The Role of Loan Forbearance in the Recovery of Financially Distressed Firms

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Abstract

This paper investigates the effect of borrower-lender renegotiation of debt terms (loan forbearance) on the recovery of financially distressed firms. Based on a novel proprietary database of a large Brazilian bank, we estimate a dynamic difference-in-difference model to compare the revenue of firms before and after forbearance, having as counterfactuals matched pre-forbearance non financially distressed firms. We find no change in financial-distressed firms' revenue in the first year after forbearance, but we identify signs of recovery in these firms' revenue in the second year. However, firms that do not fulfill forbearance terms suffer continuous deterioration of revenue after financial distress. Our results suggest that forbearance helps firms with seemingly sound projects that face temporary financial distress.

Keywords: loan forbearance, financial distress, recovery, performance.
JEL classification: G21, G34

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1 INTRODUCTION

This paper investigates the effect of borrower-lender renegotiation of debt terms (loan forbearance) on the recovery and survival of financially distressed firms. Financially distressed firms that do not comply with their debt obligations try to renegotiate the debt terms with their lenders aiming to avoid defaulting (Heaberlin, 2009). As a result of the renegotiation, new debt terms are agreed upon, and a forbearance agreement amends the existing terms of the loan. It may include temporary postponement of the loan payments, interest payment only, maturity extension and a working-capital loan to finance the firm's everyday operations (Mitchell, 2001; Arrowsmith et al., 2013). Once a borrower and a lender reach an agreement, a sustainable payment flow is settled to help the firm to meet its financial obligations and to continue to operate.

Using a novel and unique proprietary database of a large Brazilian bank, we evaluate the performance of firms before and after a loan forbearance, having as counterfactual firms that did not present signs of financial distress. We document an improvement in the firm's performance within two years after forbearance, but we identify no signs of recovery during the first twelve months. Further, by examining how the forbearance agreements evolve overtime, we find a continuous deterioration of the performance of firms that default on the forbearance terms or contract a second forbearance.

Precisely, our database contains detailed information on small and medium-sized firms that have renegotiated with that large bank in Brazil[1], as well as on similar companies that have credit operations and which have not made any type of renegotiation, used here as counterfactual. We use the firms' gross revenues as a performance indicator and monitored throughout all the periods observed. We include variables of the sector of activity, region, and size as characteristics of the companies. Our original database contains 39,356 companies, of which 6,636 have carried out renegotiations whereas 32,720 have not. These companies are followed for 5 years, from January-2016 to June-2019. Based on this dataset, we analyze small and medium-sized firms that had their debt forborne in the period between January-2016 and June-2017, by comparing their performance through the subsequent years after forbearance with the ones of similar firms that had credit operations with the bank but did not go through renegotiations in the same period.

Note that our dataset is interesting for important reasons. First, it contains loan-contract level data and measures of firms' performance for small and medium-sized enterprises (SMEs), a dataset which is quite rare given SMEs' opacity and the lack of systematic loan-level and performance data for small businesses (Rajan and Zingales, 1998; Berger and Udell, 1998;

[1] The large bank in Brazil which provided us its proprietary data has more than 10% market share, considering the balance of the credit portfolio in the financial sector in Brazil.

Beck and Demirguc-Kunt, 2006; Hyytinen and Pajarinen, 2008, DeYoung et al., 2015). Second, it comprises detailed information on all loan agreements signed between the bank and their corporate borrowers on those evolve overtime. That allows us not only to evaluate firm's performance before and after forbearance, having as counterfactual the non-financially distressed, but also to examine the consequences on firm's performance of subsequent request of loan forbearance to a bank. From the best of our knowledge, none of the previous studies on loan forbearance, summarized in Caballero et al. (2008), Arrowsmith et al. (2013) and Acharya et al. (2019, 2020), contain such detailed data neither analyze the effect of non-compliance with the forbearance terms.

Our database is restricted to the period from January-2016 to June-2019, which was the period that the large bank in Brazil made the data available to us. This time frame has an attractive feature: it is within the Brazilian Crisis of the last decade that started in 2015. That allows us, as Duchin, Ozbas and Sensoy (2010), an influential study of the 2008–2010 Global Financial Crisis (GFC), to treat the crisis as the negative shock to companies in Brazil, where the credit market suffered a major impact on loan reductions and an increase in defaults between 2015 to 2019.[2]

We estimate the effect of the loan forbearance on firms' performance using a two-stage estimation approach.[3] In the first stage, we match each firm with a forborne loan in a certain period with firms in the control group (with no forbearance) that were similar to the firms in the treatment group (with forbearance agreements) two years before the forbearance event. The treatment group is, therefore, formed by the companies that carried out a renegotiation in the periods already mentioned.[4] All the companies are followed up 2 years after the renegotiation event. The companies were identified as similar by using two methods: first, matching on observables, by using the revenues and characteristics of the companies observed two years before the event to define the pair (matching approach), and second, the propensity score matching approach.[5]

In the second stage, we estimate a dynamic difference-in-difference model (also known as difference-in-difference event study) to compare the revenue of firms before and after forbearance, having as counterfactuals matched pre-forbearance non financially distressed

[2] Specifically, for small and medium-sized enterprises, the volume of bank loans that were classified as problematic assets grew rapidly, until its stabilization in the second half of 2016, followed by a downward trend in early 2017. See Banco Central do Brasil (Relatório de Estabilidade Financeira, Vol.17, N.2, October 2018).
[3] A loan forbearance is usually a non-random process. It creates a challenge the estimation of its effects on a company's performance, as standard econometric methodology (like ordinary least squares and the traditional differences method) may produce skewed estimates of the effects to be inferred.
[4] The approach of the first stage is also known as the case and control method. For this, see Schlesselman (1982).
[5] For the propensity score matching approach, see Deheji and Wahba (2002).

firms. This approach has been used in recent studies in Economics, as in Deryugina (2017), Dobkin et al. (2018), and Athey and Imbens (2018).

Based on the event-study difference-in-difference approach, we estimate the effect of forbearance on firms' performance in the periods before and after forbearance. We find no improvement in the first year after forbearance, but in the second year it was possible to identify signs of recovery in the firms' performance that settled the forbearance operation, given that the difference between the revenues of these companies and those of the control group stabilizes. For companies that stop paying the renegotiated debt or that make a new renegotiation deal, a continuous deterioration in performance is identified even after the renegotiation, observed by an increase in the difference between the revenue of these companies and those of the control group.

Through these results, we conclude that renegotiations help companies which were solvent and are going through a difficult financial time to recover. The companies which execute a renegotiation and continue to deteriorate, apparently, were already insolvent even before the renegotiation process, therefore the readjustment of the cash flow does not help these companies to recover.

Our paper contributes to the loan forbearance literature in very important dimensions. First, from the best of our knowledge, it is first paper in the literature that uses data on actual forbearance agreements and firms' performance to analyze the link between borrower-lender renegotiation of debt terms (forbearance) and the recovery of financially distressed firms. Most of the existing papers center on assessing the impacts of bad renegotiations (insolvent companies) on the economy and the financial system, incentives that banks must renegotiate debts and how the banking relationship can help firms out of financial problems (Caballero et al., 2008; Arrowsmith et al., 2013; Bolton et al., 2016; Acharya et al., 2019, 2020). Differently, we evaluate the effect of debt loan forbearance on companies and their performance by assessing whether companies which carry out renegotiations manage to get out of financial pressure with the help of a forbearance agreement. Note that our analysis focuses on small and medium-sized financially distressed firms, which are usually opaque firms and for which data on loan forbearance and performance is rare (DeYoung et al., 2015).

Although quite rich in terms of information on loan forbearance, one may note that our dataset starts in January-2016, one year after Brazilian Crisis of the last decade started. This constraint may suggest that we are analyzing firms which are more resilient to shocks in 2015 that did not withstand the economic deterioration of the crisis' first year. It perhaps implies that our findings on the effect of loan negotiation on firms' performance may apply to firms which are less

susceptible to going bankrupt and exiting the market. However, our findings are still important and novel pieces of evidence for the loan forbearance literature.

Second, our analysis relies on loan-forbearance-level data which allows us to precisely measure forbearance agreements and their impact on each firm thereafter. Differently, previous studies (Peek and Rosengren, 2005; Caballero et al., 2008; Fukuda and Nakamura, 2011; Arrowsmith et al., 2013; Acharya et al., 2019) use indirect indicators for loan renegotiation, such increases in loans to firms with poor financial performance, interest expenses or operational margins below the risk-free rate, inaccurate measures of forbearance, to identify probable firms that had their bad loans terms renegotiated.

Third, our findings reconcile the two apparently contrasting existing evidence of loan forbearance effects on future business performance. One branch of the literature, as Mitchell (2001), Fukuda and Nakamura (2011), and Bergant and Kockerols (2019), argue that forbearance can allow some viable firms to stay in business through the difficult times and recovery in the long run. Yet, in another branch of the literature, as Caballero et al. (2008); Arrowsmith et al. (2013), Acharya et al. (2019, 2020)[6], find that loan renegotiation opens a room evergreening practices which refers to banks' strategy to forbear instead of liquidating a bad loan as it maximizes its assets value, thereby allow the firms with a negative present value keeps operating, although knowing that these firms will continue underperforming in the future.[7] Our results shed some light on this debate as it indicates that when banks can precisely identify firms with good projects, loan forbearance helps companies with sound projects that were experiencing a temporary financial distress. Yet, when banks cannot perfectly foresee a negative net present value of financially distressed firms, we document that forbearance does not aid the recovery of companies. These findings indicate, by the first time, that banks screening technology in identifying firms with sound projects is an important key for the success of forbearance agreements. In particular, it suggests that bank's inaccurate screening technologies may lead banks to forbear instead of liquidating a bad loan to firms. Worse screening technology may also be associated with banks with more distressed credit, thus

[6] Caballero et al. (2008), Arrowsmith et al. (2013) and Acharya et al. (2019, 2020) find that banks' evergreening practice in Japan has caused erosion of the economy's supply potential, lower job creation, productivity, efficiency and competition as well as slower economic recovery from crisis. Caballero et al. (2008) establish that banks are involved in unprofitable loan restructuring, keeping credit flowing to insolvent companies, and document a large persistent gap of productivity between rescued and other firms in industry and smaller profits even with more sales. This behavior leads to the congestion of credit sources, thus reducing profits for healthy companies.6 Acharya et al. (2020) find that an increase in forbearance is associated with a positive impact in sales but with lower competition, lower margins, and lower prices. Further, excess production capacity induced by "zombie credit" has a disinflationary effect due to downward pressure on profit margins (Acharya et al., 2020).

