).

The expected signs of coefficients in (1) and (2) are presented in Table 2 below:

Table 2. Expected signs of coefficients and explanations.

Variables	Expected sign	Reason
<i>Subsections</i>	Positive	The number of subsections tends to be associated to the degree of severity and damage caused.
<i>Company</i>	Positive	Companies usually aim at obtaining profits and are market oriented, which is directly related to the damage caused. Other corporations can present other priorities (unions, associations, and so on).
<i>Collusive agreement</i>	Positive	Collusive agreements are usually the most harmful type of antitrust infringement; thus, damages and aggravating factors tend to be higher if the company was framed in Art. 36, §3, subsection I of Law n° 12.529/2011.
<i>Corporations</i>	Positive	The greater the number of corporations involved in the infringement the higher tends to be the damage and the severity of misconduct.
<i>Duration</i>	Positive	Longer-lasting infringements usually impact harder the economy due the long period, reflecting on the damage caused.
<i>Leniency</i>	Positive	Leniency agreements requires the cooperation of applicants, which may help CADE to prosecute and prove a greater number of violations of the same infringement.

<i>TCC</i>	Positive	TCC agreements requires the cooperation of applicants, which may help CADE to prosecute and prove a greater number of violations of the same infringement.
<i>International</i>	Positive	In comparison to a municipal-level violation (all market-scope dummies zero), damage tends to be higher when the affected market is international.
<i>National</i>	Positive	In comparison to a municipal-level violation (all market-scope dummies zero), damage tends to be higher when the affected market is national.
<i>State</i>	Positive	In comparison to a municipal-level violation (all market-scope dummies zero), damage tends to be higher when the affected market is state-level.
<i>Years' dummies</i>	Non-applicable	These dummies are used to control for specific annual factors. There is no <i>ex-ante</i> expectation regarding signs.

As previously mentioned, since corporation gross sales and aggravating factors are not available in most of cases the variables above we seek to replace this missing information by including interesting factors that may be related to fines, thus are linked to the sales and/or aggravating factors. The estimates in the next Section suggest that the selection of variables is satisfactory in terms of model adjustment.

IV. Results and discussion

Beginning with some information on the sample, around 36% of the cases (53 antitrust cases) are collusive agreements between competitions in ordinary markets and/or procurements, while approximately 39% of the cases (57 antitrust cases) refers to influence of uniform conducts by unions, associations and/or cooperatives. About 12% of the cases (17 antitrust cases) are a mix of collusive agreement and influence of uniform conduct and the last 13% (19 antitrust cases) represent abuse of dominant position.

The Figure 1 below shows the number of cases and the number of convicted corporations in each year of the period considered in the paper.

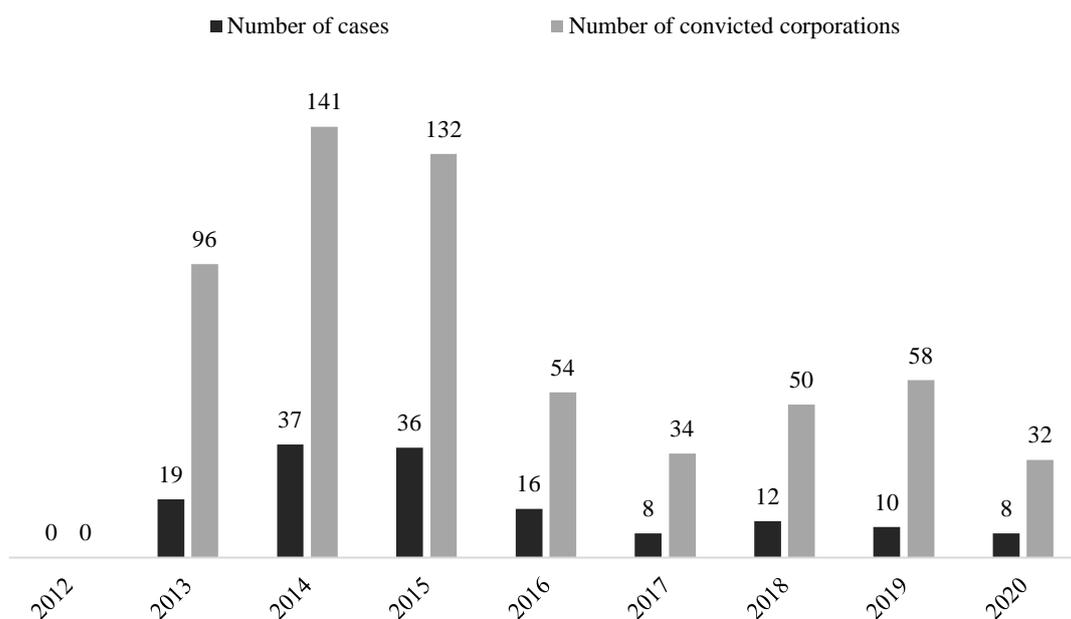


Figure 1. Number of cases and number of convictions of antitrust cases in Brazil, by year.

