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Essays on Empirical Corporate Finance

São Paulo, Brazil

July 14, 2023

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Thesis defended as requirement for the title
of Doctor in Business Economics at Insper

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Área de Concentração: Economia dos Negócios

Supervisor: Bernardo de Oliveira Guerra Ricca

Co-supervisor: Marco Antonio Cesar Bonomo

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Abstract

This thesis has three chapters, all of them aimed at empirically investigating a specific research question related to the Corporate Finance literature.

In the first chapter of the thesis, I investigate the relationship between liquidity shocks and Mergers and Acquisitions (M&A) activity during periods of credit supply shortfalls and show that firms that have higher levels of expiring debt maturities in the year of the credit shock are more likely to become targets in M&A deals. Moreover, these firms invest more and issue more debt after the deal relative to other financially constrained firms that did not undergo such transactions. Finally, we show that these firms are shifting from issuing debt in their own countries to issuing debt in countries with historically higher issuance volume, showing that M&As can work as leeway to relieve financing frictions in periods when credit supply frictions are more prevalent.

In the second chapter of the thesis, I study the effects of the introduction of the solvency margin rule in the Brazilian healthcare industry using a *differences-in-differences* approach to show that more exposed firms grew their customer base less than their counterparts, and that this effect persists even after three years of the solvency margin implementation. When it comes to firm-level prospects, I show that this higher exposure also affects firms' future financial fundamentals, firms' likelihood of being delisted, and is negatively correlated with changes in the median price levels for customer healthcare plans. Finally, to the extent that this differential growth trend is capable of shifting aggregate industry fundamentals, I show that states with a higher portion of exposed firms saw their market concentration surge 22% more than their counterparts.

Finally, the third and last chapter of this thesis studies the potential determinants of firms' debt structure decisions over time by studying the interplay between ownership and debt structure decisions. By exploiting exogenous variation in mutual funds' passive ownership due to *Russell 1000/2000* index assignments between 2010 and 2019, the estimates presented in this chapter show that a one standard deviation increase in passive ownership is related to a 29% decrease in debt concentration. In a subsequent set of results, it is possible to see that results are entirely driven by smaller firms, are mostly leaned towards increases in *Commercial Papers*, *Term Loans* and *Revolving Credit*, and are unrelated to other firms' *ex-post* fundamentals.

Keywords: Corporate Finance; Financing Frictions; Investments.

Resumo

Esta tese possui três capítulos, todos eles voltados para a investigação empírica relacionada à literatura de Finanças Corporativas.

No primeiro capítulo da tese, investigo a relação entre choques de liquidez e a atividade de Fusões e Aquisições (F&A) durante períodos de escassez de oferta de crédito e mostro que empresas com maiores níveis de maturidade de dívida vencida no ano do choque de crédito são mais propensas a se tornarem alvos em transações de M&A. Além disso, essas empresas investem mais e emitem mais dívidas após o negócio em relação a outras empresas com restrições financeiras que não realizaram tais transações. Por fim, mostramos que essas empresas estão mudando de emitir dívida em seus próprios países para emitir dívida em países com volume de emissão historicamente maior, mostrando que M&As podem funcionar como uma margem de manobra para aliviar os atritos de financiamento em períodos em que os atritos de oferta de crédito são mais prevalentes .

No segundo capítulo da tese, estudo os efeitos da introdução da regra da margem de solvência no setor de saúde brasileiro usando uma abordagem *diferenças-em-diferenças* para mostrar que empresas mais expostas cresceram menos sua base de clientes do que seus contrapartes, e que esse efeito persiste mesmo após três anos da implantação da margem de solvência. Quando se trata de perspectivas em nível de empresa, mostro que essa exposição mais alta também afeta os fundamentos financeiros futuros das empresas, a probabilidade de fechamento das empresas e está negativamente correlacionada com mudanças nos níveis de preços médios dos planos de saúde do cliente. Por fim, os resultados também demonstram que estados com maior parcela de empresas expostas viram sua concentração de mercado aumentar 22% a mais do que suas contrapartes.

Finalmente, o terceiro e último capítulo desta tese estuda os potenciais determinantes das decisões de estrutura de dívida das empresas ao longo do tempo, estudando a interação entre propriedade e decisões de estrutura de dívida. Ao explorar a variação exógena na propriedade passiva dos fundos mútuos devido às atribuições do índice *Russell 1000/2000* entre 2010 e 2019, as estimativas apresentadas neste capítulo mostram que um aumento de um desvio padrão na propriedade passiva está relacionado a um aumento de 29% diminuição da concentração da dívida. Ademais, é possível ver que os resultados são inteiramente impulsionados por empresas de menor dimensão, são majoritariamente orientados para aumentos de *Commercial Papers*, *Term Loans* e *Revolving Credit*, e são sem relação com os fundamentos *ex-post* de outras empresas.

Palavras-chave: Finanças Corporativas; Fricções Financeiras; Investimentos.

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Introduction

This thesis has three chapters, all of them aimed at empirically investigating a specific research question related to the Corporate Finance literature.

In the first chapter of the thesis, I investigate the relationship between liquidity shocks and Mergers and Acquisitions (M&A) activity during periods of credit supply shortfalls. More specifically, the chapter shows that firms can relieve the adverse effects of financing frictions during banking crisis periods by selling equity stakes to outside investors. By exploring cross-sectional variation in the supply of credit induced by banking crises, the study examines Mergers and Acquisitions (M&A) transactions worldwide between 1990-2019 and the outcomes of targeted firms ex-post deal occurrence and finds that firms that have higher levels of expiring debt maturities in the year of the credit shock are more likely to become targets in M&A deals. Moreover, it finds strong evidence that target firms invest more and issue more debt after the deal relative to other financially constrained firms that did not undergo such transactions. Finally, it is shown that these firms are shifting from issuing debt in their own countries to issuing debt in countries with historically higher issuance volume. Results remain robust after controlling for alternative explanations and show that M&As can work as leeway to relieve financing frictions in periods when credit supply frictions are more prevalent.

In the second chapter of the thesis, I study the effects of the introduction of the solvency margin rule in the Brazilian healthcare industry. Amid the growth in the number of health insurance customers in Brazil, not only the industry's market concentration increased substantially toward medium and large players, but also the number of active firms decreased by almost 50% of the beginning of 2000 levels. At the same time, the Brazilian healthcare regulatory agency has introduced the solvency margin, a capital requirement aimed at safeguarding ultimate customers from firms' insolvency risk. Despite the importance of such measure, there is still no empirical assessment of its potential side effects. By exploring firms' *ex-ante* exposure to the capital requirement rule and variation across multiple local markets, I use a *differences-in-differences* approach to show that more exposed firms grew their customer base less than their counterparts, and that this effect persists even after three years of the solvency margin implementation. When it comes to firm-level prospects, I show that this higher exposure also affects firms' future financial fundamentals, firms' likelihood of being delisted, and is negatively correlated with changes in the median price levels for customer healthcare plans. Finally, to the extent that this differential growth trend is capable of shifting aggregate industry fundamentals, I show that states with a higher portion of exposed firms saw their market concentration surge 22% more than their counterparts. The baseline results continue to hold even after

performing several robustness checks and employing alternative specifications.

Finally, the third and last chapter of this thesis studies the potential determinants of firms' debt structure decisions over time. While the study of capital structure is widespread in the corporate finance literature, debt structure – how and why firms choose a specific setting for their debt - remains a puzzle. I shed light on the potential motives that explain the choice of firms' debt structure by studying the interplay between ownership and debt structure decisions. By exploiting exogenous variation in mutual funds' passive ownership due to *Russell 1000/2000* index assignments between 2010 and 2019, I show not only that increases in passive ownership are positively associated with less concentrated debt structures, but also that the composition of such debt structure, in terms of contractual characteristics, changes significantly. Lastly, I discuss the potential mechanisms that are associated with these findings. The estimates presented in this chapter show that a one standard deviation increase in passive ownership is related to a 29% decrease in debt concentration. In a subsequent set of results, it is possible to see that results are entirely driven by smaller firms, are mostly leaned towards increases in *Commercial Papers*, *Term Loans* and *Revolving Credit*, and are unrelated to other firms' *ex-post* fundamentals. These results remain robust after different specifications and after adding a wide set of controls. In the final section of the study, I discuss the implications of these results and how they relate to some of the hypotheses previously highlighted in the most recent literature on debt structure and its determinants.

1 M&A Under Financing Frictions: Evidence From Credit Supply Shortfalls

Abstract:

Despite empirical evidence showing that firms' investments decrease during periods of credit supply shortfalls, little is known about how firms can eventually circumvent the adverse effects of negative credit supply shocks. In this paper, we show that firms can relieve financing frictions during banking crisis periods by selling equity stakes to outside investors, and the specific channel that relieves such frictions is a shift from domestic to cross-border issuance in countries with historically higher issuance volume. To do so, we examine Mergers and Acquisitions (M&A) transactions worldwide between 1990-2019 and the outcomes of targeted firms *ex-post* the deal by exploring cross-sectional variation in the supply of credit induced by banking crises. The results show that firms that have higher levels of expiring debt maturities in the year of the credit shock are more likely to become targets in M&A deals. Moreover, we find strong evidence that target firms invest more and issue more debt after the deal relative to their counterparts. Finally, we show that these firms are shifting from issuing debt in their own countries to issuing debt in countries with historically higher issuance volume. All in all, these results show that M&As can work as leeway to relieve financing frictions in periods when credit supply frictions are more prevalent.

Key-words: M&A; Banking Crises, Financing Decisions, Credit Supply Shocks

1.1 Introduction

How do firms withstand liquidity shocks induced by periods of credit supply shortfalls? This question is intrinsically tied to how some firms are more constrained than others in their ability to fund profitable investment opportunities, and traces back to the assumptions embedded in (Modigliani; Miller, 1959), where perfect capital markets imply that all profitable investment opportunities should be undertaken. In practice, absent from frictionless financial markets, standard models of firm investment under financing frictions shed light on the transmission of negative credit supply shocks into the real economy (Holmstrom; Tirole, 1997; Bernanke; Gertler, 1989). Together with financing frictions, negative shocks to the supply of external finance should dampen firms' future investments if firms are unable to fund profitable investment opportunities with internal resources (Duchin; Ozbas; Sensoy, 2010).

In line with such theoretical predictions, the financial crisis of 2008 has motivated a series of empirical studies aimed at identifying the transmission of negative credit supply shocks into the real economy – *i.e.*, the *credit supply channel* –, where corporate investment for non-financial firms significantly declined following the onset of the crisis (Almeida et al., 2012; Duchin; Ozbas; Sensoy, 2010). Moreover, the *supply-driven* nature of this crisis, which is largely attributed to being generated outside of the real sector, is also a key feature to understand how large contractions in the supply of credit might affect firms' future outcomes through the transmission of banks' weak balance sheet positions.

As shown in a recent survey presented in (Campello; Graham; Harvey, 2010), results from more than 1,050 Chief Financial Officers (CFOs) from the U.S, Europe, and Asia show that during the 2008 financial crisis, constrained firms had deeper cuts in capital spending and employment levels, burned through more internal resources, drew more on credit lines, and were more prone to liquidate assets to fund their operations. Additionally, these firms were also more likely to foregone profitable investments, as 86% of the CFOs of financially constrained firms said that investment in profitable projects was bypassed due to a lack of funding.

Notwithstanding, a fundamental question that remains is how do firms actually manage to withstand such shocks. Although there is much attention from the empirical literature on the transmission of credit supply shocks to firms' future outcomes, less is known regarding the channels by which firms can alleviate such adverse effects. As a piece of evidence on this issue, (Garcia-Appendini; Montoriol-Garriga, 2013) show that, during contractions in the supply of credit by financial lenders, *between-firm* credit provision among supplier-client parties increases: as compared to *ex-ante* cash-poor firms, more liquid suppliers extended trade credit to other corporations, consistent with supplied firms providing liquidity insurance downstream.

In this paper, we investigate an alternative leeway in which firms can attenuate the adverse effects of negative credit supply shocks: by selling equity stakes through Mergers and Acquisitions (M&A) transactions. We exploit the differential exposure of firms to credit supply shocks occurring in their countries' headquarters during several episodes of banking crises occurred between 1990-2019 and analyze their *ex-post* deal outcomes in a *differences-in-differences* setting.

More specifically, following (Almeida et al., 2012), we explore variation in long-term debt maturity due in years when target firms were experiencing a banking crisis in their home countries in *differences-in-differences* approach to analyze whether firms facing higher liquidity issues are more likely to be targeted in M&A operations. As such, the identification strategy adopted in this paper aims to insulate the estimated effects from the aforementioned selection on unobservables problem happening both in the sorting of firms into more/less exposed groups and from the potential confounders on deal *ex-post* performance.

