Economics Bulletin

Volume 39, Issue 3

Evaluating the effectiveness of the Brazilian Leniency Program

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Abstract

This paper sets out to verify if the Brazilian Leniency Program is effective in fighting cartels. The literature has already confirmed the effectiveness of leniency programs in the United States and European Union, but little is known about their effects in emerging countries. A theoretical model provides the long-term prediction of the implementation of an effective leniency program: the average hazard of cartel dissolution increases in the long-run when compared to the short-run. A competing risk model for cartels judged between 1996 and 2017 was estimated, allowing the cartel to end naturally or through antitrust intervention. It was found that the Brazilian Leniency Program is effective in increasing the hazard of cartel dissolution in the long-run, thereby confirming that this policy is effective in destabilizing cartels in Brazil. As fighting cartels is a major concern in Brazil and worldwide, an understanding of the effects of leniency programs is crucial to promoting a competitive environment and preventing anticompetitive activities.

Tha author thanks FAPEMIG for the financial support.
Citation: Lucas Campio Pinha and Marcelo José Braga, (2019) "Evaluating the effectiveness of the Brazilian Leniency Program", *Economics Bulletin*, Volume 39, Issue 3, pages 1860-1869
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Submitted: November 23, 2018. **Published:** August 11, 2019.

1. Introduction

Fighting cartels is a major concern of antitrust authorities around the world. Cartels reduce competition either by price increases or other types of agreement (market division, rotation bids in procurements, and others), which tends to increase prices, reduce allocative efficiency and harm consumers. In the medium/long-run they also tend to reduce incentives to competitive gains, such as cost reductions and innovations. It is no coincidence that cartels are characterized as exercising the most harmful anticompetitive behavior.

Several countries have recently introduced a new tool for fighting cartels, the so-called leniency programs. They aim at reducing sanctions against a cartel member which reports the infringement to the antitrust authority. As reported by Harrington (2008), a well-designed leniency program was first implemented in the United States in 1993, despite the fact that an amnesty program to fight antitrust issues had been in force since 1978. The European Commission introduced its own leniency program in 1996. For a history of leniency programs worldwide, see Spagnolo (2008).

The impact of leniency policies on collusive agreements has become a major field of study in industrial organization. There are, however, two main obstacles when empirical studies are being undertaken. The first is a lack of data, as leniency agreements in general are confidential (at least while in progress) and hard to access. The second was highlighted by Harrington and Chang (2009): because cartels are illegal, they are hidden, thus only those cartels which have been discovered are analyzed. To deal with this problem the empirical literature has developed hypotheses about the cartel behavior and formation before and after the introduction of leniency programs, generally supported by theoretical models and discussion. Significant examples are Brenner (2009), Miller (2009) and Zhou (2016).

This paper focuses on one main question: is the Brazilian Leniency Program effective in fighting cartels? This program was adopted in 2000 and underwent a major review in 2011[1]. It was inspired by the United States policies, which, for example, state that only the first to confess can obtain leniency and that there are Individual as well as a Corporate Leniency Programs. The literature has already confirmed the effectiveness of leniency programs in the United States and European Union, but little is known about their effects in emerging countries. According to CADE (2017)[2], from 2000 to 2017 more than eighty leniency agreements were signed in Brazil, but the number of agreements *per se* does not mean success or failure. A small number of agreements could mean success just because the leniency program deters collusion, but could also mean failure because cartels are not being detected. Similarly, a large number could indicate effectiveness in detecting but ineffectiveness in deterring. As the total number of cartels in Brazil (and worldwide) is unknown, there is no parameter of comparison to check if a leniency program is successful or not, hence the importance of other types of analysis.

The effectiveness of the Brazilian Leniency Program is tested on the basis of Zhou (2016) prediction that the average hazard of cartel dissolution increases in the long-run after the implementation of the program. We conclude that the program is effective and is in fact an invaluable tool in destabilizing cartels in Brazil.

This paper presents new and relevant information on the effectiveness of the Brazilian Leniency Program. It also contributes to the literature by presenting a robust estimation in terms of statistical techniques of survival analysis. As fighting collusion is a major concern

[1] Check CADE (2016) for further details on the Brazilian Leniency Program.