[7] Another stream of the literature argue creditors may not accurately evaluate the debtor's project quality due to asymmetric information. Hence, depending on the causes of firm's difficulties, forbearance may induce good or bad results to the firm and lender (see Kobayashi, 2002; Peek and Rosengren, 2005; Mitchell, 2001; Bergant and Kockerols, 2019; Giannetti and Simonov, 2013; Inoue et al., 2008; Watanabe, 2010; and Mourad, 2019).

giving a complementary reason for these banks to have higher probability to grant forbearance and issue less new credit as documented by Bergant and Kockerols (2019).

Lastly, but not least, our paper also contributes to the literature on bank lending behavior during crisis. For instance, Bolton et al. (2016) study how banks offer continuation lending, a kind of loan forbearance agreement, during the 2008–2010 Global Financial Crisis (GFC). Using data from the Italian credit register, they find that relationship banks charge a higher intermediation spread in regular times but offer continuation lending at more favorable terms than transaction banks to profitable firms in a crisis. Our paper differs from Bolton et al. in two important dimensions. First, Bolton et al. examines how the cost of relationship lending vis-à-vis transaction lending varies over the business cycle, while we investigate what happens to firms' performance after a loan forbearance. Second, by focusing on loan forbearance and firms' performance during the Brazilian Crisis of the last decade, we look at the effect of a larger set of possible bank renegotiation of debt terms than only bank continuation lending analyzed by Bolton et al. Another related paper in the same literature is Maturana (2017). By exploiting exogenous variation in the incentives to modify securitized non-agency loans, Maturana examines mortgage loan modifications (i.e., forbearance) during the housing crisis of 2008, and quantifies the effect of loan modifications on loan performance. He finds that the marginal benefit of modification likely exceeded the marginal cost. Our paper shares an important similarity with Maturana: we both consider a large set of bank loan renegotiations in our analysis. However, our papers differ in two aspects. First, Maturana focuses on bank renegotiation of loans to households (i.e., mortgages), while we look at renegotiation of corporate loans. Second, and more importantly, Maturana investigates loan performance and the benefit of modification to banks, while we examine the potential benefits of loan forbearance for firms to stay in business through the difficult times and to recovery afterwards.

The remaining of this paper is organized as follows. Section 2 presents our data set, the methodology and the empirical strategy. Section 3 shows the results and the robustness checks. Section 4 concludes the paper. Additional supporting materials can be found in Appendix A and B.

2 DATA BASE AND METHODOLOGY

To empirically assess the causal effect of a debt renegotiation on a variable of interest, the revenue of two groups of firms is compared: the group of companies that undertook a debt renegotiation at a certain point in time is the treatment group, and the group of companies that did not carry out any debt renegotiation over the period analyzed is the control group. The causal effect will be estimated by using a difference-in-difference approach through which the

forbearance effect is estimated by the difference in the temporal variation (before and after a debt renegotiation) of the variable of interest between the companies in the treatment group and the control group. For simplicity, a renegotiation event (or simply an event) is the moment when a company performs a renegotiation. Note that, for the estimated effect to be attributed to the renegotiation event, the groups must be similar before the event occurs, either in terms of the variable of interest or regarding their characteristics.

In this section, the database construction process, the criteria used to select the samples, and the empirical method will be described.

2.1 Database

We built our database from a proprietary dataset provided by a large bank in Brazil, which contains information on all its credit operations with non-publicly traded companies of micro and small size operating in Brazil from January 2016 to June 2019. Regarding credit operations, they include information on their type, amount, and days of debt arrears. In addition, the dataset includes other information about those companies, which includes size (micro or small size), industrial sector, geographic location, credit risk (rating) and revenues (as a performance indicator).

The database comprises detailed information on firms that renegotiated their credit operations with this bank, and information on their loans. Further, it contains information on firms complied with their debt obligations with the bank. These latter will be used as counterfactual. The original database has 39,356 companies, of which 6,636 have carried out renegotiations whereas 32,720 have not. Our data set focuses on the small and medium-sized firms, which are normally opaque firms for which data on loan forbearance is very rare.

2.1.1 Description of the variables

Following the regulatory norms of the Central Bank of Brazil, the credit operations in the country and also in our dataset are classified into three types: (i) loans lost, which are credit operations that are overdue and have not been renegotiated; (ii) renegotiations, or forbearance agreements, which are credit operations made after an operation is overdue or, when the bank identifies, even in an up-to-date operation, that a company has a high probability of delaying payments, thus inducing the bank to anticipate the offer of a renegotiation operation; and (iii) loans-financing, which are all other credit operations that are not classified as renegotiation or lost. In this paper, we focus only on the credit operations classified as renegotiations/forbearance agreements to assign companies into treatment group, and loans-financing operations to keep track the performance of the companies classified as control.

Note that, according to the Central Bank of Brazil definition and used by the financial institutions in Brazil, forbearance is a concession made by a bank to a borrower who is in financial difficulty. It includes debt composition, extension, renewal, granting of a new operation for partial or full settlement of a previous operation, or any other type of agreement that implies a change in the maturity terms or payment conditions originally agreed.

Our dataset also has information on companies' annual revenues, which is obtained from companies' Income Statement (DRE) and certified by the Brazilian Tax Authority (Receita Federal) through the annual's corporate income tax returns (IRPJ). We deflated annual revenues/sales by using June / 2019 as base, which is the most recent month / year in the database, considering the IPCA inflation index. We believe that other variables would be more suitable than Revenues to measure the actual firm's performance, such as ROE (Return on Equity), Net Margin and EBIT (Earnings Before Interest and Taxes). However, our database does not have any information on costs, expenses, or depreciation. For the analysis, the natural logarithm of the actual revenues will be used; Note, however, we will keep using the name *Revenue* for the natural logarithm of the actual revenues to ease understanding.

Another piece of information available in our dataset is the company credit score rating. It is a scoring grade given by a bank to each company according to the company's default probability. In line with the rating range, companies can be grouped into risk levels according to their probability of default, with the highest risk level (lowest scores) being the one with the highest probability. For reasons of confidentiality, the ratings and their respective default probabilities will not be disclosed.

The macro sectors are divided into categories according to the Brazilian CNAE official code.[8] The two-digit code was used as a category, in which includes 87 different groups. Our database contains 20 distinct macro sectors, and this is due to two factors: some CNAE groups are consolidated into a single category, thus reducing the number of internal categories; the institution does not grant credit to some categories considered to be high risk, which also reduces the number of categories in the base. Geographic location is another information about the company in our dataset. The geographic regions are divided into 10 categories according to the first digit of the zip code (CEP - Source: The Brazilian Postal Service).

The size of the companies was defined based on the observation of nominal revenue two years before the event. Two classifications were used: micro-companies (ME), with annual sales of

[8] The CNAE (National Classification Code for Economic Activities) is the classification officially adopted by the National Statistical System to produce statistics by type of economic activity; it is also adopted by the Public Administration, to identify economic activity in databases and records of legal entities. Source: The Brazilian Institute of Geography and Statistics - IBGE.

up to US$ 72 thousand; and small companies (EPP), with annual sales of between US$ 72 thousand and US$ 960 thousand.[9]

Another important piece of information from our dataset is the status of the renegotiation/forbearance. For companies that renegotiate (i.e., under forbearance agreement), the status of this operation will be observed in the second period after the renegotiation: if the operation was liquidated, the status will be "Liquidated"; if the transaction is still being paid, the status will be "Paying Reneg"; if the renegotiation operation was delayed and the company made a new renegotiation operation, the status will be "New Reneg"; and lastly, if the company was unable to pay the renegotiation and did not make a new renegotiation operation, this operation was accounted for as a loss or an agreement was made, and the status will be "Loss." The status variable of the renegotiation operation will be used in the analyses, and it was built from the modality information and days of contract delay.

2.1.2 Database development criteria

For the treatment group, companies that carried out renegotiation deals from January / 2016 to June / 2017 were considered. For this same period, companies that had credit operations with the bank, but did not renegotiate were selected, thus constituting the control group. The renegotiation analysis period was defined due to the history available in the bank's database.

To allow for a follow-up of the evolution of the revenues in both groups, the characteristics of the companies and their credit operations were observed in the two previous years and in the two years after the month the renegotiation event occurred. The oldest date available in the database is January / 2014, so the first event observed occurred in January / 2016. The most recent data available is June / 2019, so the last observed event occurred in June / 2017.

Figure 1 graphically represents the periods related to the event and which characteristics will be observed in each period. The 2nd period before the event is called t-2, the 1st period is called t-1, the event period is called t0 and so on. Each period lasts for 1 year. Note that, in order to estimate the effect of renegotiations on the performance of companies, it is necessary that companies that have undergone renegotiation (treatment group) and companies that have not undergone renegotiation (control group) are similar in the pre-renegotiation period. By ensuring that there are no pre-existing differences and trends, we will be able to associate companies' performance with renegotiation.

[9] The revenue limit for micro-companies (ME) was defined in January 2012, and for small companies (EPP) as of January 2018. Source: Receita Federal, Portal do Simples Nacional (The Brazilian Internal Revenue Service).

[Figure 1 Here]

For this purpose, only those companies that did not show signs of financial deterioration in the periods prior to treatment will be kept in the database; therefore, the information on the type of credit operation, days of operation delay and rating will be used. For the control group, only companies that have never shown signs of financial deterioration will be maintained, and ergo filters will be applied over more periods for this group.