The results show that, during years when target firms were experiencing a banking crisis in their home countries, firms with higher portions of expiring debt maturities are 15% more likely to be targeted in acquisitions. Results are robust to different specifications of firms' expiring debt maturities as well as remain unchanged even after employing a wide set of fixed effects. In several additional results, we show that this increase in the likelihood is not explained by past differences between exposed/non-exposed firms, and concentrates on the exact period when a banking crisis hits the targets' headquarters. Overall, these findings are consistent with the argument that during periods of credit supply shocks, access to debt markets is crucial for firms on mitigating the effects of uncertainty on corporate policies, such as precautionary savings and investments (Favara; Gao; Giannetti, 2021).

Despite the increased likelihood of such firms being acquired around banking crises, we cannot, directly from these results, claim that these acquisitions were exclusively motivated by liquidity needs. In terms of liquidity motivations, when access to capital markets is imperfect, value maximization will lead managers to adopt financial policies that seek to guarantee that the most important investments will be effectively put in place (Erel; Jang; Weisbach, 2015). To that matter, such rationale allows us to draw predictions on how some key firm fundamentals should behave *as if* liquidity constraints were relieved.

To shed further light on the motivations behind such transactions, we focus on the subset of firms with expiring debt maturities at the onset of a banking crisis and compare the *ex-post* outcomes of targeted firms to the outcomes of firms that *have not* engaged in any deal throughout the studied period. Overall, not only the estimates are consistent with targeted firms relieving their financing constraints *ex-post* deal occurrence during crisis periods, but also they seem to be persistent over a window of three years after the

shock. Importantly, results do not appear to present any pre-trends between targeted and non-targeted firms over a window of three years before a banking crisis, which further reinforces our argument that confounding factors are not driving the observed results.

As a first piece of evidence, our results on the *ex-post* differentials show that targeted firms were able to attenuate the adverse effects of the decrease in the supply of credit by more than their counterparts: although firms, on average, experienced a drop in -6.9% in asset levels, targeted firms were able to absorb 5.8% of this shock, or 84% less than their counterparts. Similarly, as managers of financially constrained firms might hold cash and liquid assets as a precautionary motive for insuring against credit supply shortfalls (Ferreira; Vilela, 2004), although firms' cash holding levels decreased almost 14% after the shock, the effect is much less pronounced for targeted firms, as they were able to offset 9.4% of this effect, indicating that non-targeted firms were forced to rely more on cash buffers to withstand the negative credit supply conditions.

Moreover, since credit market frictions might oblige firms to foregone economically feasible investment projects, if M&A transactions have the potential to mitigate financing frictions, one should expect financially constrained targets to present a higher growth in debt levels. The results confirm that this is the case: targeted firms increase long-term debt levels 11% more, on average, relative to otherwise similar firms, with increasing effects that amount to almost 20% , on average, three years after the shock. Interestingly, results are not statistically significant while looking at short-term debt levels, which are often related to firms' current operations, and therefore are more prone to be affected by confounding channels that also change after the deal has taken place. Overall, these results help to alleviate concerns about the specific channel that is driving *ex-post* differentials.

Key to the understanding of the channels by which firms adjust to the effects of credit supply shortfalls, our data does not allow us to distinguish between deals across the primary and secondary markets. To that matter, one could argue that the *ex-post* increases are merely a consequence of the transaction, which injected equity into the firm by means of a private placement (Ouimet, 2012). Our results, however, show the exact opposite picture: equity levels do not seem to trend differently across groups *ex-post*. This is important, as it rules out the hypothesis that a primary equity market channel is driving the differential changes observed.

We employ several robustness checks and additional analyses to our baseline results to rule out potential confounding factors that might also be related to the *ex-post* effects of M&A. The results remain robust to different specifications of the financing constraints variables, different sets of controls, and testing alternative hypotheses. Moreover, when replicating the results in a subsample of firms that *were not* exposed to liquidity issues - *i.e.*, those with lower expiring debt maturities -, we do not find any significant results. Moreover, when comparing only firms that were targeted in M&A transactions during

banking crises, but varying on their degree of exposure due to expiring debt maturities, we find higher long-term debt growth levels for the subset of financially constrained firms, with positive and statistically significant effects.

As thoroughly discussed in (Eckbo, 2014; Ouimet, 2012), apart from financing motivations, acquisitions can arise as a solution for circumventing contracting issues, as well as reducing agency costs by enhancing corporate governance practices. For example, several papers highlighted the *ex-post* effects to target and acquirer firms following M&A transactions, such as changes in governance levels and gains from operational synergies. If this is true, an interpretation of the *ex-post* effects following M&A episodes as due to *liquidity* motivations is likely not accurate. In an additional set of results, however, we provide evidence to rule out these alternative explanations.

First, if the reason behind your *ex-post* results was because there are efficiency gains stemming from operational synergies, if there are any differences in terms of where the acquirer firm is located, we would expect the results to be higher for the subgroup of domestic deals – *i.e.*, deals where the target and acquirer firm are from the same country –, as the transaction costs associated with such transactions are plausibly lower. However, when analyzing the results across subgroups of domestic and cross-border acquisitions, we find that our results are mainly driven by deals where the acquirer is a foreign firm, which likely entails higher transaction costs.

Furthermore, if operational synergies are driving our results, one would expect that *ex-post* results would be stronger for deals majority deals – *i.e.*, deals where the acquirer final stake is $\geq 50\%$ of the target's overall equity, as a majority shareholder has more flexibility to implement strategies that could otherwise not be undertaken by the minority shareholders. Again, our results show that, in reality, minority acquisitions are the force behind *ex-post* differentials: by splitting our results in terms of minority and majority acquisitions, results are stronger for the subset of deals where the acquirer's final stake was lower than 50%. Finally, in auxiliary results, we also show that our results are not explained by firms being in the same industry (which is a proxy for operational synergies) and, in reality, are stronger for deals where the acquirer firm belongs to the financial sector.

Overall, we find strong evidence that targeted constrained firms invest more, issue more debt, and reduce the dependence on cash holdings *ex-post* deal occurrence as compared to those that have not engaged in such deals. Taken together, these results highlight the role of the M&A channel in relieving firms' financing constraints during credit supply shortfalls. However, they cannot tell much about the channel by which such adjustment operates.

In the final section of the paper, we shed additional light on the channels behind our results by leveraging *Securities Data Company (SDC) Platinum* issuance database

and collecting all debt and equity issuances between 1990 and 2020, using CUSIP and ticker codes to match with our regression sample.

When comparing the change in issuance levels across firms more/less exposed to a credit supply shock around banking crises, we find not only that these firms are indeed having higher issuances after the banking crisis hits the economy, but also that this effect is entirely driven by debt, and not equity issuances. Furthermore, when splitting our sample in terms of whether the issuer firms' country and the country where the issuance was effectively made were part of the countries with historically the highest numbers of issuance activity ("*Top10*"), we find that the increase in issuances levels is entirely driven by situations where the issuer firm is located in a country outside of *Top10*, but the issuance is made in an exchange that belongs to a country in the *Top10* subset. Analogously, we find that these firms are decreasing issuances in countries outside of the *Top10*, where domestic transactions account for approximately 65% of the total.

These results are reassuring, as not only do they link directly to the findings presented in the *ex-post* results that use *COMPUSTAT* financials, finding similar evidence when using a much cleaner measure of debt and equity activity, but also show how exposed firms from countries are effectively being able of increasing issuances even in a situation of pronounced decline in credit supply. Interestingly, as firms increase access to other foreign markets while moving away from the domestic market, which itself accounts for 45% of all issuances from our sample, our results trace back to the hypothesis presented in (Burns; Francis; Hasan, 2007), where reputational and legal bonding incentivizes firms to cross-list in foreign markets, while also relate to the hypothesis of firms being certified by outside investors (Wruck, 1989; Hertzelt; Smith, 1993).

All in all, these results shed light on the potential role of M&A as a leeway for relieving target firms' financial constraints: by decreasing the marginal cost of debt, firms that were unable (or with a prohibitively higher cost) to access financial markets are now able to increase leverage levels, despite their exposure to a decrease in the supply of credit. In which the minority acquisition acted as a certification device for the target firms' investment opportunities, reducing information asymmetry and thereby relieving financing constraints.

Our findings contribute to several strands of the literature. First, we contribute to the growing literature on understanding the credit supply channel and its spillovers to the real economy. The relevance and the consequences of the transmission of credit-supply shocks to the real economy have been previously documented in several studies. For example, previous papers have documented the adverse effects of the transmission of the recent financial crisis on firms future investments and profitability (Duchin; Ozbas; Sensoy, 2010; Cingano; Manaresi; Sette, 2016; Chava; Purnanandam, 2011; Almeida et al., 2012), capital market dislocations (Jang, 2017), stock valuation (Carvalho, 2015; Tong;

Wei, 2011), corporate payouts (Bliss; Cheng; Denis, 2015), lending patterns (Haas; Horen, 2013; Schnabl, 2012; Giannetti; Laeven, 2012), and liquidity provision (Garcia-Appendini; Montoriol-Garriga, 2013). More specifically, some studies have emphasized the nature of the credit supply shock to the severity of the transmission to the real economy by contrasting different transmission channels, such as banking crises (Levine; Lin; Xie, 2016; Giesecke et al., 2014; Iyer et al., 2014; Kroszner; Laeven; Klingebiel, 2007), bank resolution (Beck; Da-Rocha-Lopes; Silva, 2021), bond market crises (Giesecke et al., 2014), as well as highlighting heterogeneous effects on firms' outcomes depending on shareholder protection laws (Levine; Lin; Xie, 2016).

To that matter, as most of these studies focus on specific market events, such as the recent financial crisis of 2007-2008, this study adds valuable insights to this literature by exploring the role of banking crises over the cross-section of countries during 1990-2019. For example, when analyzing the adverse effects of the 2008 subprime crisis, studies such as (Almeida et al., 2012; Duchin; Ozbas; Sensoy, 2010) show consistent evidence for the negative effect of the credit supply shortfall on the U.S listed firms' investment behavior *ex-post* crisis period. Overall, although there is a more consolidated understanding of the transmission of negative credit supply shocks in the real economy, less is known regarding how firms can eventually circumvent or, at least, attenuate such shocks. The results show that, in these situations, financially constrained firms are more likely to engage as targets in M&A transactions. As such, this paper complements the findings of (Garcia-Appendini; Montoriol-Garriga, 2013) on the trade-credit channel and highlights M&A as an alternative channel for financially constrained firms to smooth out negative credit supply shocks induced through credit supply shortfalls.

Furthermore, this work also adds up to the growing literature on the study of the determinants and consequences of M&A transactions. While some authors seek to understand characteristics of more aggregate phenomena, such as merger waves (Xu, 2017; Andriosopoulos; Yang, 2015; Martynova; Renneboog, 2008a), several authors have focused on understanding the specific motivations behind M&A transactions, such as governance spillovers (Martynova; Renneboog, 2008b), bonding and certification effects (Burns; Francis; Hasan, 2007), internal capital markets (Doukas; Kan, 2008), product-market relationships (Allen; Phillips, 2000), among others. On the other hand, other authors have documented the effects of such transactions on firms' market valuation (Santos; Errunza; Miller, 2008; Francis; Hasan; Sun, 2008), minority shareholders' returns (Crocì; Petmezas, 2010), and ownership concentration (Bhaumik; Selarka, 2012).

To that point, this work contributes to the specific strand of this literature that analyzes the interplay between corporate liquidity and M&A activity. (Almeida; Campello; Hackbarth, 2011) provide a theoretical framework to analyze the acquisition of distressed firms by liquid firms in the same industry, even in the absence of operational synergies.

As such, these "liquidity mergers" would emerge as a way to reallocate assets to solvent firms and avoid inefficient liquidation. Their empirical results corroborate with the model's prediction, with liquidity mergers occurrence more in industries with higher asset specificity, but transferable across firms. Additionally, while some studies have documented a relationship between M&A characteristics and liquidity provision by focusing on the acquirer side (Yang; Guariglia; Guo, 2019), other studies have documented such relationship from the target's perspective (Erel; Jang; Weisbach, 2015; Liao, 2014; Khatami; Marchica; Mura, 2015; Masulis; Simsir, 2018).