[2] CADE – *Conselho Administrativo de Defesa Econômica* is the Brazilian antitrust authority. In English it is known as the Administrative Council for Economic Defense.

both in Brazil and worldwide, an understanding of the effects of leniency programs is crucial to promoting a competitive environment and preventing anticompetitive activities.

The paper is organized in the following manner. Section 2 contains the theoretical framework and Section 3 the empirical framework. Then the results and discussion are presented in Section 4 and the conclusions in Section 5. The references then follow.

2. Theoretical framework

Harrington and Chang (2009) developed a seminal model associating the total population of cartels (both discovered and undiscovered) with the population of discovered cartels. Their objective was to verify how these populations were related by modelling the birth and death of cartels in heterogeneous industries, from which the impact of an antitrust policy on the total population can then be inferred.

Using Harrington and Chang (2009) as a basis, Zhou (2016) proposed a new theoretical model which focused on the hazard of cartel dissolution. He makes two main predictions, one for the short and the other for the long-term. The complete model can be seen in Zhou (2016).

The first prediction deals with the short-term effects of increasing the detection rate of cartels by adopting a successful leniency program. An increase in the detection rate leads to an immediate fall in the average hazard of dissolution of discovered cartels. That happens because "marginal cartels" which are about to collapse would not form *ex-ante*, which means that the discovered cartels are the stable ones with lower risks of dissolution.

The second prediction is related to the long-term effects. After the immediate fall in the average hazard of dissolution of discovered cartels following an increase in the detection rate, the hazard readjusts to above short-term levels. Stable and long-lasting cartels start to destabilize in the long-run due to the higher detection rate, therefore the discovered cartels tend not to be those that are stable.

3. Empirical framework

3.1.The empirical model

The empirical literature on cartel duration and dissolution hazard is generally included in a context of survival analysis and hazard models[3]. According to Kleinbaum and Klein (2005), survival analysis uses a collection of statistical procedures for which the outcome variable of interest is *time until an event occurs*. In our case, the event of interest is the cartel dissolution.

Cox (1972) proposed the most common hazard model, the well-known *Cox Proportional Hazard Model*. It defines a semi-parametric hazard function to verify the impact of covariates on the hazard rate of some event to occur. However, this model analyzes only one cause of the event (one type of failure), for example the hazard rate of a cancer, of unemployment or the end of a collusive agreement. Zhou (2016) and Levenstein and Suslow (2011) emphasize a crucial issue: a cartel can end for more than one reason. For instance, the reason could involve internal factors, such as betrayal or instability, or external factors, such as an antitrust intervention (the antitrust authority discovers the cartel and punishes the members). It is said that more than one type of failure causes the event, namely *competing*

[3] Key examples are De (2010) and Levenstein and Suslow (2011).

risks. The term comes from the fact that the failures are mutually exclusive, i.e., should one occur then the other cannot happen, they thus "compete" to be the one to cause the event.

The literature has developed means of dealing with competing risks. According to Noordzij *et al*. (2013), there is consensus that the model proposed by Fine and Gray (1999) is the most appropriate method because there is a direct relationship between the covariates and the *cumulative incidence function (CIF)* through the subdistribution hazard models, as presented below.

Assume that T is the survival time span of the cartel, while t is any specific value of T. According to Kleinbaum and Klein (2005), the hazard function $h(t)$ gives the instantaneous potential per time unit for the event to occur, given that the cartel has survived up to time t. Mathematically, it is expressed by the following:

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t | T \geq t)}{\Delta t} \tag{1}$$

This means that $h(t)$ equals the limit, as Δt approaches zero, of a probability statement about survival, divided by Δt (a short interval of time). This is also called the *conditional failure rate*.