The inclusion criteria for the companies in the control and treatment groups are: 1) not having made a renegotiation, agreement or entered a loss in t-2 and t-1. This filter was made to ensure that the treatment (renegotiation event) occurred only in t0 for the treatment group, and that companies that were already financially deteriorated would not remain at the base (with an agreement or turning a loss); 2) not being classified as a high-risk rating at t-2. Due to the high probability of default associated with the high-risk range, these companies were removed from the sample; 3) have at least US$ 200 worth of debt with the bank in any product in t-2. This value has been set to eliminate companies that strike few transactions with the bank from the base, which makes revenue information less accurate; 4) debt must be paid or 10 days late at the most in t-2. Companies with more than 10-day overdue loans are more likely to deteriorate financially, which is why they were removed from the base; 5) minimum revenues of US$ 2 thousand and maximum of US$ 6MM in all periods. This filter was created due to inaccuracy of revenues below U$$ 2 thousand, as it is not the bank's standard customer profile and there are few observations in the database. Companies classified in t-2 as micro or small enterprises and those in some later period exceeded US$ 6MM in revenues were excluded, as there is a high probability of being classified incorrectly in t-2.

Specifically, for the treatment group, only renegotiation operations with a maximum of a 59-day delay were kept in the database. After 60 days of delay, operations are considered to have turned into a loss, and revenue information does not necessarily continue to be updated in the databases. As the performance variable cannot be considered reliable for this group, these companies were removed from the sample.

Additional filters were created in the control group to ensure that only companies that did not show signs of deterioration in any period would be kept in the sample. Thus, companies which had their financial obligations overdue for more than 10 days and renegotiated over the observation period were removed from the sample. The companies that renegotiated over the entire period were removed from the sample, as for these companies there will be no pre-renegotiation period. Of the companies that delay their payments more than 10 days, only 34%

settle their situation, getting back on track or paying off the debt. The others will make a renegotiation deal, an agreement or turn a loss. As this group of companies (delaying more than 10 days and pay on the due date) corresponds to a small number of observations (it would represent only 2% of the control group if maintained), we have decided to remove it from the sample. Therefore, the control group is formed by companies that always paid their debts on the due date or that were 10 days in arrears at the most. In addition, companies should have had at least a US$ 250 debt with the bank in t0, to ensure that the company had a relevant contract in the same period that the treatment group companies were renegotiating.

2.2 Matching

As the database contains companies from different macro sectors and regions, and revenues may vary within a wide range (from US$ 5 thousand to US$ 960 thousand), we decided to use methods to identify similar companies in the control and treatment groups.

The companies were identified as similar by using two methods: matching on observables, using the revenues and the characteristics of the companies observed 2 years before the renegotiation/forbearance event to define the pairs of firms that are treatment-control (matching approach); and propensity score matching (PSM).[10] The characteristics of the macro sector, region and size obtained in t-2 (2 years before the event) were also used as variables for matching.

The observables matching was made by randomly choosing a control-group company for each treatment-group company as a pair, both belonging to the same macro sector, region and size in t-2, and whose revenues were as close as possible in t-2. To properly select the members of a control-treatment pair, the indicator given by the ratio between the revenues minus one was used, and the pairs whose indicators were closer to zero were prioritized. Two companies in the treatment group and the control group were considered paired when the difference between their indicators is less than a standard deviation.

The PSM was performed by maintaining control for each treatment, according to the characteristics observed in t-2, and using the nearest neighbor method. This method selects the best control matches for each individual in the treatment group by using the logit distance as a distance measure. The variables of macro sector, region and size in t-2 were also used for matching, hence companies of different sizes cannot constitute a control-treatment pair.

2.3 Empirical method

To estimate the effect of loan forbearance on the recovery of financially distressed firms, we estimate a dynamic difference-in-difference model (also known as difference-in-difference

[10] The statistics were built by utilizing R 3.4.3 (R Core Team, 2017) and MatchIt package (v3.0.2; Ho, Imai, King, Stuart amd Whitworth, 2018).

event study) to compare the revenue of firms before and after forbearance, having as counterfactuals matched pre-forbearance non financially distressed firms. It is an important and useful approach for our study as it evaluates treatment effects of the pre- and post-forbearance/renegotiation periods. Hence, it allows for an ease visualization and assessment of the results in relation to the renegotiation date.[11] This model is like the traditional difference in differences methodology in the sense that is estimate the effect of a treatment (in our case, forbearance) by comparing what we see for the treated group after treatment against our best guess at what the treatment group would have been without treatment. However, in the case of the dynamic difference-in-difference model, the causal effect will not be held constant by one or two coefficients after treatment, as is the standard approach of the differences in method differences. In the dynamic difference-in-difference the effects of treatment will be estimated at each time point. Therefore, the effects will be assessed in the periods before and after treatment, thus making it possible to observe if the control and treatment groups already showed any significant differences even before the occurrence of the event.

We have included fixed effects for the years in order to control possible economic shocks in the period that could affect company revenues and also fixed effects for companies to control time-varying influences (such as region and macro sector, which generally do not vary over time). The estimated model has the following form:

$$Y_{it} = \alpha + \theta_{ij} + \gamma_t + X_{it}\mu + \beta_1 D_{i,t-2} + \beta_2 D_{i,t-1} + \beta_3 D_{i,t+1} + \beta_4 D_{i,t+2} + \varepsilon_{it}\,, \quad (1)$$

in which, Y_{it} is the revenue of company *i*, of the treatment-control pair *j* in period t, θ_{ij} is the fixed effect of the pair, which indicates whether company *i* belongs to pair *j*, (see Appendix A for more information), γ_t are fixed effect coefficients in the periods (dummy variables from 2014 to 2019), X_{it} is the vector of the region and macro sector control variables, $D_{i,t-2}$, $D_{i,t-1}$, $D_{i,t+1}$ and $D_{i,t+2}$ are the period indicator variables related to the event for the agreements and ε_{it} is the error term. The variables $D_{i,t-2}$, $D_{i,t-1}$, $D_{i,t+1}$ and $D_{i,t+2}$ assume the value 1 only for a company *i* in the treatment group solely when that observation corresponds to the analyzed period. For example, for the observation of company XYZ's revenues 2 years before treatment (i.e., in t-2), such variables would assume the following values for company *i* of the treatment group: $D_{i,t-2} = 1$; $D_{i,t-1} = 0$; $D_{i,t+1} = 0$; $D_{i,t+2} = 0$, and zero for the other companies. For this company's control-treatment pair, control group, all variables would equal zero. The coefficients β_1 and β_2 are the estimates of the effects of renegotiation 2 periods (t-2 and t-1)

[11] This approach has been used by Deryugina (2017), Dobkin et al. (2018) and Athey and Imbens (2018).

after treatment, and β_3 and β_4 are the estimates of the effects of renegotiation 2 periods (t-2 and t-1) before treatment.

To assess whether there is a difference in the effect of renegotiation for companies of different sizes, it was decided to include these effects separately in the equation. Thus, equation 1 will be expanded, replacing the variables $D_{i,t-2}$, $D_{i.t-1}$, $D_{i,t+1}$ and $D_{i,t+2}$ with the variables indicating a period related to the event (period indicator variables) according to a company's size, as follows:

$$\begin{aligned} Y_{it} = {} & \alpha + \theta_{ij} + \gamma_t + X_{it}\mu + \gamma_1 Mi_{i,t-2} + \gamma_2 Mi_{i,t-1} + \gamma_3 Mi_{i,t+1} \\ & + \gamma_4 Mi_{i,t+2} + \gamma_5 Pe_{i,t-2} + \gamma_6 Pe_{i,t-1} + \gamma_7 Pe_{i,t+1} \\ & + \gamma_8 Pe_{i,t+2} + \epsilon_{it}\,, \end{aligned} \qquad (2)$$

where, $Mi_{i.t-2}$, $Mi_{i,t-1}$, $Mi_{i,t+1}$ and $Mi_{i,t+2}$ are the indicator variables for the micro-sized deals event, $Pe_{i,t-2}$, $Pe_{i,t-1}$, $Pe_{i,t+1}$ and $Pe_{i,t+2}$ are the period indicator variables for the small deals event, and the other variables already described for equation 1. The meaning of the coefficients and the expected result follow the same logic described for the coefficients in equation 1, the coefficients γ_1, γ_2, γ_3 and γ_4 are the estimates of the effects of renegotiation for micro-sized companies, and the coefficients γ_5, γ_6, γ_7 and γ_8 are the estimates of the effects of renegotiation for small-sized ones.

As described in subsection 2.1.1, companies that renegotiate have different statuses in relation to the renegotiation status at t0 when we observe them at t + 2. They may: (1) have been liquidate ("Liquidate"); (2) be still making payments ("Paying Reneg"); (3) have made a new renegotiation for not complying with the obligations of the initial transaction ("New Reneg"); (4) have turned a loss ("Loss"). In order to assess whether there is a difference in the effect of renegotiation for companies with a different renegotiation status at t + 2, we have decided to include these effects separately in the equation. Thus, equation 1 will be expanded, replacing the variables $D_{i,t-2}$, $D_{i,t-1}$, $D_{i,t+1}$ and $D_{i,t+2}$ with the period indicator variables related to the event according to the company's status in period t + 2, as follows:

$$\begin{aligned} Y_{it} = {} & \alpha + \theta_{ij} + \gamma_t + X_{it}\mu + \delta_1 Liq_{i,t-2} + \delta_2 Liq_{i,t-1} + \delta_3 Liq_{i,t+1} + \delta_4 Liq_{i,t+2} + \\ & \delta_6 Rec_{i,t-1} + \delta_7 Rec_{i,t+1} + \delta_8 Rec_{i,t+2} + \delta_9 New_{i,t-2} + \delta_{10} New_{i,t-1} + \delta_{11} New_{i,t+1} + \\ & \delta_{12} New_{i,t+2} + \delta_{13} Prej_{i,t-2} + \delta_{14} Prej_{i,t-1} + \delta_{15} Prej_{i,t+1} + \delta_{16} Prej_{i,t+2} + \nu_{it}, \end{aligned} \qquad (3)$$

in which $Liq_{i,t-2}$, $Liq_{i,t-1}$, $Liq_{i,t+1}$ and $Liq_{i,t+2}$ are the period indicator variables related to the event of "Liquidated" at t+2, $Rec_{i,t-2}$, $Rec_{i,t-1}$, $Rec_{i,t+1}$ and $Rec_{i,t+2}$ are the period indicator variables related to the event "Paying Reneg" at t+2, $New_{i,t-2}$, $New_{i,t-1}$, $New_{i,t+1}$ and $New_{i,t+2}$ are the period indicator variables related to "New Reneg" at t+2, $Prej_{i,t-2}$, $Prej_{i,t-1}$, $Prej_{i,t+1}$ and $Prej_{i,t+2}$ are the period indicator variables related to the event of "Loss" at t+2.