For example, (Erel; Jang; Weisbach, 2015) use a sample of European acquisitions and find that majority acquisitions are an effective way by which financially constrained firms can relieve financing frictions and foster corporate investment. Their results show that target firms decrease their degree of financial constraints in several measures *ex-post* the deal occurrence. However, as a full integration between the target and the acquirer firm is also potentially related to operational synergies - which in turn can affect the likelihood of a deal outcome-, it is difficult to assess the relative importance of financial constraints motive to the observed increases in investment. As a way to partly overcome such difficulty, (Liao, 2014) uses a panel of minority block acquisitions from 1990 to 2009 and shows a positive relationship between minority acquisitions and financial constraints. Her results indicate that not only target firms are, in general, financially constrained, but also that minority acquisitions are related to increasing stock prices at announcement dates, as well as increases in future investments after the deal occurrence. Considering a time-span of two years following the acquisition, 27% (9%) of the target firms issue new equity (debt), raising 27% (24%) of their market capitalization.

Notwithstanding, none of the previous studies is conducted under a situation of pronounced decline in the supply of credit. Crucially, to the extent that unobserved investment opportunities can be heterogeneous across deals, the lack of a clean identification strategy casts doubt on the endogeneity of the relationship between deal occurrence and investment opportunities, which can severely undermine a causal interpretation of the effect (Farre-Mensa; Ljungqvist, 2015). In this sense, by focusing on periods marked by banking crises, we complement previous findings (Liao, 2014; Erel; Jang; Weisbach, 2015; Ouimet, 2012) on financial constraints and M&A activity not only by explicitly considering a situation of special interest on the behavior of financially constrained firms - *i.e.*, when credit market imperfections are more prevalent and credit supply has decreased but also by employing an identification strategy that is less affected by the presence of unobserved confounders that might also explain deal activity and firms' *ex-post* outcomes.

Overall, although several papers have emphasized the relevance of credit supply shocks and, in special, the specific role that banking crises have on the transmission of these shocks to the real economy, less is known about firms can eventually attenuate these

adverse effects. To that point, this work extends the understanding of M&A as a potential channel to alleviate firms' liquidity needs induced by banking crises.

The remainder of this paper is structured as follows. Section 1.2 describes the data sources and sampling procedures used to construct the dataset used in this study. After that, Section 1.3 provides a detailed discussion on how to measure financial constraints and the empirical caveats related to assessing the causal effects in our framework, as emphasizing the role of our identification strategy as a way to circumvent some of the empirical issues found in previous studies. Section 1.4 and Section 1.5 provides a discussion of the results and several robustness checks based on the baseline estimates. Section 1.6 sheds light on the channels related to the findings shown in the previous sections. Section 1.7 provides an overall discussion of the findings and its relationship with the results previously documented in the literature. Finally, Section 1.8 concludes and provide directions for future research.

1.2 Data and Sampling Procedures

We construct an extensive database at the *firm-year* level by using three main sources of data: deal information, target firms' financials, and country characteristics. In the next subsections, we provide a thorough description of the main steps to construct the dataset used in the empirical analysis.

1.2.1 Deal Activity Data

We collect transaction data from *Securities Data Company Platinum (SDC Platinum)*, the industry's standard for information on M&A activity, maintained by *Refinitiv*. *SDC Platinum* provides broad coverage of detailed information on historical transactions for listed and non-listed firms worldwide, such as acquirer and target information, percentage of acquired and final shares by the acquirer firm, payment method, among others. Specifically, we collect all transactions from 1990 to 2019 in which the deal status was defined as "completed" and remove any duplicated transactions, yielding 928,48 deals.

Next, we remove all deals in which i) target and acquirer firm belong to the same ultimate parent (67,237); and ii) deals where the target firm belongs to the financial industries and the utilities sector¹ (178,458), leaving us with 683,053 unique deals.

In addition to information on domestic and cross-border deal activity, we also collect information on debt and equity issuances worldwide, from 1990 to 2020. Issuance data from *SDC Platinum* contains key information, at the firm-issuance level, regarding I)

¹ Specifically, we drop all observations for firms that belong to the following 2-digit SIC codes: 45, 49, 60, 61, 63, 64, 65, 66, 67, 92, 94, 95, 96, 97, and 99.

type of instrument issued; II) the amount and maturity related to the issuance; III) the exchange where the issue is listed, among others.

1.2.2 Firm-level Financials

Along with the transactions collected in *SDC Platinum*, we collect target firms' financials in *COMPUSTAT US/Global* by matching on firms' Ticker, SEDOL and CUSIP identifiers. As such, for all the deals in our sample, we collect firm-year information regarding key target firm fundamentals, such as Cash-Flows, Assets, Profits, Short and Long-Term Debt, among others. Importantly, we drop all deals in which we are not able to recover target firm financials from *COMPUSTAT* using Ticker, CUSIP, or SEDOL codes (622,393), leaving us with 60,660 deals.

To be able to compare targeted and non-targeted firms, we merge our data with the universe of *COMPUSTAT* firms that *have not* entered in any M&A transaction as targets during the sample period, collecting their financials across the same sample period. This procedure yields an (unbalanced) panel of firm-year level information regarding targeted and non-targeted firms in M&A activity during 1990 and 2019.

Finally, with our firm-year data, we merge target and acquirer country-year level information regarding firm countries' financial development characteristics using the *Global Financial Development Data (GFDD)*, an extensive dataset developed by *The World Bank Group* that comprises financial and market characteristics for almost 210 economies. More specifically, this dataset comprises several measures of (1) the size and prevalence of financial institutions and markets, (2) the degree to which individuals can and do use financial services, (3) the efficiency of financial intermediaries and markets in intermediating resources and facilitating financial transactions, and (4) the stability of financial institutions and markets.

After applying all the filters regarding key financial indicators – *e.g.*, negative values for Assets, Debt ratios, Leverage, as well as negative/greater than one for PPE/Assets, Cash Holdings/Assets, etc –, we reach a final sample of 58,814 deals, with 962,073 firm-year observations comprising targeted/non-targeted firms. Based on this sample, all firms' financial variables were winsorized on an yearly basis at the 1th and 99th percentiles. A detailed description of the main variables used in the baseline specifications is presented in Table 1. Before formally describing the empirical strategy employed in the study, in the next subsection we provide detailed descriptive information regarding several relevant facts in the final sample.

Table 1 – Variable names, definitions, and sources.

This table presents a detailed description of the main variables used in the study. All information is collected through the sources indicated in Section 1.2.

Name	Variable	Definition
Deal information (Source: SDC Platinum)		
<i>Deal Occurrence</i>	<i>Deal</i>	A dummy variable that assigns 1 (one) if a firm has engaged in a minority acquisition as target, and zero otherwise.
<i>Deal Stake Acquired (%)</i>	<i>DealStake</i>	The percentage of shares bought by the acquirer firm of target's outstanding shares.
Financial Data (Source: Compustat Global and Compustat US)		
<i>Cash Holdings/Assets</i>	<i>CH</i>	Cash and Short-Term Investments over Total Assets
<i>PPE/Assets</i>	<i>PPE</i>	Property, Plant and Equipment over Total Assets
<i>Debt/Assets</i>	<i>DA</i>	Total Debt over Total Assets
<i>Long-Term Debt Ratio</i>	<i>LTDebt</i>	Long-Term Debt over Total Debt
<i>Short-Term Debt Ratio</i>	<i>STDebt</i>	Short-Term Debt over Total Debt
<i>Size</i>	<i>Size</i>	Natural Logarithm of Total Assets
<i>Sales Growth</i>	<i>SG</i>	Yearly growth in gross revenues.
<i>Dividend Yield</i>	<i>Yield</i>	Dividend paid over share price.
<i>Dividend Dummy</i>	<i>Dividend</i>	A dummy variable that assigns one if $Yield > 0$.
<i>Sales Growth</i>	<i>SG</i>	Yearly growth in gross revenues.
<i>Sales Growth</i>	<i>SG</i>	Yearly growth in gross revenues.
<i>Maturing Debt</i>	<i>Maturing</i>	The firm's proportion of long-term debt due in one year.
<i>Financially Constrained</i>	<i>FC</i>	A dummy variable that assigns 1 (one) if the firm's proportion of long-term debt due in one year is greater than the industry-year median (Fama French Industry Classification).
Country-level data (Source: Global Financial Development Database (The World Bank))		
Banking Crisis	<i>BankCrisis</i>	A dummy variable that assigns 1 (one) if a banking crisis has emerged in a firm's headquarter country in a given year, and zero otherwise, following (Laeven, Valencia, 2018).

1.2.3 Summary Statistics

As it can be seen from Table 2, firms that have engaged in minority acquisitions as targets are somewhat different in these years from the rest of the sample. In general, these firm-year pairs are slightly bigger, present higher levels of *Cash Holdings*, *Short-Term Debt* and *Sales Growth*, while also presenting lower levels of *Cash Flow* generation and *Long-Term Debt*. The average firm in our sample - weighted by the number of firm-year observations - has an Asset size of approximately 77 billion USD in nominal values. This value is considerably *higher* than the median firm in *COMPUSTAT*: among all years, the average firm in our sample is equivalent, in terms of *Total Assets*, to the 85th percentile of the *Total Assets* distribution for that year. This possibly reflects the fact that firms that engage in minority acquisitions - or that are headquartered in countries with higher deal activity - tend to be bigger than those that do not have well-developed capital markets in their home countries, which can coincide with the coverage from *SDC Platinum*. While we acknowledge that our effects are not representative of the overall population of firms, due to its representativeness in terms of size, we hypothesize that a better *ex-post* deal performance for financially constrained firms in our sample would possibly imply significant aggregate effects for the economy.

Finally, despite the fact that some of the firms' financial characteristics are statistically different among target/non-target firms, the magnitudes of such differences are generally modest. Notwithstanding, since a naive comparison between these groups is unfeasible, the next section will provide a detailed description of the empirical strategy adopted in the study to tease out the relationship between financing constraints and deal outcomes.

1.3 Methodology

1.3.1 Measuring the effects of financial constraints

Several papers have emphasized the interplay between firms' financial constraints and the occurrence of M&A as a way to boost firms' ability to access funding, either by direct equity placements or through better access to capital markets. For example, using a sample of European majority acquisitions, (Erel; Jang; Weisbach, 2015) show that financially constrained firms are more likely to be targeted in such transactions, and that *ex-post* deal occurrence, these firms are able to relieve their financing constraints on several dimensions, such as increasing levels of future investments, debt, and a lower dependence upon internal resources. Similarly, other papers, such as (Ouimet, 2012; Liao, 2014), show that, among other motivations, target firms' financial constraints are positively related to the occurrence of minority acquisitions. Finally, (Khatami; Marchica; Mura, 2015) shows that, in terms of acquisition gains, acquisitions involving financially constrained targets

Table 2 – Summary Statistics for the Regression Sample

This table presents the summary statistics for the sample used in the baseline specifications described in Section 1.4. "Deal Sample" is a binary variable that assigns "Yes" if a firm was involved in an M&A operation as a target during the sample period, and zero otherwise. The remaining columns refer to average means, standard deviations, minimum value, first quartile, median, third quartile, and the maximum of each subsample. Finally, *p-val* denotes the p-value for the *Welch t-test* of the differences between the two subsamples. Our sample comprises 58,814 unique cross-border and domestic M&A transactions. All variable definitions are presented in Table 1.