The above framework expresses the hazard function when there is one type of failure. Fine and Gray (1999) propose the following specification in a competing risk context for the type 1 failure:

$$h_1(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t | (T \geq t,\ if\ failure = 1) \cup (T < t,\ if\ failure \neq 1)}{\Delta t} \tag{2}$$

This expression is known as the *subdistribution hazard function* for the type 1 failure, while the expression is analogous for other failures. As reported by Austin and Fine (2017), the subdistribution hazard function for a given type of failure of an event is defined as the instantaneous rate of occurrence of that failure in subjects which have not yet experienced an event of that type of failure. In other words, it considers the hazard in those subjects which are either currently event-free or have previously experienced a competing failure. The CIF is obtained by the following:

$$CIF_1(t) = 1 - \exp[-H_1(t)] \tag{3}$$

where $H_1(t) = \int_0^t h_1(t)\, dt$. As highlighted by Austin and Fine (2017), the CIF describes the incidence of occurrence of an event for a specific type of failure while taking competing risks into account.

The estimation of the subdistribution hazard function is similar to the Cox Proportional Hazards Model. The regression is the following:

$$h_1(t|\boldsymbol{x}) = h_{1,0}(t|\boldsymbol{x}) \exp(\boldsymbol{x\beta}) \tag{4}$$

where $\boldsymbol{x}$ is the vector of explanatory variables and $\boldsymbol{\beta}$ the vector of coefficients. The term $h_{1,0}(t|\boldsymbol{x})$ is the baseline subhazard, defined when covariates are set to zero. This term is left unspecified, and this is the reason why this model (and the Cox model) is known as semi-parametric. The estimation of $\boldsymbol{\beta}$ produces the exponentiated coefficients $exp(\boldsymbol{x\beta})$, also known as *subhazard ratios*. They provide the magnitude of the relative change in the subdistribution hazard function in relation to a one-unit change in the given covariate. When

the subhazard ratio is greater than 1 (one) the impact generated by the covariate on the subdistribution hazard function is positive, otherwise (lower than 1) the impact is negative[4].

The objective was to estimate the theoretical predictions presented in the previous Section. They are related to the natural death of cartels, thus this is the failure of interest. The competing risk failure is the antitrust intervention, as explained later. However, to test the short-term prediction a sample would be needed of cartels which were formed and ended before the introduction of the Brazilian Leniency Program to compare with a sample of cartels which started before and ended after the policy was implemented. There are very few cases of cartels which formed and ended before the policy was implemented, thereby making such an estimation unfeasible. On the other hand, the long-term prediction requires a comparison of cartels which started before and ended after the policy was implemented with cartels which started and ended after the policy was adopted. This test is now undertaken.

3.2.The data

The data were collected from files on the administrative procedures of cartel cases in Brazil. These open-access files can be obtained in the CADE (2018). The sample is a cross-section of 68 cases of cartels judged between 1996 and 2017. This study considered only classic cartel cases, where competitors coordinate their actions to reduce competition. These are the cases where a cartel member can apply for leniency[5]. Such cases include gas station, cement, stone and sand cartels and also some world-famous cases, such as the vitamin cartel. How the covariates are constructed is explained below.

The dependent variable is the cartel duration in months (*duration* from hereon). It is assumed that the agreement can end for either of two reasons: naturally or through an antitrust intervention, thus these are the competing risk failures. As information on cartel duration is neither clear nor obvious, many files had to be checked and certain assumptions made. The start date is the month reported in the files or January of the year indicated when the reference is the year (for instance, if the cartel started in 1999, January 1999 is considered). A cartel ends naturally when that is explicitly reported in the files in terms of meetings, phone calls, coordinated actions or procurements and the end date is prior to the beginning of the investigation. It is assumed that the cartel ends through antitrust intervention if there is no information about a previous collapse at the time when the investigation begins. In such cases, the end date considered is the month in which the administrative procedure was registered in the Brazilian system[6].

The covariates are those which can affect the hazard of dissolution of the cartel. The main covariate is the dummy which represents the long-term prediction (*long-run dummy* from hereon). It assumes a value of 0 (zero) if the cartel started before December 2000 (when the law was enacted) and ended after this same date, and a value of 1 (one) if the cartel started and ended after this date. A coefficient which is significant and greater than 1 (one) means that the Brazilian Leniency Program is effective in increasing the hazard of cartel dissolution in the long-run when compared to the short-run, as predicted by the theoretical model.