It is expected that the coefficients δ_3 and δ_4 will be the least negative of all those estimated by this equation, given that they correspond to the effect of renegotiation in companies that have liquidated the renegotiation contract, that is, that apparently are no longer in a condition of financial deterioration. It is expected that the coefficients δ_7 and δ_8, referring to the effect on companies that are still paying renegotiation contracts, will be less negative than the coefficients related to companies that have made a new renegotiation or have turned a loss. It is expected that these companies have not yet emerged from the financial difficulties they were in, as they have not yet liquidated the renegotiation, but as they continue to pay the debt, this may indicate that they are recovering. It is expected that the coefficients $\delta_{11}$and δ_{12}, referring to the effects on companies that made a new renegotiation contract, will be negative and without showing signs of recovery. It is understood that if the company had to make a new renegotiation, it is still in financial difficulty. It is expected that the coefficients δ_{15} and δ_{16}, referring to the effects on companies that have suffered losses, will be the most negative in relation to all the coefficients of the equation, and without any signs of improvement. A company that hires a renegotiation product and turns a loss, interrupting the payment of the bank debt, is unlikely to recover and its performance tends to worsen.

3 DATA ANALYSIS

In this section, we show a descriptive analysis of the database and the samples obtained by matching on observables and PSM and also, the graphic analyses of the paired samples. In addition, we present the results obtained through the regression models.

3.1 Analysis of the database

The initial database contains information on 6,636 companies in the treatment group and 32,720 companies in the control group. In Table 1, the companies in the treatment group are presented according to the month in which the renegotiation occurred. The columns referring to the control group refer to the companies considered as possible controls for the treated companies. We show descriptive statistics on company revenues two years before the renegotiation event on the table.

3.1.1 Samples paired with observable variables

Through the matching method, described in subsection 2.2, we obtained a sample with 8,604 distinct companies, totaling 4,302 treatment-control pairs of companies: for each company that made a renegotiation in a period, a similar company was obtained from the control group. We notice that as we could not match 2,234 companies in the treatment group with any company in the control group they were dropped from our sample.

[Table 1 Here]

Table 2 shows the same information already described for Table 1 but using the paired sample as the data source. There is greater uniformity between the groups, given that only the companies that share the most similarities were kept in the database. For example, 425 pairs were obtained in the period of January 2016. This means that 425 companies renegotiated in January 2016, companies which had an average revenue of 13.95 in January 2014. For this same period, we obtained 425 companies that never renegotiated and had a bank debt in January 2016, and whose average revenue was also 13.95 in January 2014. Each company that renegotiated has a similar pair that did not renegotiate, and this treatment-control pair of companies is identified in the base.

[Table 2 Here]

Tables 3 and 4 show the distribution of companies according to the macro sector and the region of the paired sample. There is a concentration of pairs in the Southeast region, and this is due both to the greater number of companies in these regions and the bank's client portfolio, which has more branches in the states of São Paulo, Rio de Janeiro and Minas Gerais, which are the largest states in Brazil in terms of population. The control and treatment groups have similar statistics, as observed in Tables 3 and 4, thus showing the uniformity of the sample in the two years before the renegotiation event for the treatment group.

[Table 3 Here]

[Table 4 Here]

For illustration, our data show that the debt status after 2 periods of undergoing a renegotiation, 26% of the companies liquidate the contract; 29% of the companies are still making payments; 37% undergo a new renegotiation; 8% turn into a loss.

Figures 2A, 2B and 2C show the average revenues of the companies in the treatment and control groups in each observation period, with the renegotiation event occurring in period 0. Periods t-2 and t-1 are the periods before the event, and periods t + 1 and t + 2 are the periods after the event. In graph 1, the complete database is used as a source, whereas in graphs 2 and 3 only data from micro-sized and small-sized companies are used respectively.

In Figure 2, we show companies that have on average, similar performances in periods t-2 and t-1 because in these periods the treatment group had not yet shown signs of deterioration, so

the curves have the same tendency as the that of the control group. In the t0 period, when treatment occurs, it is possible to notice a sharp downward trend in the treatment group, while the control group shows a slight upward trend in micro companies and a trend of stability in small companies. In figure 2B, there is a decrease in the slope of the curve for the treatment group at point t + 2, which may mean an improvement in the company's financial situation. The control and treatment curves are practically parallel between t + 1 and t + 2, which may indicate that the treatment group is evolving similarly to the control group, in which companies are financially healthy. In figure 1C, the sharp downward trend remains at t + 2 for the treatment group whereas the control group shows a slight drop.

[Figure 2 Here]

To better evaluate the evolution of the curves, we build two plots with the revenue ratio between the treatment and control groups for both sizes. As previously mentioned, in the pre-event periods the ratio is close to one in both sizes. In figure 3A, we notice that the ratio falls at t0, maintains the downward trend at t + 1 and shows a slight upward trend at t + 2. In figure 3B, the trend continues to fall at t + 2, with a slight decrease in the slope.

[Figure 3 Here]

3.1.2 PSM sample

By using the PSM method, described in subsection 2.2, a sample was obtained with 13,272 companies, with 6,636 companies in the treatment group and 6,636 companies in the control group. In table 5, it is possible to see an improvement in the uniformity of the base with the use of PSM compared to the total database. The average revenues of the treatment and control groups are closer to the matched sample than to the total base. With this method, a balanced sample is also obtained in terms of the characteristics of the companies and revenues, as we have obtained using the matching approach in the previous subsection.

[Table 5 Here]

Figure 4 shows the distribution of the propensity score for each group, with each circle representing a case. There are no cases of treatment that were left out of the sample. The closest treatment and control cases are in “Matched Treatment Units” and “Matched Control Units”. The control cases that were out of the sample are in “Unmatched Control Units”.

[Figure 4 Here]

In this subsection, the evolution of the average income of the treatment and control groups throughout the observation periods will be evaluated for the sample obtained through PSM, as was done in subsection 2.1.1.2 for the sample obtained through matching on observables.

There is a similarity in the revenue evolution curves in Figure 5 compared with the previous sample in Figure 2. The graphics are similar for the total base, as well as for the micro and small-sized enterprises. The results of the regression model (equation 1) will be assessed by using both samples in subsection 2.2.

[Figure 5 Here]

3.2 Results

In this subsection, we show the regression models results as described in section 2.3, with the matching on observables in subsection 3.2.1 and PSM sample as robustness check in subsection 3.2.2.

3.2.1 Main results

Figure 6A shows the impact of renegotiations on the companies' revenues (equation (1), the results of the estimates of the parameters in table 6), in which the filled circles are the estimated coefficients of the periods related to the event, and the unfilled circles refer to standard deviations. We notice that the estimates of the effects in the pre-treatment, measured by the estimates of the coefficients β_1 and β_2, are close to zero, which does not identify a difference between the treatment and control groups before the renegotiation. This was the expected result, given that the sample was matched to obtain similar companies in both groups. In the first period after the renegotiation (t + 1), the companies that renegotiated present a revenue approximately 20% lower than that of the companies in the control group, which was already expected of the graphical analysis given that in the year following the renegotiation process the firms had not yet shown signs of recovery. In the second period after the renegotiation (t + 2), the performance of the companies that renegotiated is approximately 30% lower than that of those that did not renegotiate, so it is not yet possible to see a sign of improvement in the companies' revenues.

[Figure 6 Here]

Figure 6B shows the impact of renegotiation on the companies' revenues according to size (equation (2), results of the parameters estimation in table 7), in which the circles filled are the estimated coefficients of the periods related to the event for the micro companies, and the completed squares are the estimated coefficients for small companies. Notice that the estimates of the effects on pre-treatment for micro companies are considerably different from zero (approximately 35% lower in t-2 and 10% higher in t-1). This result was not expected, given that, before the renegotiation, the treatment and control groups should have similar performances, and the graph shows a negative effect on t-2, which becomes positive on t-1. In the first period after the renegotiation (t + 1), the micro companies that renegotiated have a revenue approximately 10% lower than that of the companies in the control group, and this difference remains in the following period (t + 2). This effect may mean a trend of improvement in the performance of companies, but more periods would be necessary to verify this improvement. For small companies, it is noted that the revenue of companies that renegotiated is approximately 10% higher than that of those that did not renegotiate in t-2, but this difference is close to zero in t-1. In the first period after the renegotiation, the revenue of the companies that renegotiated is 20% lower, and it is approximately 35% lower in the second period.

Figure 7 shows the impact of the renegotiation on the companies' revenues according to the status of the renegotiation contract 2 years after being made (equation (3); the results of the parameter estimates are presented in table 8). As described in subsection 2.1.1, the 4 possible statuses are: the contract has been liquidated; the company is still paying for the renegotiation; the company was unable to fulfill the obligations of the first renegotiation and entered into a new contract; the contract turned into a loss.