Descriptive Statistics - Targeted and non-targeted Firms									
	Deal Sample	μ	σ	Min	Q1	Median	Q3	Max	<i>p-val</i>
<i>Size</i>	Yes	7.29	3.10	-0.89	5.11	7.08	9.33	15.68	<0.001
	No	6.76	3.20	-0.89	4.59	6.68	8.84	15.68	
<i>Cash Holdings/Assets</i>	Yes	0.14	0.15	0.00	0.03	0.09	0.19	0.83	<0.001
	No	0.14	0.15	0.00	0.03	0.09	0.19	0.83	
<i>PPE/Assets</i>	Yes	0.32	0.23	0.00	0.13	0.28	0.47	0.94	<0.001
	No	0.31	0.23	0.00	0.13	0.27	0.46	0.94	
<i>Debt/Equity</i>	Yes	0.87	2.03	-13.02	0.15	0.50	1.12	14.67	<0.001
	No	0.73	1.84	-13.02	0.11	0.41	0.96	14.67	
<i>Cash-Flow/Assets</i>	Yes	0.01	0.11	-0.69	-0.02	0.00	0.03	0.69	<0.001
	No	0.01	0.10	-0.69	-0.01	0.00	0.03	0.69	
<i>Long-Term Debt Ratio</i>	Yes	0.52	0.35	0.00	0.18	0.56	0.84	1.00	<0.001
	No	0.47	0.35	0.00	0.11	0.48	0.80	1.00	
<i>Short-Term Debt Ratio</i>	Yes	0.48	0.35	0.00	0.16	0.44	0.82	1.00	<0.001
	No	0.53	0.35	0.00	0.20	0.52	0.89	1.00	
<i>Debt/Assets</i>	Yes	0.29	0.26	0.00	0.11	0.25	0.40	3.15	<0.001
	No	0.29	0.31	0.00	0.10	0.23	0.39	3.15	
<i>Dividend Yield</i>	Yes	0.16	0.36	-1.62	0.00	0.07	0.24	3.01	<0.001
	No	0.18	0.37	-1.62	0.00	0.10	0.25	3.01	
<i>Dividend Dummy</i>	Yes	0.63	0.48	0.00	0.00	1.00	1.00	1.00	<0.001
	No	0.69	0.46	0.00	0.00	1.00	1.00	1.00	
<i>Sales Growth</i>	Yes	0.30	3.01	-1.00	-0.05	0.07	0.24	1,126	0.007
	No	0.27	3.81	-1.00	-0.05	0.07	0.22	1,126	
<i>Bank Crisis</i>	Yes	0.08	0.28	0.00	0.00	0.00	0.00	1.00	<0.001
	No	0.09	0.28	0.00	0.00	0.00	0.00	1.00	

yield positive abnormal results for both parties. Overall, empirical evidence is in line with the argument that such transactions are able to increase the ability of target firms to access resources, either through an internal reallocation of assets (*i.e.*, internal capital markets) or a better a access to external markets, by decreasing the firms' information asymmetry to outside market participants (Hertzel; Smith, 1993).

As in most of the Corporate Finance issues, analyzing the effects of financing constraints on firms' future behavior is not straightforward, as a series of unobservable characteristics may be related to the firms' degree of financial constraints and, at the same time, determine their future outcomes. Importantly, simply absorbing firm-invariant confounders through firm fixed effects is unlikely to be sufficient, as there are concerns that time-varying, unobservable investment opportunities, which are observable to the firms' but unobservable to the econometrician, may be driving the results. Due to this reason, analyzing the effects of target firms' financial constraints on their decision to sell minority stakes has several empirical caveats.

First, as financial constraints are not directly observable, empirical attempts to analyze the willingness of firms to forego positive NPV projects generally use indirect proxies related to firms' investment sensitivity. Since the seminal paper by (Fazzari et al., 1988), several attempts to effectively measure the degree of firms' financial constraints have been applied, although there is no consensus regarding which is the best proxy for identifying a firms' investment sensitivity to financing conditions. While some measures focus on only one specific dimension of financial constraints (*e.g.*, size, dividend payout, ratings) - (Fazzari et al., 1988; Carpenter; Guariglia, 2008), indexes of financial constraints that spans several dimensions of firms' financial decisions have been widely applied, such as the *KZ* (Kaplan; Zingales, 1997; Lamont; Polk; Saa-Requejo, 2001), the *WW* (Whited; Wu, 2006) and the *SA* (Hadlock; Pierce, 2010) indexes.

Despite the lack of a general agreement with regards to these measures of financial constraints, several recent papers adopt some of these measures by splitting the sample into terciles/quintiles of the distribution, assigning firms into groups of high/low degree of financial constraints (Khatami; Marchica; Mura, 2015; Liao, 2014). However, recent work by (Farre-Mensa; Ljungqvist, 2015) shows that although widely applied in the literature, such measures do not adequately identify firms that behave as if they were financially constrained. By defining two testable assumptions regarding the behavior of financially constrained firms in debt and equity markets, the authors show that none of these measures adequately classifies financially constrained firms as if they were in fact constrained.

As such, relying on such indirect proxies for firms' internal cash dependence, may capture several firms' dimensions other than financial constraints, such as unobservable investment opportunities. (Farre-Mensa; Ljungqvist, 2015) highlights that most of the indirect proxies used proposed in the literature do not adequately capture the degree to which firms are financially constrained in situations where these firms should behave *as if* they were financially constrained, such as episodes of decrease in the supply of credit .

To overcome some of these limitations, we depart from the aforementioned studies and follow (Almeida et al., 2012) by using the value of long-term debt due in one year as a measure of financial constraints. Being applied to analyze the differential effects of credit supply shocks on financially constrained firms during the recent financial crisis, this approach has several advantages over the preexisting proxies for financial constraints, as it represents a situation in which firms with higher levels of maturing debt suffer more from exogenous variations in the supply of bank loans (Farre-Mensa; Ljungqvist, 2015). As such, the rationale behind considering the long-term debt maturity as a measure of financing constraints is that firms with a higher of long-term debt maturing *at the onset of the crisis* were forced to adjust their decisions in a more pronounced way than otherwise similar firms that were not *ex-ante* exposed to higher levels of maturing debt in such a short time-span.

Notwithstanding, there are potential endogeneity issues arising from using this measure as a proxy for firms' financing constraints if the level of maturing debt in a specific year is determined by managerial forward-looking behavior seeking to choose the best maturity period to maximize the firm's value. We argue that this concern is unlikely to hold in our specific setting. First, as the *timing* of maturity is arguably exogenous, any potential source of endogeneity coming from factors unrelated to financial constraints should also explain the firms' decisions to issue debt maturing at that exact period. If it were the case, then firms should be able to time the market and optimally decide the maturity date, which is unlikely to hold in a setting marked by firms being unable to comply with debt payments accordingly.

Given all of the above, we define $Maturing_{i,t}$ as the firm's i Long-Term Debt maturing in one year normalized by its Total Long-Term Debt in period t . To define our measure of financial constraints, we follow closely (Almeida et al., 2012) and define $FC_{i,t}$ as a dummy variable that assigns 1 (one) if the firm's long-term maturing debt (normalized by total long-term debt is higher than the *industry-year* median, and zero otherwise. To the point that (Almeida et al., 2012) define a stricter measure of firms' financing constraints by assigning 1 (one) if the firm's normalized long-term maturing debt is higher than 20%, we argue that as the empirical setting presented in (Almeida et al., 2012) was focused on understanding the effects of the 2007-2008 financial crisis, such an absolute measure can fail to capture differences between financially constrained and unconstrained firms over time and across different countries².

That being said, even though the timing of maturity is arguably unrelated to several firm characteristics that might correlate with future outcomes, one might still be concerned about the relevance of this measure to proxy for financing constraints. To that matter, given that the sample is comprised only of listed firms, is it reasonable to assume that a firm that has a high portion of its long-term debt in its balance-sheet maturing in the current period would be restricted from pursuing its investments upfront? Put another way, would this firm have any difficulty in simply rolling over debt and extending its maturity? If this is the case, then a high portion of maturing debt would be a weak instrument for the degree of firms' financial constraints.

Even though it is unlikely that listed firms with expiring debt would have any difficulties in extending their maturities, a different situation emerges in situations where credit market imperfections are more prevalent. When considering periods of credit supply shortfalls, such as banking crises, successfully rolling over debt may not be an option, even for listed firms. In this situation, with a higher level of maturing debt that due *exactly* in periods of negative credit supply shocks, firms may anticipate the lack of financial

² In unreported tables, we run repeat our baseline regressions and find qualitatively similar results when defining our financing constraints variable as in (Almeida et al., 2012).

resources and be forced to withdrawn future investments.

To capture the idea that maturing debt may affect firms' investments during adverse credit supply conditions, we use the *Systemic Banking Crises Database*, discussed in (Laeven; Valencia, 2018) and available on *GFDD* database, and highlight deals in years when banking crises were in place in the target firms' country headquarters. Drawing upon (Laeven; Valencia, 2018)'s study, we define $BankCrisis_{m,t}$ as a dummy variable that assigns 1 (one) if country m was suffering from a banking crisis in year t .

More specifically, a banking crisis is defined as systemic if *two* conditions are met: first, there are significant signs of financial distress in the banking system, as indicated by significant bank runs, losses in the banking system, and/or bank liquidations; second, there are significant banking policy intervention measures in response to significant losses in the banking system. As such, the first year that *both* criteria are met is considered as the year when the crisis starts becoming systemic (*i.e.*, $BankCrisis_{m,t} = 1$). Relatedly, the end of a crisis is defined as the year before both real GDP growth and real credit growth are positive for at least two consecutive years (*i.e.*, $BankCrisis_{m,t} = 0$).

1.3.2 Baseline Specification

In our main specification, we employ a *differences-in-differences* approach to analyze the differential effect on the likelihood of being targeted in an acquisition for financially constrained firms during periods of credit supply shortfalls induced by banking crises. For that, we run a linear probability model (LPM) regression model with the following specification:

$$Deal_{i,t} = \beta_1 \times BankCrisis_{m,t} + \beta_2 \times FC_{i,t} + \beta_{DD} \times (BankCrisis_{m,t} \times FC_{i,t}) + \gamma_1' Controls_{i,t-1} + \gamma_2'(Controls_{i,t-1}' BankCrisis_{m,t}) + \alpha_i + \alpha_t + \varepsilon_{i,t}, \quad (1.1)$$

where $Deal_{i,t}$ is a dummy variable that assigns 1 (one) if firm i was target of an acquisition in year t , and zero otherwise, $FC_{i,t}$ is a dummy variable that equals one if firm i is considered financially constrained, and $BankCrisis_{i,t}$ is defined as before. Even though the timing of debt maturity is arguably unrelated to firms' behavior, we employ a wide set of fixed and time-varying covariates to control for possible confounders that may drive the likelihood of selling equity. More specifically, we control for firm fixed effects (α_i and α_t , respectively), and include a vector of one-year lagged firms' financial characteristics to control for possible confounding variation in our results. More specifically, we include *Cash Holdings*, *Cash Flow*, *Leverage*, and *Property, Plant and Equipment*, all normalized by *Total Assets*, *Size*, as measured by the natural logarithm of assets, and *Sales Growth*. In our full specification, we also include *pre post* trends for $Controls_{i,t-1}$ to capture any effect coming from the deterioration of firms' fundamentals.

In this framework, β_{DD} measures the differential effect of a firm having a significant portion of its long-term debt maturing in the same year when their headquarter country is suffering from a banking crisis. As the previous discussion makes clear, we expect β_{DD} to be *positive*, as firms with debt maturing in periods where credit market imperfections are more prevalent might seek to attenuate the adverse effects of such shocks, either by private placements or certifying investment opportunities to outside investors.

1.4 Results

1.4.1 Differential effects for the occurrence of M&A transactions during banking crises

Table 3 presents the results of the *differences-in-differences* estimation highlighted in Equation (1). In all specifications, the interaction term, $FC \times BankCrisis$, is positive and statistically significant, which indicates that firms with expiring debt maturities are more likely to be targeted in M&A transactions during banking crises. The results hold even when considering different specifications for classifying the degree of firms' financing constraints, $FC_{i,t}$, such as terciles and quintiles of $Maturing_{i,t}$ distribution, as well as a continuous, standardized version of $Maturing_{i,t}$ ³. All specifications include clustered standard errors at the firm level.

It is interesting to compare the estimates presented in Columns (1)-(4) to understand the effect of including different sets of controls in our baseline specification. While in Columns (1)-(2), where we include no controls/only firm-level covariates and year fixed effects, respectively, banking crises, in general, seem to have a significant effect on M&A activity, in general. However, if M&A activity (from the target's perspective) is generally located in countries that are less likely to suffer from banking crises, then *BankCrisis* is also measuring some sorting of firms into different locations⁴. As shown, the inclusion of firm fixed effects, presented in Column (3), amplifies the effect of the *BankCrisis* during banking crises by more than twice the magnitude presented in Column (2).

Notwithstanding, it could also be the case that firms headquartered in countries with a higher propensity to suffer from a banking crisis also suffer more from declining stock prices during downturns. As the sample is comprised of listed firms only, a potential concern with respect to the first three specifications is the fact that firms' fundamentals may deteriorate in the event of a banking crisis, driving stock prices down and ultimately affects M&A activity due to firms exposure to hostile takeovers.

³ In unreported tables, we run the same specifications presented in Table 3 for terciles, quintiles, and a continuous version of $Maturing_{i,t}$. All results hold, quantitatively and qualitatively.

⁴ For example, drawing on an institutional analysis framework, if a country's investor protection system is poor, this can be related to a low degree of M&A activity and at the same time to lower economic development that ultimately leads to a higher likelihood of being hit by a banking crisis.