The Law n° 12.529/2011 is in force in Brazil since July 2012. Note that no antitrust case was condemned in 2012, but the number increased sharply for the next three years and then remained stable in a lower level from 2016 to 2020. We can presume that the fight against antitrust violations was encouraged and became more effective right after the Law. Regarding the stability since 2016, Harrington and Chang (2009) highlights that a major challenge when dealing with cartels (and we extend to most antitrust infringements) is that only the discovered cases are observable, thus we do not know the whole population of cases. It means that a low rate of condemnations can mean that the enforcement is not being effective in punishing, but also that the number of infringements is low. The latter is more plausible, that is, the Law n° 12.529/2011 improved the enforcement against antitrust offenses and on the mid-run and long-run we have fewer cases to be detected and condemned (deterrence effect). This deterrence effect in the long term is certified by Miller (2009) for effective innovations in fighting cartels.

The Table 3 below presents some descriptive statistics of the non-dummy variables.

Table 3. Descriptive statistics of ordinary (non-dummy) variables.

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

For the corporation-level variables (597 condemnations), the table above informs that, on average, corporations' activities were framed in approximately four subsections of Law n° 12.529/11, with a modest standard deviation. The fines' values show a high standard deviation,

representing the variability of corporations and cases condemned. However, these values must be analyzed cautiously due the fact that fines were determined in distinct periods of time, and despite the adjustment to December 2020 there are unobserved factors that are not captured by simple descriptive statistics (but are on the main model). For the case-level variables (146 antitrust cases), cases lasted five years on average and involved approximately five corporations, on average.

For the corporation-level dummy variable “*Company*”, almost 75% are ordinary companies (value one), and the remainder are unions, associations, among other legal entities (value zero). In relation to the corporation-level dummy variable “*collusive agreement*”, around 67% of corporations were punished for collusive agreements and the rest for influence of uniform conduct and/or abuse of dominant position. For the other dummies, all at case-level, for “*TCC*” approximately 20% of the cases had at least one Cease and Desist Agreement, while for “*Leniency*” the value was almost 12% (at least one leniency agreement). Regarding the affected market, about 8% of the cases were international (value one in “*International*”), near 20% affected the national market (value one in “*National*”), approximately 31% affected the State (value on in “*State*”) and the remainder was at the municipal level. Lastly, in relation to the year of condemnation, as can be observed in Figure 1 in absolute values, 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 20120.

Estimates are presented in Table 4 below.

Table 4. OLS and multilevel model estimates.

<i>Dependent variable: ln(Fines)</i>	OLS		Multilevel model (random intercept)	
	Coefficient	% change	Coefficient	% change
<i>Intercept</i>	11.51*** (0.33)	-	12.11*** (0.72)	-
<i>Subsections</i>	0.20*** (0.05)	21.89%	0.30** (0.13)	35.51%
<i>Duration</i>	0.05*** (0.01)	5.41%	0.04* (0.02)	4.40%
<i>Collusive agreement</i>	0.71*** (0.26)	103.00%	-0.09 (0.46)	-8.82%
<i>Corporations</i>	0.00 (0.01)	-0.71%	-0.01 (0.03)	-1.44%
<i>Company</i>	0.67*** (0.25)	95.81%	0.81*** (0.27)	125.82%
<i>Leniency</i>	-0.30 (0.45)	-25.89%	0.25 (0.71)	28.45%
<i>TCC</i>	0.75** (0.26)	111.45%	0.63 (0.49)	87.39%
<i>International</i>	1.58*** (0.61)	386.14%	1.19 (0.87)	229.81%
<i>National</i>	1.74*** (0.24)	468.79%	1.19*** (0.42)	229.00%
<i>State</i>	0.25 (0.18)	28.98%	0.05 (0.28)	4.90%

<i>Year2020</i>	-0.17 (0.36)	-16.01%	-0.44 (0.61)	-36.09%
<i>Year2019</i>	-0.02 (0.43)	-1.76%	-0.67 (0.83)	-49.64%
<i>Year2018</i>	-0.56 (0.38)	-43.08%	-1.00 (0.74)	-63.30%
<i>Year2017</i>	-0.74* (0.41)	-52.46%	-1.45** (0.68)	-76.44%
<i>Year2016</i>	-1.13*** (0.39)	-67.81%	-0.99 (0.68)	-63.33%
<i>Year2015</i>	-0.15 (0.28)	-14.30%	-0.97* (0.57)	-61.95%
<i>Year2014</i>	-0.57** (0.25)	-43.23%	-0.67 (0.53)	-48.75%
<i>Random intercept variance</i>	-	-	1.70*** (0.35)	-
<i>R²</i>	0.38	-	-	-
<i>F-test</i>	24.78***	-	-	-
<i>Likelihood ratio test</i>	-	-	304.36***	-
<i>Intraclass correlation</i>	-	-	0.61	-