In Figure 7A, the filled triangles are the estimated coefficients of the periods related to the event for the companies that settled the renegotiation contract at t + 2. Note that the estimates of the effects in the pre-treatment are close to zero, as expected. In the first period after the renegotiation (t + 1), the companies that renegotiated have a revenue approximately 20% lower than that of the companies in the control group, and this difference remains practically the same in the following period (t + 2). This may indicate a possible recovery from the companies, because if the company was able to liquidate the renegotiation contract, it may be recovering from a difficult financial situation.

In Figure 7B, the circles filled are the estimated coefficients of the periods related to the event for the companies that were paying the renegotiation contract at t + 2. It is noted that the estimates of the effects in the pre-treatment are slightly different from zero, still within the expected. In the first period after the renegotiation (t + 1), the companies that renegotiated have a revenue approximately 15% lower than that of the companies in the control group, and in the

following period (t + 2) this difference reaches approximately 25%. This increase in the difference among revenues indicates that it is not yet possible to see an improvement in the performance of companies, but this behavior is expected given that the companies had not liquidated the renegotiation contracts, and ergo they had not completely recovered.
In Figure 7C, the filled diamonds are the estimated coefficients of the periods related to the event for companies that were unable to comply with the renegotiation obligations carried out at t0, and that had to make a new renegotiation. The pre-treatment effects are similar to the previous status. In the first period after the renegotiation (t + 1), the companies that renegotiated have a revenue approximately 20% lower than that of the companies in the control group, and in the following period (t + 2) this difference roughly reaches 40%. This increase in the difference from one period to another indicates that companies that renegotiate their debts and that need to renegotiate them again later, will probably not be able to get out of financial difficulties, given that the performance of these companies has even worsened in relation to those in good financial conditions.

In Figure 7D, the completed squares are the estimated coefficients of the periods related to the event for companies that were unable to comply with the renegotiation obligations carried out at t0, and the contract was accounted for as a loss. The pre-treatment effects are similar to the previous status. In the first period after the renegotiation (t + 1), the companies that renegotiated show a very sharp drop in revenues, by approximately 30%, in relation to the companies of the control group. In the following period (t + 2), this difference reaches approximately 40%. This large drop in the first period and the increase in the following period indicate that these companies should not have probably undergone a renegotiation at t0, as they were apparently unable to keep making the payments. The initial debt contract should have been accounted for as a loss as early as t0, which would have allowed the bank to recognize the losses at an earlier stage.

[Figure 7 Here]

Appendix B presents the results of the parameter regressions estimated from the database.

3.2.2 Robustness

Some analyses of subsection 3.2.1 have been redone by using the sample obtained through PSM (propensity score matching) as a source. In Figure 8 (results of the parameter estimates in table 9), in which the filled circles are the estimated coefficients of the periods related to the event for the PSM sample, a result similar to that observed in graph 9 (results of the parameter estimates in table 6), with the pre-treatment effects close to zero, and the post-treatment effects without clear signs of improvement in performance.

[Figure 8 Here]

Appendix B presents the result of the parameter regression estimated from the database.

4 CONCLUSIONS

We aim to assess the effect of debt renegotiation on the performance of companies that are in financial pressure. We used a proprietary database of a large bank in Brazil was used with the performance information of companies that underwent renegotiation contracts, evaluating this indicator before and after the event, and taking as a counterfactual question companies that did not show any sign of financial deterioration.

Our regressions were estimated by using data from companies that renegotiated bank debts in the periods from Jan/16 through Jun/17. To assess the effect of the renegotiation on the companies' performances, the companies' revenues we include in our sample 2 years before and 2 years after the event, comparing this indicator for the treatment and control groups involved. To compare the indicators and obtain the causal effect of the renegotiation, we used the dynamic difference in differences methodology.

Our results show, before renegotiation, that the treatment groups (companies that renegotiate) and control groups (companies that did not show signs of financial deterioration) do not have significant differences, in line with the expected result of the inexistence of a trend prior to the event. After a renegotiation, there is a negative effect on the treatment group in the first period, and a tendency to reduce the effect in the second period. When the same analysis is carried out by separating companies by size, a negative effect is noted 2 years before the renegotiation for micro-sized companies, thus indicating some trend prior to the event. The most interesting result is obtained when the effects according to the final status of the renegotiation contract are included in the regressions, in which we observe that the companies that liquidate their renegotiation contracts show signs of recovery, whereas the companies that make new renegotiations or turn a loss show a continuous deterioration. Groups that renegotiate or turn a loss represent 45% of the base, and this may be one of the reasons why we do not see clear recovery effects when analyzing the coefficients of the complete base, regardless of the renegotiation status.

Through the results, we find strong evidence that solvent companies, which are going through a period of financial difficulty, show signs of recovery in the post-renegotiation periods. The

readjustment of the payment flow for these companies, through the renegotiation operation, seems to help them to improve their performance.

Companies that renegotiate and that continue to deteriorate were apparently already insolvent even before renegotiating, so the readjustment of cash flow does not help in the recovery of these companies. Using the nomenclature of the literature on this topic, these renegotiations could be classified as *zombie lendings*, which is the maintenance of credit through renegotiations for insolvent companies.

For future studies, we consider it important to include more observation periods after the renegotiation event, as in some groups there is an indication of improvement in performance, but that could only be confirmed with one more observation point. The lack of information in our dataset about the firm's revenue for more than 2 years after forbearance did not allow us to estimate the long-term effects of forbearance, which is an important investigation to be pursued in the future. Another evolution for this study would be to use another performance indicator, such as ROE or EBIT, if it is possible to obtain data on the companies for the construction of the indicators.

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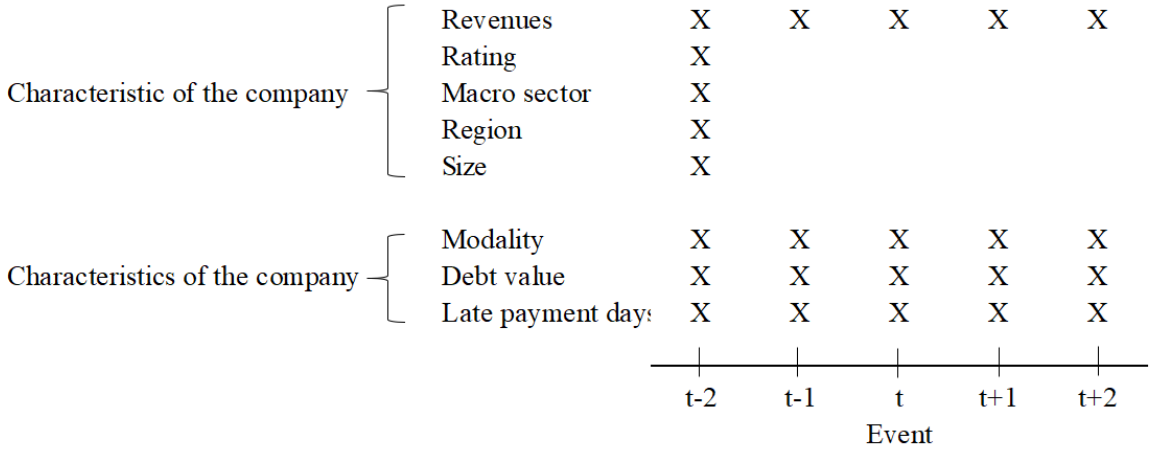
FIGURES AND TABLES

Figure 1 - Timeline with periods related to the event.



Note: The figure describes the periods before and after treatment, which occurs at t0. The t-2 period corresponds to 2 years before the event, the t-1 period to 1 year, and so on. In t-2, all the characteristics of the company were observed, and in the following periods only the revenues were monitored. The characteristics of the operations were monitored in all periods (t-2 to t2).

Figure 2 - Evolution of Revenues for the control and treatment groups.

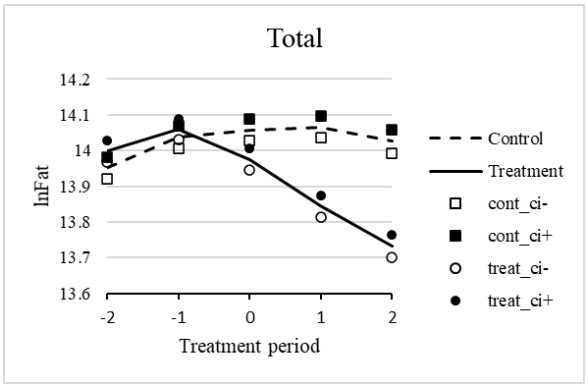


Figure 2A

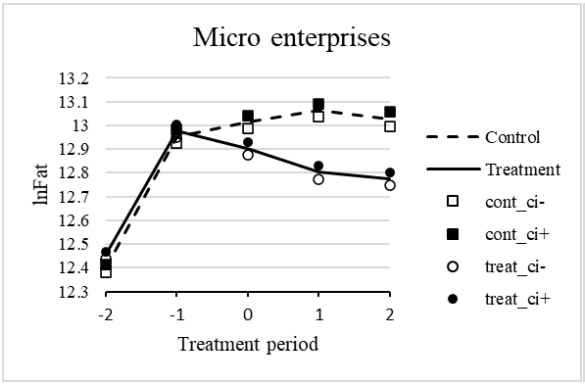


Figure 2B

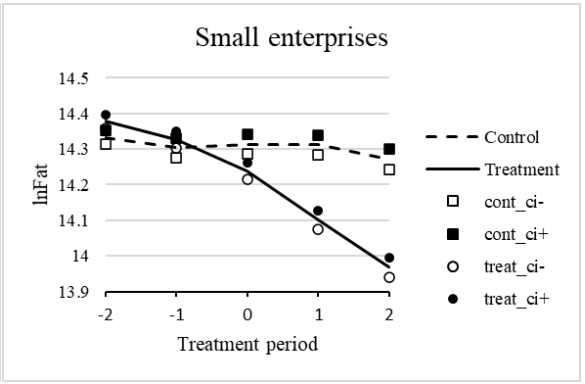


Figure 2C

Note: Squares and diamonds represent the 95% confidence interval. Each point on the graph represents the group's average revenue in the treatment period. Period -2 refers to 2 years before undergoing a renegotiation, period -1 refers to 1 year before undergoing a renegotiation, period +1 refers to 1 year after undergoing a renegotiation and period +2 refers to 2 years after undergoing a renegotiation. lnFat is the natural log of the deflated revenues.