Table 3 – Differences-in-Differences estimates - Maturing \geq Industry-Year Median

This table presents the estimation results of the Linear Probability Model (LPM) specification, presented in Equation (1) and described in Section 1.3. The dependent variable, $Deal_{i,t}$, is a binary variable that assigns 1 if firm i was involved in an M&A transaction as a target in period t , and zero otherwise. FC_i is a binary variable that assigns 1 if firm i is considered financially constrained in period t i.e. $Maturing_{i,t} \geq$ Industry-Year median, and zero otherwise. $BankCrisis$ assigns 1 if the observation is measured in an year when a banking crisis hits the firm's headquarters. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Deal Dummy (1 if Deal in that year, zero otherwise)				
	(1)	(2)	(3)	(4)	(5)
FC	0.002*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.001 (0.001)	0.001 (0.001)
$BankCrisis$	-0.005*** (0.001)	-0.005*** (0.001)	-0.012*** (0.001)	-0.004** (0.002)	-0.008** (0.004)
$FC \times BankCrisis$	0.004** (0.002)	0.004* (0.002)	0.006*** (0.002)	0.005** (0.002)	0.005** (0.002)
Controls?	No	✓	✓	✓	✓
Year fixed effects	No	✓	✓	✓	✓
Firm fixed effects	No	No	✓	✓	✓
Controls \times Crisis?	No	No	No	No	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm
Observations	601,784	504,815	504,815	504,815	504,815
R ²	0.0001	0.0003	0.002	0.086	0.086
Adjusted R ²	0.0001	0.0003	0.001	0.011	0.011

Note: * p<0.1; ** p<0.05; *** p<0.01

To address such concern, we also include in our specifications interactions between firms' financials and *BankCrisis*, seeking to capture any effect that comes through firms' decreasing fundamentals. In Column (4), we present our most preferred specification, which includes one-year-lagged firm's financials and their interactions with the banking crisis variable, as well as firm and time fixed effects. Interestingly, expiring debt maturities, *individually*, do not seem to be related to firms' propensity to sell minority stakes anymore. That is, after including controls for pre/post trends on banking crisis for firms' fundamentals, the effect of $FC_{i,t}$, which is positive and statistically significant in specifications (1)-(3), vanishes. In other words, absent from any relevant change in firms' fundamentals *ex-post* a banking event, the level of expiring debt maturity does not seem to drive the likelihood of firms to be targeted in acquisitions⁵. Interestingly, to evaluate the extent to which the change in firms' fundamentals during downturns is relevant to explain deal activity, it is worth noticing the substantial increase in the Adjusted R^2 upon the inclusion of $Control \times BankCrisis$ terms, which potentially indicates the relevance of deteriorating firms' fundamentals during periods of negative credit supply shocks.

More importantly, during periods of banking crises, although firms are overall less likely to engage as targets in M&A transactions, there is an *increase* in the likelihood for financially constrained firms, as shown by the interaction term, $FC \times BankCrisis$, which is positive and statistically significant in all specifications. More importantly, the *net* effect (the sum of the coefficients FC and $FC \times BankCrisis$) for financially constrained during banking crises is positive and statistically significant in Column (4), which indicates that such effects more than compensate for the decrease in M&A activity during adverse credit supply conditions. Not only statistically significant, the estimates for $FC \times BankCrisis$ presented in Table 3 are also of economic significance: as the unconditional (conditional) average occurrence of a deal in the sample is 0.036 (0.046), estimates from Column (4) imply an increase of 13.8% (10.3%) on the likelihood of an acquisition. These effects are sizable, especially when considering a situation often marked by a stark increase in financial market volatility.

1.4.2 Robustness Checks

The results from the last subsection highlight that firms with a higher portion of expiring debt maturities in years that coincide with banking crises are more prone to sell equity stakes, even after considering a wide set of covariates and fixed effects to control for potential confounders. In this section, we provide additional evidence that the results

⁵ For example, if due to the banking crisis, firm's fundamentals deteriorate severely as to drive stock prices down, this firm is more prone to be target of a hostile takeover from an acquirer seeking to explore a decrease in the target's stock prices. To be able to insulate the estimation from relevant changes in firm's fundamentals, in Column (4) we include *pre* and *post* trends for firms' financials by interacting them with $BankCrisis_{i,t}$.

are robust to different specifications of the estimation procedure, timing patterns, and outliers.

1.4.2.1 Industry-wise and Country-wise trends

First, we address potential endogeneity concerns related to omitted time-varying confounders, which we present in Table 4. For example, one may be concerned that the results are specific to industries with intense M&A activity during periods that coincide with banking crises, as industries characterized by low asset redeployability may be more leveraged and, at the same time, more prone to M&A activity during adverse credit conditions. If this is the case, then the inclusion of industry-year fixed effects should absorb all within industry-year variability that explains merger activity. As shown in Column (1) of Table 4, the inclusion of time-varying industry effects does not qualitatively change the results.

Additionally, it could also be the case that country-specific factors are driving the results. For example, if some countries with higher levels of corporate debt implemented institutional in response to the potential adverse effects of banking crises, then controlling for time-varying, country specific factors, should absorb all the variability that is within country-year specific and relevant to explain merger activity. As shown in Column (2), this is also unlikely to be the case, as the estimated coefficients are still in line with the baseline estimations presented in Table 3. In Columns (3)-(6), we run different specifications using combinations of firm, industry-year, and country-year fixed effects, finding no evidence that industry-specific and country-specific trends are responsible for explaining the surge in M&A activity during credit supply shortfalls for financially constrained firms.

1.4.2.2 Timing around banking crises

Another concern related to the results presented in Table 3 relates to the specific *timing* of banking crises. Our identification strategy implicitly assumes that the timing of banking crises reflects *supply-side* shocks that affect the firms' set of financing options. Notwithstanding, another possible concern is that the timing of banking crises experienced by firms in our sample may be confounded by other relevant time-varying country-level factors that are present even in the absence of banking crisis and that, in turn, could generate supply-side contractions. In special, one might be concerned that the discussed effects are ultimately *demand*, and not *supply*, driven. If this is the case, then our identification may be capturing *demand-side* factors that correlates with firms' unobservable investment opportunities.

Moreover, since our measure of credit supply shocks relies on a series of events that happened during 1990 to 2019, a potential concern with this approach is that results might be driven by some specific event - *i.e.*, the rise in uncertainty associated with the 2008

Table 4 – *Differences-in-Differences* estimates - Alternative sets of controls

This table presents the estimation results of alternative specifications of the Linear Probability Model (LPM) presented in Equation (1) and described in Section 1.3. In Column (1), we include industry-year fixed effects to control for time-varying unobserved heterogeneity at the industry-level by using the Fama-French Industry Classification. In Column (2), we include country-year fixed effects to control for time-varying unobserved heterogeneity at the country-level. Column (3) includes both sets of time-varying controls presented in (1) and (2). Column (4) adds firm-fixed effects to Column (1) specification, and Column (5) adds firm-fixed effects to Column (2) specification. Finally, Column (6) includes all sets of alternative controls (firm fixed effects, industry-year fixed effects, and country-year fixed effects). Therefore, the remaining variation in column (6) captures firm-year level variation that is not related to any of the covariates and/or controls. All variable definitions and specifications are similar to Table 3. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Deal Dummy (1 if Deal in that year, zero otherwise)					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>BankCrisis</i>	-0.017*** (0.004)	-	-	-0.010*** (0.004)	-	-
<i>FC</i>	0.003*** (0.001)	0.002** (0.001)	0.001** (0.001)	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)
<i>FC × BankCrisis</i>	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.005** (0.002)	0.005** (0.002)	0.005*** (0.002)
Fixed Effects	Ind. × Year Firm	Country × Year Firm	(1+2) Firm	Firm + Ind. × Year Firm	Firm + Country × Year Firm	All Controls Firm
S.E Clustering	498,406	504,815	498,406	498,406	504,815	498,406
Observations	0.006	0.014	0.018	0.089	0.095	0.098
Adjusted R ²	0.004	0.010	0.012	0.012	0.016	0.017

Note: * p<0.1; ** p<0.05; *** p<0.01

financial crisis - rather than a common component of distinct banking crisis episodes related to the supply of credit. If this is true, then the presented estimates may be confounded with time-specific drivers not related to negative credit supply shocks.

To address both of these issues, we re-estimate a dynamic version of Equation (1) by running the following regression:

$$\begin{aligned} Deal_{i,t} = & \beta_1 \times FC_{i,t} + \sum_{t=-3}^{+3} \beta_t \times \{1[Rel.Year_{m,t} = t] \times FC_{i,t}\} \\ & + \gamma'_1 Controls_{i,t-1} + \gamma'_2 (Controls_{i,t-1}' BankCrisis_{m,t}) \\ & + \alpha_i + \alpha_t + \varepsilon_{i,t}, \end{aligned} \quad (1.2)$$

where $Rel.Year_{m,t}$ is the relative year with respect to the banking crisis, and all the other variables defined as before, using the year right before the banking crisis (*i.e.*, $BankCrisis_{-1}$) as the reference category. As Table 5, Column (1) shows, the positive and statistically significant results found in Table 3 are driven mainly by the *exact* year when a banking crisis hits the economy, and do not seem to be related to preexisting events. As such, these results reinforce that the surge in the likelihood is related to the specific timing of banking crises, and not to other potential preexisting trends, such as demand-induced trends, that might also affect the likelihood of a deal. Furthermore, the increase in the likelihood of a transaction seems to be concentrated at the onset of the crisis, when credit supply conditions are more deteriorated and do not seem to survive over time, as shown by the non-statistically significant results for periods that are ahead of the exact year of the banking crisis.

Moreover, Column 2(3) expands the set of controls by adding country-year (industry-year) fixed effects as a way to control for time-varying unobservables at the country(industry) level. Figure 1 shows a graphical interpretation of the deal likelihood estimates presented in column (3) of the table. All in all, these results show that evidence that the effects are not driven by a specific country and/or industry that is more exposed to an episode of severe credit supply contractions. Together, these findings provide additional evidence that the previous results do reflect common characteristics of banking crises with regard to the adverse effects implied by severe credit supply constraints.

1.4.3 Assessing *ex-post* deal effects

The results discussed in the last subsection provide evidence that although the overall level of M&A tends to decrease during periods of banking crises, such transactions are more likely to target firms with a high level of expiring debt maturities. Along with a set of additional results, we show that the results are likely to arise due to *liquidity* issues from the *target* firms' perspective, and not through other motivations, such as

Table 5 – *Differences-in-Differences* Estimates - Deal Likelihood Around Banking Crises

This table presents the estimation results of the dynamic effects, linear probability model (LPM) specification, presented in Equation (2) and described in Section 1.3. The dependent variable, $Deal_{i,t}$, is a binary variable that assigns 1 if firm i was involved in an M&A transaction as a target in period t , and zero otherwise. FC_i is a binary variable that assigns 1 if firm i is considered financially constrained in period t *i.e.*, $Maturing_{i,t} \geq$ Industry-Year median, and zero otherwise. $BankCrisis_{\pm t}$ refers to the relative year of the banking crisis that occurred in firm's i country headquarters - *i.e.*, how many leads or lags relative to a banking crisis year in his headquarters firm i , in period t , is. In all specifications, we present only the interaction terms with the financially constrained status, FC . Column (1) presents the estimation results of Equation (2) using firm and year fixed effects. Column (2) includes country-year fixed effects to account for unobserved, time-varying heterogeneity at the country-level, and Column (3) includes country-year fixed effects to account for unobserved, time-varying heterogeneity at the industry-level, according to the Fama French Industry Classification. Covariates definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