Note: ***Statistically significant at 1%; ** Statistically significant at 5%; * Statistically significant at 10%

First, for the OLS model, variables explain almost 37% of $\ln(\text{Fines})$, and the F-test rejects the null hypothesis that variables in group are not relevant in explaining the dependent variable. In its turn, for the multilevel model, the Likelihood ratio test rejects the null hypothesis that both models provide similar adjustment, confirming that a random coefficient is more adequate. The random intercept variance is significant at 1%, which also arguments in favor of a multilevel model. Furthermore, the intraclass correlation informs that 61% of variance in $\ln(\text{Fines})$ is explained by group-level factors (antitrust cases, in our paper).

Focusing on the multilevel model estimates, the *subsection*'s coefficient is significant at 5% and has the expected sign, informing that being framed by CADE's judges in one additional subsection of Law n° 12.529/11 is related to an increase of 35.51% on the average level of fines. This is an important result for defendants' legal teams, since it indicates that efforts in the sense of reducing the number of subsections may help to decrease the amount of fines defined by CADE. Regarding the variable *duration* the coefficient was significant at 10% with a positive sign, indicating that one additional year of the infringement is associated to 4.40% more on fines. This variable is positively related to the damage caused, which in its turn is related to the criteria of fines setting by the aggravating factors. Finding a statistical and positive coefficient is a valuable result in the sense of increasing the fear of corporations to maintain the infringement over the years. Curiously, our result differs from Connor and Miller (2009) and Connor and Miller (2013), that found no association between the cartel duration and increased penalties.

From the dummy variable *company* we obtained the information that being a ordinary company is related to an increase of 125.82% on fines, statistically significant at 1%. As expressed in Section 2, companies are legally required to provide information on gross sales to base the penalty (when possible), which facilitates the fine setting by CADE after considering the aggravating factors. Moreover, companies tend to be more profitable than unions, associations, and so on, thus it is expectable that they are punished harder, at the same time that

ordinary companies tend to incur in highly “disapproved” infringements, as horizontal collusion, while other types of corporations are usually associated to influence of uniform conduct or abuse of dominant position.

Regarding the market scope, the coefficient of *national* was positive and statistically significant at 1%. An antitrust infringement with national scope is associated to a penalty increase of 229.00%, which was also expected because the greater the market affected the higher tends to be the damage caused, and by consequence the aggravating factors considered by CADE. Lastly, years’ dummies are used to control for specific factors, such as the political and economic environment, CADE’s administrative and legal changes, among other possible aspects. These dummies comprise many distinct issues and it is hard to find direct interpretations for significant coefficients. Since the focus of the paper is on the determinants of antitrust corporate fines in Brazil, we absent from it.

Speaking briefly about the non-significant coefficients, for market scopes, *international* and *state* coefficients are not significant, although present the expected signs. We found that the number of corporations involved in the infringement is not significant in explaining the level of fines imposed by CADE. We expected that the greater the number of corporations the higher would be the damage caused and the severity of the violation, which is directly related to the fines. The coefficient for *collusive agreement* was significant in the OLS model, but not in the random coefficient model. We expected a positive relation between this dummy variable and the level of fines. Despite having the expected sign, coefficients for *leniency* and *TCC* are also non-significant. These policies require that applicants help the investigation with information about the antitrust violation, which could be positively related to the fines applied to other members. In our estimates, the number of corporations and the presence of leniency/TCC agreements are not statistically determinants of fines set by CADE.

V. Conclusions

Considering the increased number of factors analyzed by CADE when imposing a monetary penalty to offenders, understanding which factors are related to the level of fines becomes a crucial task. Based on a multilevel model (random coefficient), the objective of this paper was to analyze the determinants of corporate antitrust fines in Brazil.

Our estimates indicate that the number of subsections of Law nº 12.529/11 and the duration of the infringement are positively related to the level of fines, so as being an ordinary company (in comparison of being another type of corporation). The market scope at international and national levels are also significant in explaining monetary penalties.

The results provide useful information for CADE’s team, researchers, lawyers and interested people in general. On top of that, we highlight the importance of this information for corporations, in the sense of increasing the fear of initiating or maintaining the misconduct. In other words, results contribute to the deterrence effect of antitrust laws, which tends to be the most important goal of anticrime law enforcement. For future research, we suggest the analysis of other possible determinants, including institutional factors. It would be interesting to focus on what is behind the years’ dummies in our model.

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