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[4] This occurs because the subhazard ratios are exponentiated coefficients. Non-exponentiated coefficients (β) are obtained taking the natural logarithm. Assume a general x, when $\exp(x) > 1$ then $ln[exp(x)]$ is positive, and when $\exp(x) < 1$, $ln[exp(x)]$ is negative.

[5] We consider that the Brazilian Leniency Program only impacts cartels. There are cases where associations, unions or trade associations influence certain classes of workers or firms to act together. These can be considered cartels; however, in such cases only the association is punished. There is no room for leniency in these cases.

[6] To check robustness, the same statistical procedures, considering the final judgment date to be the end date of the cartel, were undertaken. However, results were quite similar to those presented below.

The other explanatory variables are divided into three categories: cartel characteristics, severity of anti-cartel enforcement and the economic environment. There are four variables for the cartel characteristics: 1) number of companies and individuals involved in the infringement and punished (*number of members* hereafter) - it is expected that the greater the number of participants the riskier the agreement; 2) number of subsections of Brazilian Law 8.884/94 in which the cartel is involved (*number of subsections* hereafter) – it is expected that the greater the number of violations the higher the risk of a cartel collapse; 3) a categorical variable indicating the range of the relevant market in which the cartel operated (*relevant market* hereafter) – it is expected that the broader the range of action the greater the hazard of dissolution; 4) a dummy indicating whether the cartel acted in a normal market or in procurements (*market or procurement dummy* hereafter) - no *ex-ante* predictions about the impact on the hazard of dissolution.

For the severity of anti-cartel enforcement, the variable is the number of cases judged in the year the cartel ends (*number of cases* from hereon). It is expected that the greater the severity of antitrust action the higher the risk of dissolution. Finally, the economic environment is represented by a dummy which assumes a value of 1 (one) if the cartel underwent the crisis of 2008 (started before September 2008 and ended after this date), and 0 (zero) otherwise (*crisis of 2008 dummy* hereafter)[7]. As Rotemberg and Saloner (1986) argue that collusion is harder to sustain when demand is relatively high, it is expected that if a cartel underwent the crisis, the hazard of dissolution decreases (it is easy to remain faithful to the agreement in a recession period).

4. Results and discussion

Table 1 presents the descriptive statistics of the discrete covariates. It is worth noting the variability of cartel duration, that is, a standard deviation greater than the mean, with the minimum duration being one month and the maximum 272 months. Another valuable item of information is that there is a relevant number of companies and individuals involved in the cartel on average. In terms of the dummies and the categorical variable we have the following: *long-run dummy* - 38% of the cartels started before and ended after the Brazilian Leniency Program was adopted (value zero) and 68% started and ended after its implementation (value one); *market or procurement dummy* – 78% of cases occurred in normal markets (value one), while 22% operated in procurements (value zero); *crisis of 2008 dummy* – around 21% of the sample underwent the crisis (value one), while 79% of cartels started and ended before this date or started and ended after this date (value zero); *relevant market* – around 57% of collusive agreements operated in cities (value one), 13% in states (value 2), 21% in the whole country (value three) and 9% internationally (value four).

[7] This date was chosen because of the bankruptcy of the Lehmann Brothers in September 2008.

Table 1. Descriptive statistics of discrete covariates

	Mean	Standard deviation	Min.	Max.
Duration (months)	50.91	56.70	1	272
Number of cases	1.59	2.63	0	13
Number of subsections	5.25	2.27	2	11
Number of members	12.93	9.72	2	51

Source: Research Results.

The main results are now presented. Table 2 shows the subhazard ratios while Table 3 presents the non-exponentiated coefficients (which indicate whether the impact is positive or negative, all else being equal). The Wald test indicates a *p-value* of 0.00, which confirms the joint significance of the variables in explaining the hazard model.