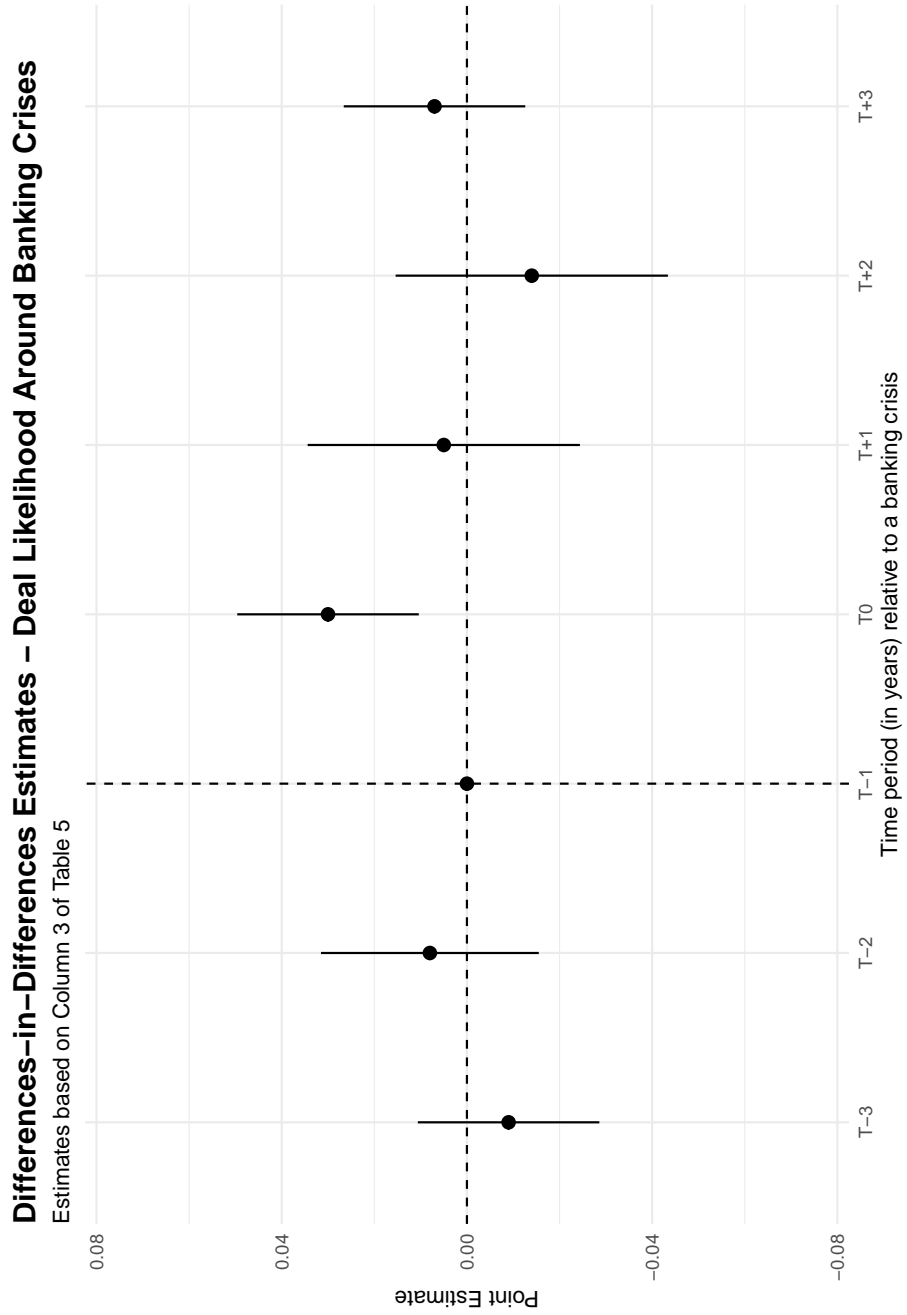
	Deal Dummy (1 if Deal in that year, zero otherwise)		
	(1)	(2)	(3)
$BankCrisis_{-3} \times FC$	-0.010 (0.010)	-0.031* (0.016)	-0.009 (0.010)
$BankCrisis_{-2} \times FC$	0.012 (0.012)	0.006 (0.017)	0.008 (0.012)
$BankCrisis_0 \times FC$	0.023** (0.012)	0.028* (0.016)	0.024** (0.012)
$BankCrisis_{+1} \times FC$	-0.002 (0.015)	0.018 (0.023)	0.005 (0.015)
$BankCrisis_{+2} \times FC$	-0.016 (0.014)	-0.017 (0.022)	-0.014 (0.015)
$BankCrisis_{+3} \times FC$	0.014 (0.009)	0.015 (0.013)	0.007 (0.010)
Controls	Firm + Year	Firm + Country-Year	Firm+Industry-Year
Controls x Crisis?	✓	✓	✓
S.E Clustering	Firm	Firm	Firm
Observations	67,531	50,395	66,670
R ²	0.636	0.661	0.651
Adjusted R ²	-0.009	-0.005	-0.004

Note:

* p<0.1; ** p<0.05; *** p<0.01

Figure 1 – *Ex-Post* Effects Based on the Final Equity Stake Held by the Acquirer Firm (in Deciles)

This figure presents the dynamic deal likelihood estimations presented in Column (3) of Table 5, and described in Section 1.3. For each panel, the interaction term coefficient, $1[Rel.Year_{m,t} = t] \times FC_{i,t}$, is plotted on a black point, with the solid black line denoting the 95% confidence interval.



stock price devaluation through the deterioration of firms' fundamentals. Moreover, the increased likelihood of a financially constrained firm to be targeted in a M&A deal seems to be concentrated in the exact year of the banking crisis, with statistically insignificant results for periods before or after the country's headquarter is considered to suffer from a banking crisis. Put another way, the results translate the fact that firms with higher levels of expiring debt maturities during credit supply contractions found difficulties in accessing credit markets to successfully roll over on debt, and opt to act as targets in M&A transactions as a way to alleviate such frictions.

Despite this evidence, it is not clear from these results *how* selling equity stakes would eventually help firms to mitigate such financing constraints. Assuming that managers are optimally choosing how to allocate between the available funding sources, understanding *why* such transactions are happening with these firms is of primary importance. To shed light on this issue, as well as to provide even further evidence of the motivations that justify the increased likelihood of selling equity stakes presented in Table 3, one must assess what happens *after* deal occurrence. This subsection provides several results to address these points.

To that matter, if expiring maturing debt levels are binding to firms' financing capacity, then firms that have actively engaged in selling equity stakes should suffer *less* from the adverse consequences of credit supply than otherwise similar firms. Likewise, in the presence of positive investment opportunities, if these firms do not have their financial capacity constrained, they should also be *less* likely to cut investment levels *ex-post*. Even though we find evidence that financially constrained firms do engage in equity selling during banking crisis periods, we cannot infer if it actually eases firms' financial constraints, and what is the *channel* that translates *e.g.*, a direct equity placement or an increase in borrowing capacity from outside lenders.

Like identifying a causal relationship between the target's financial constraints and the likelihood of selling equity stakes, assessing the *ex-post* effects of deal occurrence is empirically challenging. Fundamentally, selection on unobservables may drive the decision of some firms to sell equity stakes in a given period and, at the same time, influence their future outcomes. For example, if targeted firms simply tend to have better prospects than non-targeted firms during banking crisis periods, a naive regression estimate of firms' future outcomes on deal occurrence is likely to yield biased estimates. Moreover, there is vast literature on the *ex-post* effects of M&As. To the extent that these effect captures a reduced-form of the transaction effect for the target firm, one must also be able to highlight the contribution of the *ex-post* differentials that is attributable to the liquidity problem by insulating them from any other potential effect induced by M&A transactions previously discussed in the literature.

If credit rationing is indeed the mechanism behind the surge in acquisitions, we

should expect targeted firms to behave differently *ex-post* deal occurrence relative to other constrained firms during a banking crisis. As such, to investigate the *ex-post* effects related to liquidity-induced deals, we analyze the subsample of target/non-targeted firms that with higher levels of expiring maturing debt maturities in banking crisis years. In this sense, for the case of targeted firms, we consider only the firms that were exposed to banking crises and have become targets in the *same* year. To shed light on what happens *ex-post* deal occurrence for these financially constrained firms during crisis periods, we run the following specification:

$$\log(Y_{i,t}) = \beta_1 \times Deal_i + \beta_2 \times After_{i,t} + \beta_{DD} \times (Deal_i \times After_{i,t}) + \alpha_i + \alpha_t + \epsilon_{i,t}, \quad (1.3)$$

where $Deal_i = 1$ if a firm has been targeted (in any moment of the sample), and $After_{i,t} = 1$ for periods after the firm's i headquarter country has been classified as being suffering from a banking crisis – here, we consider the "zero" period as $After_{i,t} = 1$ ⁶.

Additionally, to get a better understanding of the timing of the *ex-post* effects, we also employ a dynamic version of Equation (3) by running:

$$\begin{aligned} \log(Y_{i,t}) = & \beta_1 \times Deal_i + \sum_{t=-3}^3 \gamma_t \{1[Rel.Year = t]\} \\ & + \sum_{t=-3}^3 \beta_t \{1[Rel.Year = t] \times Deal_i\} + \alpha_i + \alpha_t + \epsilon_{i,t}, \end{aligned} \quad (1.4)$$

where $Rel.Year_{i,t}$ is the relative year with respect to the banking crisis period, considering the year exactly before – *i.e.*, $Rel.Year_{i,-1}$ as the baseline year, and all other variables defined as before. We measure the differential effect of selling equity stakes in crisis years for financially constrained firms on future outcomes such as *Assets*, *Cash Holdings*, *Property, Plant and Equipment (PPE)*, and *CAPEX*, as well as debt and equity measures, such as *Long-Term* and *Short-Term* Debt, and *Equity*.

Table 6 presents the estimates for firms' *ex-post* outcomes around banking crisis periods using the industry-year median of *Maturing* as the criteria for classifying firms into financially constrained/unconstrained groups, while Figure 2 presents a graphical illustration of the dynamic-specification regression presented in Equation (4) by plotting β_t for each outcome over a window of ± 3 years.

Interestingly, the coefficients on $Deal \times After$ presented in Table 6 are in line with target firms alleviating their financial constraints *ex-post* deal occurrence. More specifically, even though firm firms' growth in *Assets*, on average, drops significantly during banking

⁶ For example, if a firm has its headquarter country classified as a suffering from a banking crisis in 2008, $After_{i,2008} = 1$

Table 6 – *Ex-Post* Deal Occurrence Effects for Financially Constrained Firms

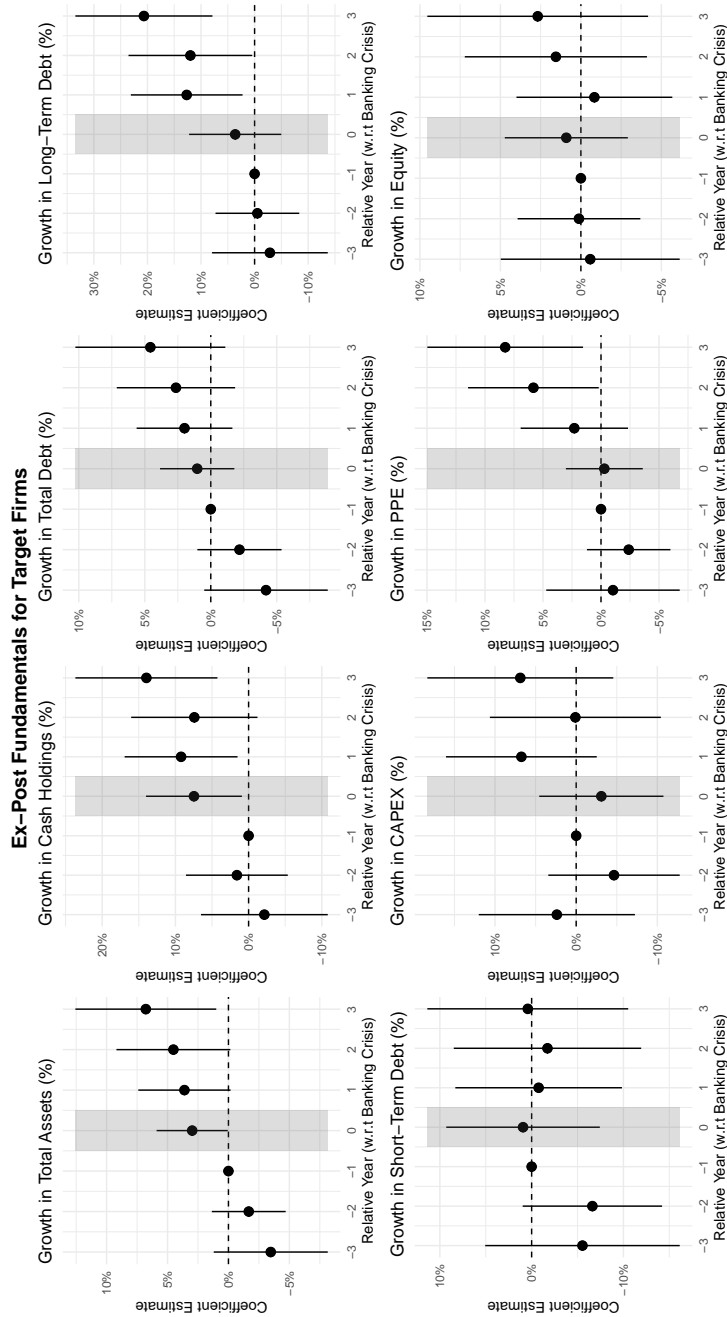
This table presents the estimation results of the *ex-post* deal effects specification, presented in Equation (3) and described in Section 1.3, considering only the subsample of firms that were exposed to a banking crisis during the studied period and classified as financially constrained in the crisis year. *Deal_i* is a binary variable that assigns 1 if firm *i* belongs to the subsample of firms that have been targeted in an M&A transaction during any period of the study, and zero otherwise. *After* assigns 1 if the observation is measured in the same year of after the banking crisis hits the firm's headquarters. Dependent variable definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Target Firm Fundamentals						
	log(Assets) (1)	log(Cash Holdings) (2)	log(LT Debt) (3)	log(ST Debt) (4)	log(PPE) (5)	log(CAPEX) (6)	log(Equity) (7)
<i>Deal</i>	1.340** (0.665)	1.358** (0.662)	1.340* (0.696)	1.388** (0.678)	1.371** (0.661)	0.940 (0.677)	1.410** (0.695)
<i>After</i>	-0.069*** (0.020)	-0.131*** (0.034)	-0.816*** (0.045)	0.573*** (0.041)	-0.059** (0.023)	-0.199*** (0.040)	-0.044* (0.023)
<i>Deal</i> × <i>After</i>	0.058*** (0.020)	0.094*** (0.034)	0.117*** (0.045)	0.051 (0.038)	0.046* (0.025)	0.029 (0.040)	0.010 (0.024)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	74,243	73,822	68,537	72,318	73,965	60,471	69,694
R ²	0.977	0.945	0.925	0.935	0.975	0.943	0.965
Adjusted R ²	0.974	0.939	0.916	0.928	0.972	0.935	0.961