Figure 3 - Evolution of the Revenue Ratio for the Treatment and Control groups

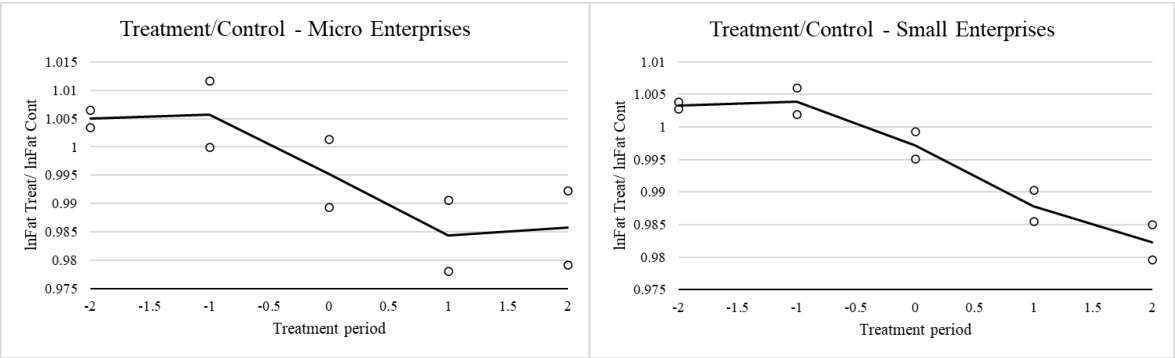


Figure 3A Figure 3B

Figure 3 - Evolution of the Revenue Ratio for the Treatment and Control groups

Note: Empty circles represent the 95% confidence interval. Each point on the graph represents the ratio between the average revenues of the treatment and control groups in the period related to the treatment for micro companies. Period -2 refers to 2 years before undergoing a renegotiation, period -1 refers to 1 year before undergoing a renegotiation, period +1 refers to 1 year after undergoing a renegotiation and period +2 refers to 2 years after undergoing a renegotiation. lnFat refers do the natural log of deflated revenues.

Figure 4 – Distribution of the propensity scores.

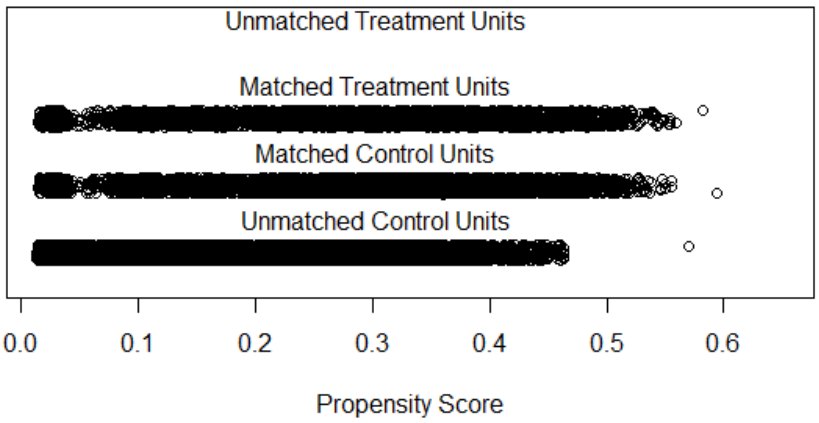


Figure 4 – Distribution of the propensity scores.

Note: Figure 4 shows the distribution of the propensity score for each group, with each circle representing a case. Below each title are the cases for each group. The Unmatched Treatment Units group refers to the companies in the treatment group that did not remain in the sample, and there is no case in this group because all companies in the treatment group remained in the sample. The Matched Treatment Units group refers to the companies in the treatment group that remained in the sample. The Matched Control Units group refers to the companies in the control group that remained in the sample. The Unmatched Control Units group refers to the companies in the control group that did not remain in the sample.

Figure 5 – Revenue evolution for the control and treatment groups of the PSM sample.

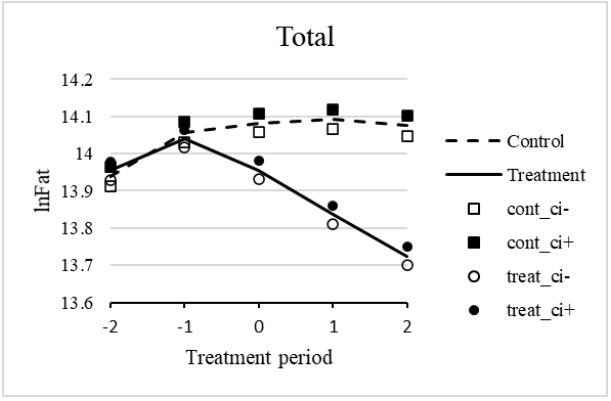


Figure 5A

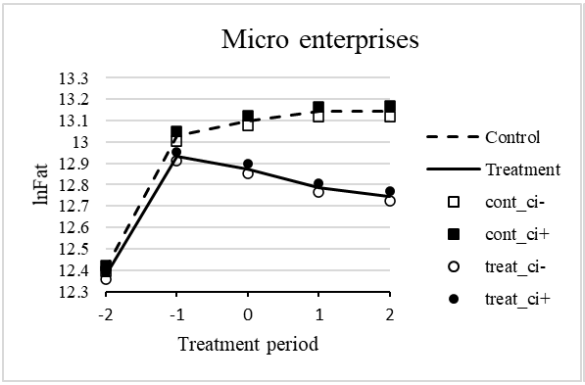


Figure 5B

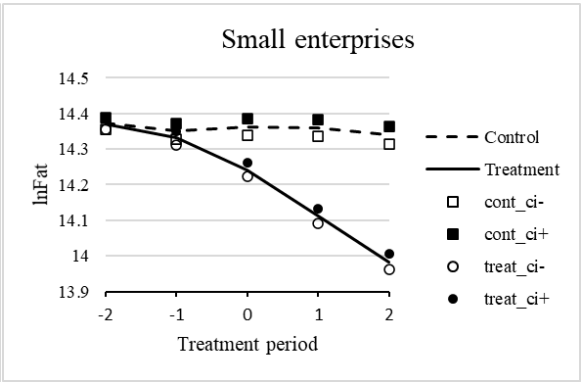


Figure 5C

Figure 6 - Impact of renegotiation on companies' revenues.

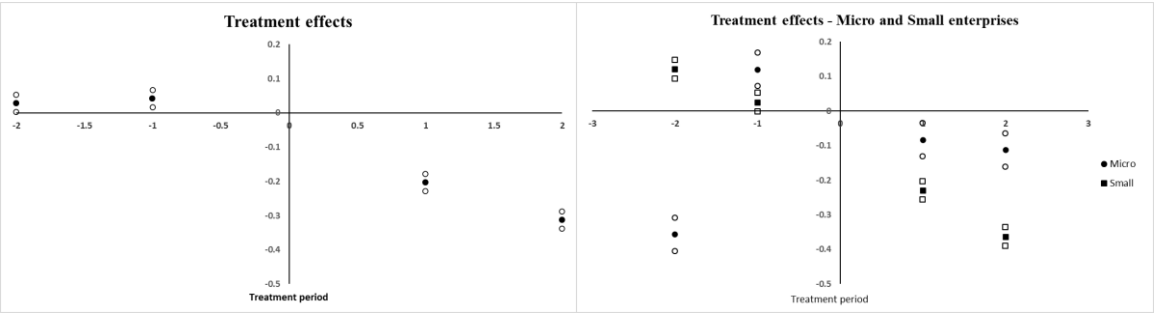


Figure 6A Figure 6 B

Figure 6 - Impact of renegotiation on companies' revenues.

Note: An empty circle represents the 95% confidence interval. Each circle filled in graph 9 corresponds to a coefficient estimated by regression equation 1. The circle at -2 corresponds to the estimate of β_1, the circle at -1 corresponds to the estimate of β_2, the circle at 1 corresponds to the estimate of β_3 and circle 2 corresponds to the estimate of β_4. The coefficients represent the estimated effect, in that period, of undergoing a renegotiation.

Figure 7 - Impact of renegotiation on the revenues of companies that liquidated the renegotiation contracts at t + 2.