The covariates *number of members*, *number of subsections, relevant market* and *number of cases* are not significant, that is, the three explanatory variables related to cartel characteristics and the one explanatory variable related to severity of anti-cartel enforcement. On the other hand, the *market or procurement dummy* is significant and negatively associated with the hazard of dissolution. The fact that a cartel operates in the market rather than in procurements reduces the instantaneous rate of dissolution, which means that market cartels run less risk of ending naturally. One possible explanation is that normal cartels tend to operate indefinitely and have more ways of maintaining the agreement solid and stable, which include acts of concealment, periods of no contact between members, and other acts. Procurement cartels demand that there are procurements (if there is no procurement the cartel ends naturally) and it is harder to find ways of maintaining the stability of the agreement (there is not much that can be done other than maintaining contact and arranging the bids), which makes it riskier.

The covariate *crisis of 2008 dummy* is also significant and negatively related to the hazard of dissolution, as previously predicted. That means that collusive agreements which underwent the crisis present less risk of ending naturally, mainly because changes in the economic environment strengthened the cartel by reducing the gains of deviation.

Table 2 – Subdistribution hazard model estimates – subhazard ratios

	Subhazard ratio	**z-statistic**	**p-value**
Long-run dummy	2.35** (0.90)	2.24	0.02
Number of members	1.00 (0.02)	0.03	0.98
Number of subsections	1.00 (0.08)	-0.06	0.95
Relevant Market	1.05 (0.18)	0.29	0.77
Market or procurement dummy	0.24*** (0.08)	-4.03	0.00
Number of cases	1.09 (0.09)	1.12	0.27
Crisis of 2008 dummy	0.18*** (0.10)	-2.99	0.00

Note: Standard deviation in parentheses. ***Significance of 1% **Significance of 5%.
Source: Research results

Table 3 – Subdistribution hazard model estimates – non-exponentiated coefficients

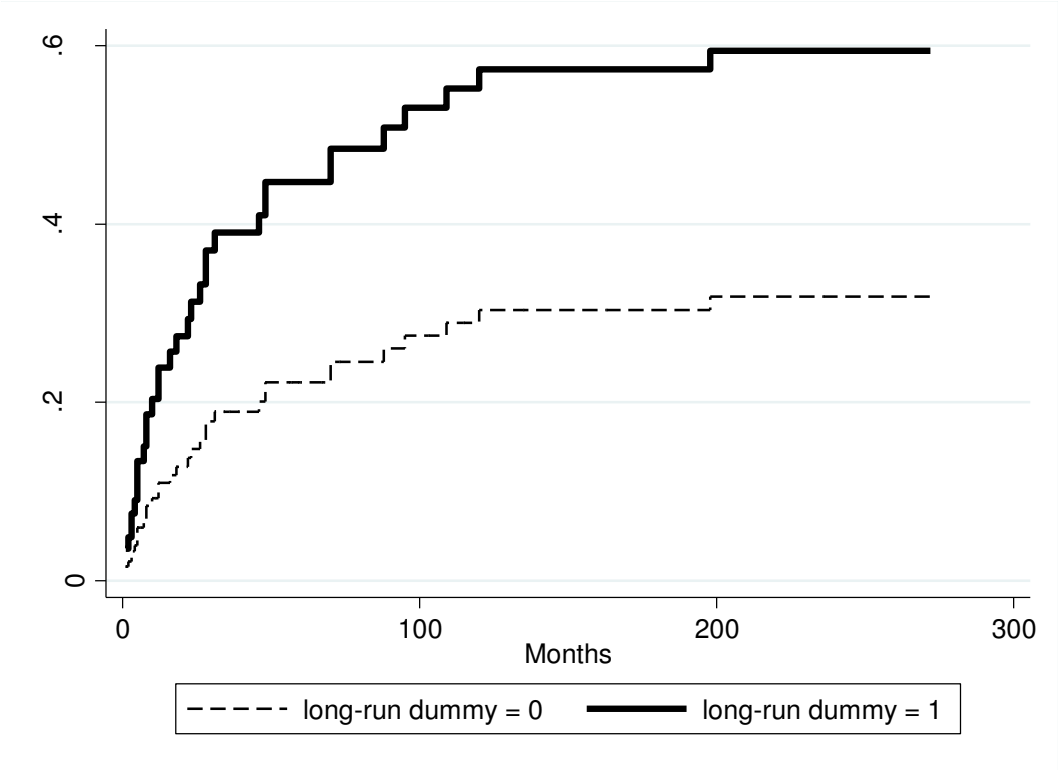
	Coefficients	**z-statistic**	**p-value**
Long-run dummy	0.86** (0.38)	2.24	0.02
Number of members	0.00 (0.23)	0.03	0.98
Number of subsections	0.00 (0.08)	-0.06	0.95
Relevant Market	0.05 (0.17)	0.29	0.77
Market or procurement dummy	-1.44*** (0.37)	-4.03	0.00
Number of cases	0.09 (0.08)	1.12	0.27
Crisis of 2008 dummy	-1.73*** (0.58)	-2.99	0.00