Note: * p<0.1; ** p<0.05; *** p<0.01

Figure 2 – *Ex-Post* Deal Occurrence Effects for Financially Constrained Firms - Dynamic Effects Specification

This figure presents the *ex-post*, dynamic effects estimations of THE *ex-post* deal effects, presented in Equation (4) and described in Section 1.3, considering only the subsample of firms that were exposed to a banking crisis during the studied period and classified as financially constrained in the crisis year. In each panel, the interaction term coefficient of the firms' *ex-post* crisis fundamentals regression on deal occurrence, $Deal_i \times RelYear_{i,t}$, is plotted on a black point, with the solid black line denoting the 95% confidence interval. Dependent variable definitions are presented in Table 1.



crisis periods, targeted firms are able to attenuate these adverse effects substantially: as shown in the first Column of 6, while the average drop in *Assets* is 7%, targeted firms can accommodate 5.8% of this drop. Moreover, these firms also show to be able to accommodate the drawdown in *Cash Holdings* levels significantly better than their counterparts, while also being able to attenuate the drop in and *Property, Plant and Equipment* growth levels. Interestingly, while long-term debt levels seem to drop substantially during the credit supply shock, on average, short-term debt levels also increase substantially, although not fully compensating for the decrease. However, targeted firms are able to partly compensate for the drop in long-term debt levels, possibly by extending their debt maturities.

Of special attention to get a better understanding on the channels by which firms are able to alleviate liquidity shocks, Column (7) highlights that there are no clear *ex-post* effects for Equity levels. On the one hand, if constrained firms were more prone to act as targets in deals characterized by in the primary market, – *i.e.*, a new equity issuance with increase in the number of shares and, consequently, shareholder’s equity –, then one should expect equity levels to be increasing in a substantially higher trend for the group of exposed firms. The results, however, show that there is no significant increase in equity levels.

On the other hand, targeted firms may be exploiting such opportunities to unlock new debt issuance opportunities that would not have been feasible due to tighter credit market conditions at the onset of the crisis. That can happen, for example, if firms benefit from a certification effect (Wruck, 1989) as new shareholders decrease the information asymmetry related to firms’ prospects. Interestingly, merely the fact that equity levels are not increasing *ex-post* deal occurrence provides evidence that are occurring in the secondary market – *i.e.*, without a real increase in the firms’ equity levels.

Seeking to provide additional evidence on the results of Table 6, Figure 2 provides evidence on the *timing* of such *ex-post* effects. As we can see from the coefficient dynamics, *Total Assets*, *Cash Holdings* and *Long-Term* debt seem to respond immediately to the deal, with persistent and increasingly higher effects throughout the next three years, while *Equit levels* do not seem to be significantly affected by the deal. On the other hand, *PPE* levels shown in Table 6 seem to increase, on average, for targeted firms, the last plot of Figure 2 shows that the dynamics of the differential in growth levels is concentrated after two to three years following the banking crisis. Overall, none of the firms’ outcomes seem to be related to pre-crisis differences among targeted/non-targeted firms, which alleviates concerns about the effects being driven by firms’ unobservable characteristics.

1.5 Confounding Factors and Other Mechanisms

Together, the results from the last subsection are illustrative of target firms being able to attenuate the credit supply shock with a higher portion of long-term debt, while also tapping into internal resources to a lesser extent than their counterparts. Importantly, when looking at a longer horizon, these firms also seem to invest in tangible assets to a higher extent than non-targeted firms, which also reinforces the liquidity hypothesis motivating the occurrence of such deals. Importantly, none of the differentials seem to be related to *ex-ante* differences between targeted/non-target characteristics, as shown by the statistically insignificant coefficients pre-crisis coefficients in all plots, providing even further evidence that the effects are not related to firms' unobservables that could otherwise affect the likelihood of firms engaging in M&A transactions as targets.

To the extent the estimated effects are not *demand-driven* – *i.e.*, not correlated to target firms' unobservable characteristics, such as investment opportunities –, one can interpret these findings as evidence that firms that engaged in M&A as targets did not need to adjust their behavior and foregone their investments due to the expiring debt maturity coinciding with the credit supply shock. However, these set of results does not overcome the empirical difficulties arising when insulating *ex-post* deal effects described before from other potential M&A consequences. As argued before, M&A transactions can be related to other changes in target firms' characteristics – such as managerial ability, economies of scale and scope, among others – that could also drive the *ex-post* differential results described before, even in the absence of any liquidity issue.

To that matter, we provide several complementary that enhance our understanding of the potential underlying mechanisms that drive the *ex-post* differential effects. Along with the analysis of the acquisition-induced results on *ex-post* target firms' fundamentals, presented in Table 6, Figure 2, we provide several cross-section heterogeneity tests to explore whether the extent of our results varies in the cross-section in ways that are consistent with our hypothesis and therefore further buttress the liquidity interpretation. In the next subsections, we provide detailed and convincing evidence that the estimated effects of the deal *ex-post* differentials relate to the *liquidity* channel, and not due to any other channel that might affect firms' future outcomes in the presence of M&As.

1.5.1 Comparing across Financially Unconstrained firms

A first concern related to the findings on the *ex-post* firms' fundamentals is that they reflect distinct M&A motivations other than liquidity. For example, the literature on M&A has suggested several other motivations for firms to engage in transactions that also predict increases in firm performance. If this is the case, then our regressions are likely to reflect the effect of *other* changes occurring within the target firm, such as operational

synergies, managerial turnover, among others.

To be able to insulate the results from other M&A-related motivations, we claim that, if anything, such effects should also manifest when comparing firms with lower levels of expiring maturity during banking crisis periods. Based on that, we repeat the analyses presented in Figure 2 considering only the subset of financially unconstrained firms – *i.e.*, those that have presented lower levels of expiring debt maturities when being hit by a banking crisis in their headquarters.

The results, shown in Table 7, provide interesting insights with respect to the concern that *ex-post* effects unrelated to the liquidity motive biasing the results. First, contrasting with the case of financially constrained firms, unconstrained firms, on average, did not present any fundamental change in *Asset Levels*, *Cash Holdings*, *PPE*, or *CAPEX* when being hit by a banking crisis, which is consistent with the interpretation that liquidity problems are not binding to this subset of firms. More importantly, the differential *ex-post* effects for targeted firms are statistically insignificant for almost all firms' outcomes. In special, unconstrained target firms do not present any different dynamic for debt levels, either short or long-term. Together, the contrasting results for financially constrained and unconstrained firms provide convincing evidence that other M&A-related motivations are unlikely to explain the *ex-post* differential effects for financially unconstrained firms.

1.5.2 Change of control, Managerial Turnover, and Operational Synergies

Also related to different motivations for M&As other than liquidity issues, another potential concern is that the *ex-post* results merely reflect potential synergy gains between the target and acquirer firms, as well as managerial improvements induced by the change of control. For example, equity ownership between customer-supplier relationships can arise as way to bond trading parties together through reducing the adverse effects from contractual incompleteness and financial frictions (Fee; Hadlock; Thomas, 2006). Additionally, if these transactions also trigger changes in corporate control, firms' fundamentals *ex-post* deal could also reflect changes induced by managerial turnover and/or any changes that are attributable to ownership.

As shown in additional results, however, when looking at differences between minority and majority acquisitions, such motivations are unlikely to be driving the results. Representing block equity purchases that do not exceed 50% of the target firms' total equity, minority acquisitions represent partial integration strategies between acquirers and targets⁷

⁷ In practical terms, one in every seven firms was a target of a minority acquisition between 1990 and 2009 (Liao, 2014): overall, there have been more than 40,000 completed deals during the period, summing up to more than \$2 trillion in constant 2008 U\$ dollars. Despite its occurrence, the study of minority acquisitions and their *ex-post* performance effects has been carried out by relatively few authors (Liao, 2014; Fee; Hadlock; Thomas, 2006; Kang; Kim, 2008), as compared to studies on the

Table 7 – *Ex-Post* Deal Occurrence Effects for Financially Unconstrained Firms

This table presents the estimation results of *ex-post* deal effects, presented in Equation (3) and described in Section 1.3, considering only the subsample of firms that were exposed to a banking crisis during the studied period and classified as financially unconstrained in the crisis year. Similar to Table 6, $Deal_i$ is a binary variable that assigns 1 if firm i belongs to the subsample of firms that have been targeted in an M&A transaction during any period of the study, and zero otherwise. *After* assigns 1 if the observation is measured in the same year of after the banking crisis hits the firm's headquarters. Dependent variable definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Target Firm Fundamentals						
	log(Assets) (1)	log(Cash Holdings) (2)	log(LT Debt) (3)	log(ST Debt) (4)	log(PPE) (5)	log(CAPEX) (6)	log(Equity) (7)
<i>Deal</i>	0.312 (0.318)	0.321 (0.322)	0.529 (0.327)	0.247 (0.351)	0.306 (0.320)	0.286 (0.265)	0.293 (0.323)
<i>After</i>	0.034* (0.017)	-0.047 (0.031)	0.607*** (0.042)	-0.395*** (0.045)	0.055*** (0.021)	0.001 (0.033)	-0.009 (0.022)
<i>Deal</i> × <i>After</i>	0.014 (0.018)	0.050* (0.029)	0.008 (0.041)	0.035 (0.040)	0.001 (0.022)	0.014 (0.031)	-0.002 (0.022)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	73,625	73,236	70,927	68,820	73,369	64,925	68,440
R ²	0.975	0.940	0.914	0.915	0.974	0.940	0.961
Adjusted R ²	0.973	0.934	0.904	0.905	0.971	0.933	0.957

Note: * p<0.1; ** p<0.05; *** p<0.01

Importantly, minority acquisitions represent a distinct organizational choice in terms of integration strategies, which can, under some circumstances, provide a more efficient allocation of incentives (Ouimet, 2012). For example, minority acquisitions can facilitate integration and mitigate incomplete contracting between independent firms when property rights are blurry, such as research and development (R&D) activities (Fee; Hadlock; Thomas, 2006). Aside from other governance and contracting motives, minority acquisitions may as well have first-order importance for firms' *financing* motives. Since financial constraints hinges upon asymmetric information between the firm and its potential lenders, any gains from a decrease in the degree of information asymmetry may improve the firms' capability to contract new debt at economically viable contract terms. In this sense, partially integrating with a better-informed party may have the potential to relieve target firms' financial constraints, either *directly* or *indirectly* (Ouimet, 2012).

More specifically, for financially constrained firms, block equity transactions with a more informed party can provide capital directly to the issuing firm by equity private placement, reducing the potential dilution effect on the actual shareholders (Myers; Majluf, 1984). Moreover, by the same information asymmetry argument, minority acquisitions can also act indirectly as a *certification device* from the target's investment opportunities to the capital market or other capital providers (Hertzel; Smith, 1993; Wruck, 1989). As such, if the results are reflecting changes in corporate control, we should expect the effects to be stronger for majority acquisitions – that is, those where the acquirer firm has more than 50% of the total voting shares of the target firm – especially for the case of debt levels.