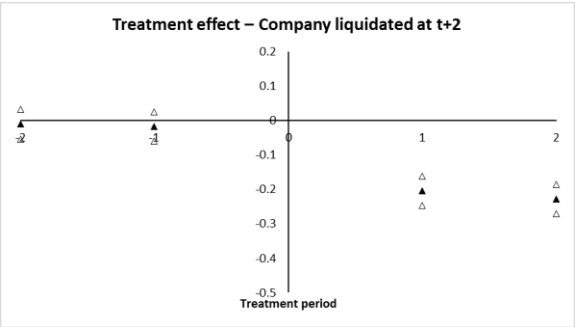


Figure 7A

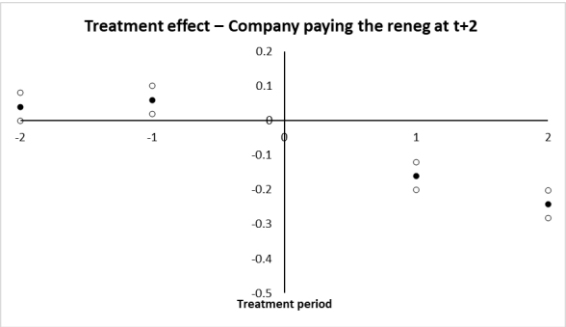


Figure 7B

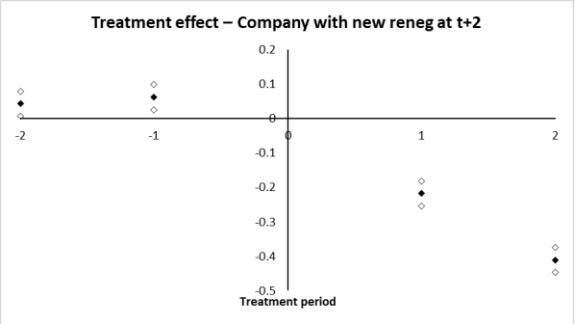


Figure 7C

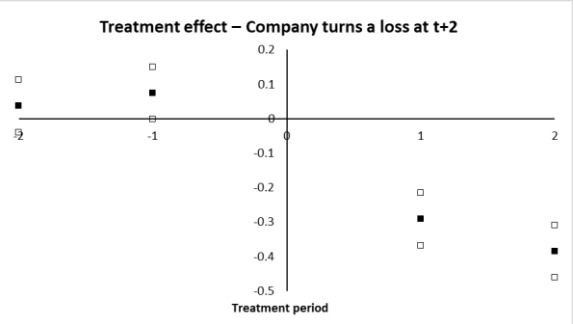
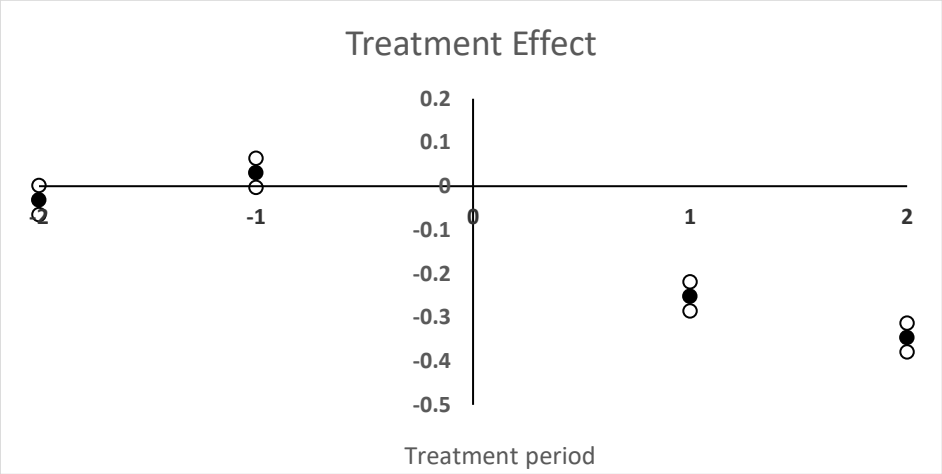


Figure 7D

Note: The empty triangle represents the 95% confidence interval. Each triangle filled in graph 11 corresponds to a coefficient estimated by regression equation 3 for the companies that liquidated a renegotiation. The triangle at -2 corresponds to the estimate of β_1, the triangle at -1 corresponds to the estimate of β_2, the triangle at 1 corresponds to the estimate of β_3 and triangle 2 corresponds to the estimate of β_4. The coefficients represent the estimated effect of undergoing a renegotiation for companies that paid off the renegotiations.

Figure 8 - Impact of renegotiation on companies' revenues for the PSM sample.



Note: The empty circle represents the 95% confidence interval. Each circle filled in graph 15 corresponds to a coefficient estimated by the regression equation 1 without the term θ_{ij}. The circle at -2 corresponds to the estimate of β_1, the circle at -1 corresponds to the estimate of β_2, the circle at 1 corresponds to the estimate of β_3 and circle 2 corresponds to the estimate of β_4. The coefficients represent the estimated effect, in that period, of undergoing a renegotiation.

Table 1 - Companies in the treatment and control groups by period of time.

Event	Treatment					Control				
	N	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**
2016-01	449	14.37	1.07	9.85	15.69	14,990	14.51	1.12	9.86	15.69
2016-02	406	14.46	1.04	10.75	15.67	3,967	14.15	1.04	9.51	15.68
2016-03	556	14.36	1.08	10.19	15.67	1,479	14.36	1.08	9.81	15.67
2016-04	457	14.39	1.03	10.19	15.66	1,634	14.36	1.09	9.96	15.67
2016-05	536	14.34	1.08	10.08	15.64	1,044	14.41	1.05	10.18	15.66
2016-06	458	14.40	0.99	10.87	15.65	1,083	14.36	1.00	9.72	15.64
2016-07	381	14.33	1.01	10.55	15.65	2,225	14.22	0.99	10.18	15.66
2016-08	351	14.37	0.94	10.75	15.65	630	14.40	0.97	10.18	15.66
2016-09	251	14.47	0.99	11.12	15.65	664	14.47	1.03	9.76	15.65
2016-10	244	14.38	0.94	10.64	15.62	621	14.36	1.04	9.99	15.65
2016-11	297	14.52	0.87	11.22	15.64	639	14.47	0.93	10.75	15.64
2016-12	283	14.55	0.99	10.51	15.62	601	14.44	0.99	10.02	15.63
2017-01	285	14.51	0.97	11.44	15.61	400	14.22	1.01	10.40	15.60
2017-02	262	14.42	0.89	10.99	15.60	520	14.26	0.91	10.13	15.60
2017-03	370	14.36	0.98	10.24	15.59	511	14.26	1.03	9.89	15.60
2017-04	261	14.29	1.05	9.75	15.58	608	14.32	1.07	9.95	15.58
2017-05	404	14.29	0.86	10.51	15.57	488	14.34	0.95	10.47	15.57
2017-06	385	14.23	0.92	10.45	15.56	616	14.42	1.01	10.28	15.57
Total	**6,636**	**14.39**	**1.03**	**9.75**	**15.69**	**32,720**	**14.40**	**1.08**	**9.51**	**15.69**

Note: Table 1 shows every month from Jan/16 to Jun/17 and the number of companies that underwent a renegotiation in each of these periods of time. These data are in the Treatment columns. In addition, data on companies with bank debts, no sigh of financial deterioration and without renegotiation in the same period are shown in the Control columns. For the two groups, Control and Treatment, the following statistics are presented regarding revenues in each period: average, standard deviation, minimum and maximum.

Table 2 - Paired companies in the treatment and control groups by period of time

Event	Treatment					Control				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
2016-01	425	13.95	1.07	9.85	15.69	425	13.95	1.06	10.21	15.68
2016-02	356	13.98	1.05	10.75	15.67	356	13.97	1.02	11.13	15.66
2016-03	374	13.96	1.07	10.89	15.67	374	13.92	1.07	10.79	15.67
2016-04	333	14.00	1.03	10.19	15.66	333	13.96	1.04	9.96	15.66
2016-05	344	13.94	1.07	11.14	15.61	344	13.90	1.07	10.97	15.61
2016-06	287	14.04	0.99	11.10	15.64	287	14.01	0.96	10.63	15.61
2016-07	322	13.92	0.99	11.40	15.64	322	13.88	0.98	11.49	15.66
2016-08	208	14.07	0.93	11.53	15.65	208	13.99	0.94	11.47	15.65
2016-09	168	14.12	0.99	11.12	15.65	168	14.05	1.00	11.11	15.64
2016-10	150	14.01	0.94	11.29	15.62	150	13.93	1.03	10.39	15.64
2016-11	173	14.20	0.85	11.22	15.60	173	14.14	0.88	11.07	15.58
2016-12	157	14.09	0.97	11.10	15.61	157	14.03	0.97	11.17	15.59
2017-01	133	14.12	0.92	11.74	15.57	133	14.01	0.93	11.60	15.60
2017-02	142	14.09	0.88	11.45	15.56	142	14.00	0.86	11.65	15.60
2017-03	190	13.95	0.95	11.01	15.59	190	13.87	0.99	11.21	15.58
2017-04	146	13.91	1.04	10.98	15.58	146	13.86	1.03	10.86	15.58
2017-05	187	13.98	0.86	11.16	15.49	187	13.93	0.87	10.51	15.57
2017-06	207	13.94	0.90	11.33	15.56	207	13.87	0.97	10.61	15.57
Total	**4,302**	**14.00**	**1.00**	**9.85**	**15.69**	**4,302**	**13.95**	**1.00**	**9.96**	**15.68**

Note: Table 2 shows for every month from Jan/16 to Jun/17 the number of paired companies in the control and treatment groups. Each company that underwent a debt renegotiation has a pair, which is a company that owed to the bank in the same period but did not renegotiate. In the columns called Treatment are the statistics of companies that have renegotiated, and in the columns called Control are the same statistics for companies that have not renegotiated. For the two groups, Control and Treatment, the following statistics are presented regarding revenues in each period, whose reference of observation is t-2: average, standard deviation, minimum and maximum.

Table 3 - Pairs of companies in the control and treatment groups by macro sector.