Note: Standard deviation in parentheses. ***Significance of 1% **Significance of 5%.
Source: Research results

The variable of main interest is now considered. The *long-run dummy* subhazard ratio is significant and greater than one, thus it positively impacts the instantaneous rate of risk of dissolution (as presented in Table 3). That means that the Brazilian Leniency Program is effective in accordance with the long-term prediction. In other words, a collusive agreement which started and ended after implementation of the policy is associated with a 135% increase in the instantaneous rate of cartel dissolution when compared to cartels which started before and ended after the Brazilian Leniency Program was adopted, with all else remaining constant.

As highlighted by Austin and Fine (2017), an alternative means of looking at this result is to interpret the covariates as influencing the CIF. That allows for a comparison between the cumulative incidence of the occurrence of a natural cartel break in any covariate setting. As the main interest is in the *long-run dummy* two CIF curves are estimated, one for the value of each dummy. The other explanatory variables are set at the mean of the data set. The CIF curves are presented in Figure 1.

Figure 1. Cumulative Incidence Functions (CIF) for *long-run dummy* values



Source: Research results

When the dummy is 1 (one) the CIF is always higher than when the value is 0 (zero), which corroborates the previous result, i.e., the hazard of natural dissolution is higher when the dummy is 1 (one). For cartels which started before and ended after the Brazilian Leniency Program was adopted (*long-run dummy* = 0) the risk of a cartel collapsing within 50 months is close to 20%, and roughly 25% within 200 months, *ceteris paribus*. On the other hand, for cartels which started and ended after the policy was implemented (*long-run dummy = 1*) the risk of dissolution within 50 months is almost 40%, 45% within 100 months and nearly 60% within 200 months.

This study found that the Brazilian Leniency Program is effective in increasing the hazard of dissolution of a cartel in the long-run when compared to the short-run, as predicted by the theoretical model when an effective antitrust policy is implemented. To sum up, this policy is efficient in destabilizing cartels, which is desirable in any antitrust enforcement. When compared to the literature on the topic, these results corroborate those found by Miller (2009) for US, Choi and Hahn (2014) for South Korea, Zhou (2016) for the EU (after the 2002 reform) and US and Yusupova (2017) for Russia (after the 2009 reform).

5. Conclusions

Policy evaluation is a key issue in empirical economic analysis. Anti-cartel policies aim to increase the rate of cartel detection and reduce the formation of cartels through destabilization and/or non-profitability. The main problem is that the total number of cartels is unknown, i.e., only those uncovered are observable, thus the literature had to develop models which allow one to infer the total population of cartels from information available about those that are known.

The starting point of this paper was the short-term and long-term theoretical predictions. Due to a lack of data, the short-term test was unfeasible, hence the study focused on the long-term prediction. It was found that the Brazilian Leniency Program was effective in increasing the hazard of cartel dissolution in the long-run when compared to the short-run, which is consistent with the destabilizing capacities of a successful intervention.

The results of this study contribute to an understanding of this policy in Brazil, however the debate is far from over. Many aspects of the leniency program both in Brazil and globally are being discussed with a view to improving its effectiveness. One such aspect is the interplay between the Brazilian Leniency Program and private damage claims and the length of proceedings in Brazil, which tend to harm the effectiveness of anti-cartel policies. As a suggestion for future studies such topics could be analyzed.

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