Macro Sector	Treatment					Control				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
Food, Drink and Tobacco	486	14.04	1.01	10.19	15.64	486	14.00	1.01	9.96	15.62
Automotive	318	13.88	1.01	11.23	15.59	318	13.82	1.03	10.39	15.60
Trade	520	13.95	0.99	10.75	15.66	520	13.92	1.00	11.07	15.67
Communication	59	14.18	0.95	11.31	15.60	59	14.10	0.97	11.43	15.62
Construction	488	14.32	0.91	11.14	15.69	488	14.30	0.90	11.17	15.68
Education	103	13.99	0.89	11.60	15.56	103	13.89	0.91	11.98	15.63
Electronics	98	14.06	0.92	11.89	15.60	98	13.96	0.87	11.82	15.52
Pharmaceutical	88	13.94	0.93	11.64	15.69	88	13.84	0.91	10.92	15.67
Real Estate Developers and Assets	77	14.43	0.73	12.60	15.53	77	14.39	0.71	12.60	15.61
Leisure and Food	542	13.80	0.97	10.89	15.65	542	13.75	0.98	10.63	15.63
Wood	20	14.79	0.54	13.53	15.58	20	14.54	0.76	13.05	15.40
Machines and equipment	95	14.56	0.82	11.31	15.65	95	14.52	0.81	11.66	15.67
Metallurgical (iron and steel)	58	14.48	0.76	12.51	15.66	58	14.47	0.77	12.48	15.66
Crude Oil and Gas	35	14.47	1.03	11.34	15.64	35	14.36	1.06	11.53	15.66
Chemical and Petrochemical	23	14.77	0.53	13.08	15.65	23	14.60	0.68	12.10	15.50
Health	168	13.91	0.90	11.31	15.66	168	13.84	0.87	11.14	15.64
Services	511	13.74	1.10	9.85	15.65	511	13.70	1.09	10.21	15.58
Information Technology	36	14.01	0.97	11.66	15.64	36	13.94	0.99	11.66	15.55
Textiles and Apparel	379	13.82	0.99	11.14	15.67	379	13.78	1.02	10.51	15.68
Transportation and logistics	198	14.19	0.92	11.63	15.61	198	14.16	0.97	11.17	15.64
Total	**4,302**	**14.00**	**1.00**	**9.85**	**15.69**	**4,302**	**13.95**	**1.00**	**9.96**	**15.68**

Note: Table 3 shows the number of pairs of companies by macro sector in the control and treatment groups. Each company that underwent a renegotiation has a pair, which is a company that had a bank debt, and belongs to the same macro sector and did not renegotiate. In the columns called Treatment are the statistics of companies that have renegotiated, and in the columns called Control are statistics for companies that have not renegotiated. For both groups, the following statistics are presented regarding revenues in each period, whose reference of observation is t-2: average, standard deviation, minimum and maximum.

Table 4 - Pairs of companies on the treatment and control groups by region.

Region	Treatment					Control				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
BA SE	74	14.10	0.93	11.66	15.48	74	13.90	0.92	11.65	15.57
DF GO RO TO MT MS	140	14.16	0.81	11.69	15.69	140	14.08	0.85	11.66	15.67
SP Metropolitan Region	1.024	14.01	1.05	9.85	15.67	1.024	13.98	1.07	10.21	15.67
Coastal cities and countryside of SP	1.261	13.85	1.05	10.19	15.66	1.261	13.83	1.04	9.96	15.65
MG	392	14.04	0.91	10.21	15.69	392	14.00	0.91	10.21	15.68
CE PI MA PA AP AM RR AC	94	14.34	0.79	11.63	15.59	94	14.18	0.80	11.47	15.55
PE AL PB RN	182	14.22	0.93	11.60	15.61	182	14.10	0.92	10.97	15.60
PR SC	395	14.09	0.95	11.10	15.67	395	14.04	0.96	11.12	15.68
RJ	549	14.01	0.93	11.43	15.65	549	13.95	0.95	10.57	15.64
RS	191	14.10	0.93	11.15	15.65	191	14.01	0.94	11.13	15.60
Total	**4,302**	**14.00**	**1.00**	**9.85**	**15.69**	**4,302**	**13.95**	**1.00**	**9.96**	**15.68**

Note: Table 4 shows the number of pairs of companies by macro sector in the treatment and control groups. Each company that underwent a renegotiation has a pair, which is a company that had a bank debt, and belongs to the same region and did not renegotiate. In the columns called Treatment are the statistics of companies that have renegotiated, and in the columns called Control are the statistics for companies that have not renegotiated. For both groups, the following statistics are presented regarding revenues in each period, whose reference of observation is t-2: average, standard deviation, minimum and maximum.

Table 5 - Result of the effectiveness of propensity score matching.

Total Base	Treatment mean	Control mean	SD Control	Difference between means	eQQ Median	eQQ Mean	eQQ Maximum
Distance	0.2914	0.1437	0.1349	0.1477	0.1408	0.1477	0.2580
Revenue	13.9541	13.9268	1.0833	0.0274	0.0665	0.0670	0.2969

Matched Sample	Treatment mean	Control mean	SD Control	Difference between means	eQQ Median	eQQ Mean	eQQ Maximum
Distance	0.2914	0.2912	0.1213	0.0001	0.0000	0.0002	0.011
Revenue	13.9541	13.9383	1.0716	0.0158	0.0638	0.0645	0.426

Improvement percentage with matching	Difference between means	eQQ Median	eQQ Mean	eQQ Maximum
Distance	99.9016	99.9908	99.8929	95.7218
Revnue	42.0689	4.0462	3.7263	-43.5006

Samples sizes	Control	Treatment
Total	32720	6636
Matched	6636	6636
Unmatched	26087	0
Discarded	0	0

Note: Table 5 shows the results obtained after matching by using the PSM. Statistics for the total base, the matched sample and the improvement obtained from the base balancing process due to the use of the PSM are presented. The Average Treatment and Average Control columns show the weighted averages in the treatment and control groups. The SD Control column shows the standard deviation calculated in the control group. The Difference Between Means column is the difference between the mean of the treatment and control groups. The columns eQQ Median, eQQ Average and eQQ Maximum present the median, average and maximum distance between the two empirical functions (treatment and control groups). Values greater than 0 indicate deviations between groups in some part of the empirical distributions. The number of companies (sample size) of the treatment and control groups in each database is observed before and after matching.

APPENDIX A – Model variables

Let j be the identifier of the pair. According to our definition, $\theta_{ij} = 1$ if company i belongs to pair j. Mathematically, the matching matrix is an identity matrix of order j, with j being the number of control and treatment pairs.

$$\theta_j = \begin{bmatrix} \theta_1 & 0 & 0 & & 0 & 0 & 0 \\ 0 & \theta_1 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & \theta_2 & & 0 & 0 & 0 \\ & \vdots & & \ddots & & \vdots & \\ 0 & 0 & 0 & & \theta_{n-1} & 0 & 0 \\ 0 & 0 & 0 & \cdots & 0 & \theta_n & 0 \\ 0 & 0 & 0 & & 0 & 0 & \theta_n \end{bmatrix} \times \begin{bmatrix} D_{par\ 1} \\ D_{par\ 1} \\ D_{par\ 2} \\ \vdots \\ D_{par\ n-1} \\ D_{par\ n} \\ D_{par\ n} \end{bmatrix}$$

where $D_{par\ j}$ is equal to one if company i belongs to pair j.

APPENDIX B – Regression Results

Tables 6, 7 and 8 show the results of the regressions of the estimated parameters with the sample obtained from matching on observables.

Table 6 - Impact of renegotiation on companies' revenues.

	lnFat
Effect in t-2	0.027751*
	(0.012763)
Effect in t-1	0.041845**
	(0.012763)
Effect in t+1	-0.202802***
	(0.012763)
Effect in t+2	-0.312660***
	(0.012763)
Number of pairs	4,302
Observations	34,416

Notes: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. This table shows the estimated effects of the renegotiation in each time period related to the event, being t- 2 the period two years before the event, t-1 the period 1 year before the event, t + 1 the period 1 year after the event and t + 2 the period 2 years after the event.

Table 7 - Impact of negotiation on companies' revenues, by size.

	lnFat
Effect in t-2 Micro	-0.35684***
	(0.0244582)
Effect in t-1 Micro	0.11978***
	(0.0244039)
Effect in t+1 Micro	-0.08338***
	(0.0244582)
Effect in t+2 Micro	-0.11315***
	(0.0244039)
Effect in t-2 Small	0.12001***
	(0.0136194)
Effect in t-1 Small	0.0247576.
	(0.0136442)
Effect in t+1 Small	-0.23006***
	(0.0136194)
Effect in t+2 Small	-0.36359***
	(0.0136442)
Number of pairs	4,302
Observations	34,416

Note: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. This table presents the estimated effects of the renegotiation in each time period related to the event for micro and small-sized enterprises, being t-2 the period two years before the event, t-1 the period 1 year before the event, t + 1 the period 1 year after the event and t + 2 the period 2 years after the event.

Table 8 - Impact of renegotiation on companies' revenues, by status.

	lnFat
Effect in t-2 Liq	-0.01007 (0.0217433)
Effect in t-1 Liq	-0.01784 (0.0217616)
Effect in t+1 Liq	- 0.20419*** (0.0217433)
Effect in t+2 Liq	- 0.22800*** (0.0217616)
Effect in t-2 Ren	0.03985. (0.0206307)
Effect in t-1 Ren	0.05979** (0.0206301)
Effect in t+1 Ren	- 0.16038*** (0.0206307)
Effect in t+2 Ren	- 0.24242*** (0.0206301)
Effect in t-2 New	0.04321* (0.0185524)
Effect in t-1 New	0.06211*** (0.0185424)
Effect in t+1 New	- 0.21774*** (0.0185524)
Effect in t+2 New	- 0.41087*** (0.0185424)
Effect in t-2 Loss	0.03729 (0.0388844)
Effect in t-1 Loss	0.07384. (0.0388545)

Effect in t+1 Loss	-0.29222*** (0.0388844)
Effect in t+2 Loss	-0.38517*** (0.0388545)
Number of pairs	4,302
Observations	34,416

Note: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. This table shows the estimated effects of the renegotiation in each time period related to the event according to the status of the renegotiation contract at t + 2, being t-2 the period two years before the event, t-1 the period 1 year before the event, t + 1 the period 1 year after the event and t + 2 the period 2 years after the event.

Table 9 shows the results of the parameter regressions estimated with the sample obtained from the PSM.

Table 9 - Impact of renegotiation on companies' revenues for the PSM sample.

	lnFat
Effect in t-2	-0.031828. (0.016991)
Effect in t-1	0.030790. (0.016963)
Effect in t+1	-0.252133*** (0.016991)
Effect in t+2	-0.345956*** (0.016963)
Observations	53,088

Notes: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. This table shows the estimated effects of renegotiation in each time period related to the event, being t- 2 the period two years before the event, t-1 the period 1 year before the event, t + 1 the period 1 year after the event and t + 2 the period 2 years after the event.