To investigate this point, we rerun Equation (4) by subgroups according to the final equity stake position held by the acquirer. As shown in Table 8, *ex-post* differentials for both long and short-term debt are positive and statistically significant only when considering the subsample of minority acquisitions, showing negative and statistically insignificant effects for the case of majority acquisitions. Notwithstanding, when looking at future investment levels, the *opposite* situation emerges: majority acquisitions present positive and statistically significant results for increases in *CAPEX* and *PPE*, whereas minority acquisitions do not appear to affect future investment levels.

To shed even further light on this issue, we divide our regression sample into deciles of the distribution of *Final Equity* held by the acquirer firm and run the same specification within subsamples of equity bins. The coefficients for the *ex-post* differentials, plotted in Figure 3, shows that there is a *non-monotonic* relationship between the size of the final equity stake held by the acquirer firm and their future growth in fundamentals after the deal has taken place. Interestingly, the effect seems to increase *within* the subsample of minority acquisitions according to the final size of the acquirers' position in the target firm, but decays abruptly for majority acquisitions, showing statistically insignificant results for

grounds of full integrations.

Table 8 – *Ex-Post* Effects - Majority and Minority Deals

This table presents the estimation results based on different subsamples for minority and majority acquisitions of the *ex-post* deal effects, presented in Equation (3) and described in Section 1.3, for firms that were exposed to a banking crisis during the studied period and classified as financially constrained in the crisis year. *Panel A* presents the estimation results for acquisitions where the acquirer final equity stake is less than 49.99% of the target - *i.e.*, *minority acquisitions*, whereas *Panel B* presents the same set of results for acquisitions where the acquirer owns more than 50% of the target's equity stake *i.e.*, *majority acquisitions*. Similar to table 6, $Deal_i$ is a binary variable that assigns 1 if firm i belongs to the subsample of firms that have been targeted in an M&A transaction during any period of the study, and zero otherwise. *After* assigns 1 if the observation is measured in the same year of after the banking crisis hits the firm's headquarters. Dependent variable definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

<i>Panel A: Only Minority Acquisitions (Final Equity by the Acquirer is less than 49.99%)</i>								
	log(Assets)	log(Cash Holdings)	log(LT Debt)	log(ST Debt)	log(Total Debt)	log(CAPEX)	log(PPE)	log(Equity)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treated</i>	1.511** (0.770)	1.524** (0.767)	1.524* (0.796)	1.619** (0.782)	1.539** (0.764)	1.105 (0.805)	1.564** (0.763)	1.624** (0.811)
<i>After</i>	-0.068*** (0.020)	-0.142*** (0.036)	-0.790*** (0.048)	0.528*** (0.044)	-0.067*** (0.021)	-0.220*** (0.043)	-0.053** (0.023)	-0.050** (0.024)
<i>Treated × After</i>	0.061*** (0.023)	0.109*** (0.040)	0.186*** (0.052)	0.073* (0.042)	0.057** (0.023)	0.018 (0.046)	0.038 (0.028)	0.004 (0.027)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	52,639	52,361	48,630	51,451	52,633	41,873	52,437	49,501
R ²	0.977	0.946	0.928	0.937	0.977	0.943	0.975	0.966
Adjusted R ²	0.974	0.939	0.919	0.929	0.974	0.934	0.972	0.961
<i>Panel B: Only Majority Acquisitions (Final Equity by the Acquirer is greater than 50%)</i>								
	log(Assets)	log(Cash Holdings)	log(LT Debt)	log(ST Debt)	log(Total Debt)	log(CAPEX)	log(PPE)	log(Equity)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treated</i>	0.647 (0.869)	0.739 (0.851)	0.658 (0.972)	0.531 (0.902)	0.728 (0.865)	-0.483 (0.763)	0.635 (0.881)	0.614 (0.883)
<i>After</i>	-0.054*** (0.018)	-0.087*** (0.030)	-0.799*** (0.041)	0.631*** (0.038)	-0.043** (0.017)	-0.156*** (0.035)	-0.040** (0.020)	-0.033 (0.020)
<i>Treated × After</i>	0.053** (0.021)	0.075** (0.035)	-0.015 (0.049)	-0.009 (0.042)	0.016 (0.020)	0.068* (0.041)	0.058** (0.027)	0.022 (0.025)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	35,832	35,512	32,598	34,727	35,828	29,415	35,614	33,125
R ²	0.977	0.946	0.926	0.934	0.978	0.940	0.976	0.967
Adjusted R ²	0.973	0.935	0.910	0.921	0.974	0.926	0.972	0.961

Note:

*p<0.1; **p<0.05; ***p<0.01

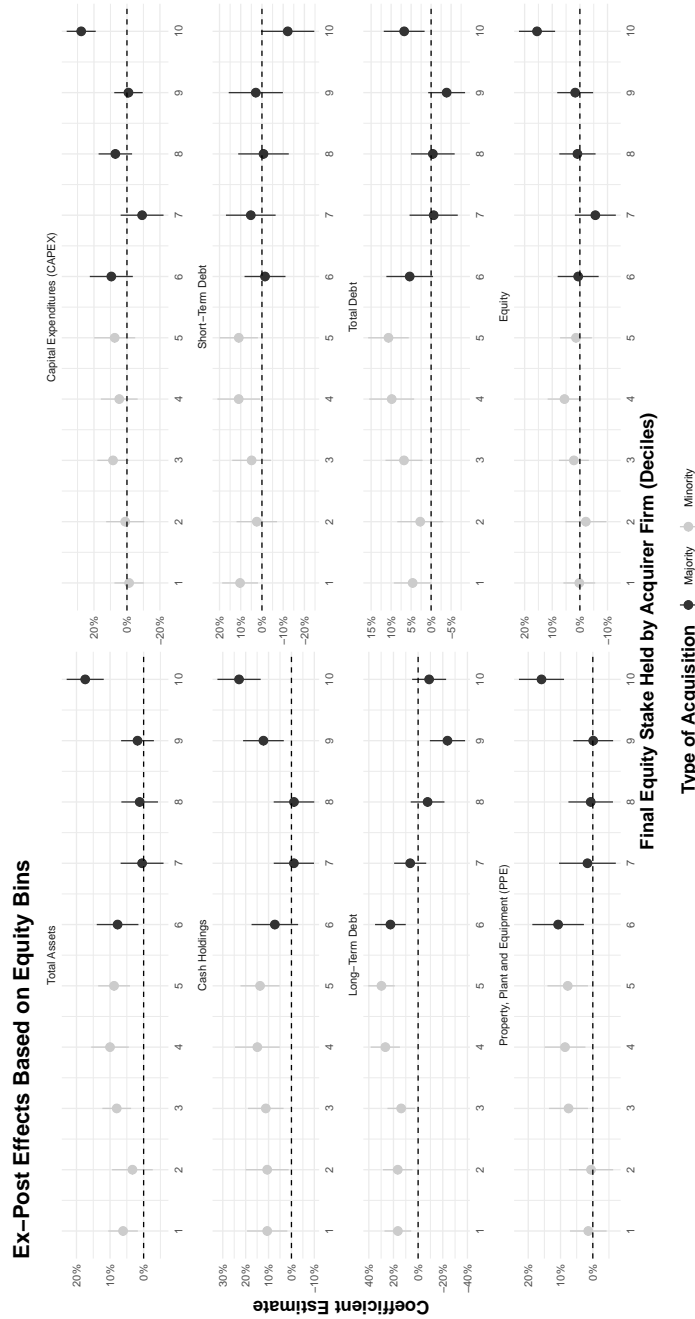
almost all outcomes. While increases in *CAPEX* seems to be only relevant for the case of majority acquisitions, the second panel of Figure 3 shows that these effects are driven by deals with the largest equity stakes held by the acquirer, while presenting statistically insignificant results for all other subsamples.

Crucially, the results for *Long-Term Debt* shows a clearer picture of the potential channel by which *ex-post* differentials manifest in the results: the effects seem to increase on the size of the acquirer final stake held in the target firm, with positive and statistically significant results irrespective of the decile, but decays smoothly for majority acquisitions. All in all, these results move away from a change of control explanation for the *ex-post* differentials found before. As such, if there are other channels other than liquidity issues, we should expect these effects to be stronger for the case of majority acquisitions, as a formal change of control arguably facilitates firm reorganization.

Finally, one may still be concerned about *selection*: if firms that are targeted

Figure 3 – *Ex-Post* Effects Based on the Final Equity Stake Held by the Acquirer Firm (in Deciles)

This figure presents the *ex-post* deal effects estimations, presented in Equation (4) and described in Section 1.3, considering different subsamples of according to the final equity stake held by the acquirer firm in the target firm. For all transactions, we divide the final equity stake of the target firm held by the acquirer in deciles and run the specification described in Equation (4). For each panel, the interaction term coefficient of the firms' *ex-post* crisis fundamentals regression on deal occurrence, $Deal_i \times After_{i,t}$, is plotted on a black point, with the solid black line denoting the 95% confidence interval. Dependent variable definitions are presented in Table 1.



are different in unobservables from those that are not targeted, then the results may merely reflect differences that are attributable to variables that are not observed by the econometrician, such as differences in investment opportunities. As such, another dimension that can add to the results is to compare only firms that were targets during banking crises, varying across the distribution of expiring debt maturities. For that, we run the following regression:

$$\log(Y_{i,t}) = \beta_1 \times FC_{i,t} + \beta_2 \times After_{i,t} + \beta_{DD} \times (FC_{i,t} \times After_{i,t}) + \alpha_i + \alpha_t + \epsilon_{i,t}, \quad (1.5)$$

where all variables are defined as before. In this setting, any unobservables that are likely to be related to selection of firms into M&As as targets is properly controlled for, as we are only comparing firms were effectively targeted during banking crises, but varying their exposure to the credit supply shock. The results, shown in Table 9, shows that the future debt levels for financially constrained firms increase approximately 17% more, relative to unconstrained targeted firms. Interestingly, none of the other outcomes seems to differ across different levels of expiring debt maturities, which also reinforces our interpretation of the liquidity channel.

Finally, in unreported results, we also estimate *ex-post* results based on sub-samples of deals where the acquirer firm belongs to the financial sector or not, and find that results are stronger for the subset of deals where there is a financial acquirer, which is in line with the argument that these acquirers are a strategically convenient way to decrease information asymmetry to the overall financial market.

1.6 Debt and Equity Issuance during banking crises

The results from the earlier sections provide clear evidence that faced with a negative credit supply shock due to a banking crisis in their home country, targeted firms with expiring debt maturities present positive growth differentials in their fundamentals relative to similar firms that have not been targeted in a transaction. Importantly, the fact that *ex-post* debt levels are increasing, but equity levels did not seem to be significantly related to the deal occurrence provides additional evidence that the *ex-post* differentials are not merely due to an increase in firms' asset levels driven by equity issuance in the primary market. Rather, as increases in debt levels – and, in special, long-term debt – show to be significantly affected *ex-post* deal occurrence, the channel by which deals are occurring and firms are alleviating the drop in investments relates to the secondary market.

However, taken individually, these results do not tell much about *how* do these firms were able to increase investment and raise more resources. To shed more light on the specific channel that generates target firms' growth differentials after the banking crisis

Table 9 – *Ex-Post* Effects - Using only the deal subsample in banking crises

This table presents the estimation results of the *ex-post* deal effects specification, presented in Equation (3) and described in Section 1.3, considering only the subsample of targeted firms that were exposed to a banking crisis during the studied period, irrespective of its financial constraints status. FC_i is a binary variable that assigns 1 if firm i is considered financially constrained in period t *i.e.*, $Maturing_{i,t} \geq \text{Industry-Year median}$, and zero otherwise. *After* assigns 1 if the observation is measured in the same year of after the banking crisis hits the firm's headquarters. Dependent variable definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Deal Dummy (1 if Deal in that year, zero otherwise)					
	log(Assets) (1)	log(Cash Holdings) (2)	log(Total Debt) (3)	log(CAPEX) (4)	log(PPE) (5)	log(Equity) (6)
<i>FC</i>	-0.107 (0.066)	-0.134 (0.120)	-0.227*** (0.076)	-0.157* (0.083)	-0.134* (0.070)	-0.027 (0.080)
<i>After</i>	-0.066 (0.123)	-0.103 (0.139)	0.045 (0.136)	-0.419*** (0.144)	-0.057 (0.131)	-0.194 (0.135)
<i>FC</i> × <i>After</i>	0.084 (0.086)	0.119 (0.120)	0.173* (0.093)	-0.041 (0.100)	0.072 (0.088)	0.053 (0.096)
Year fixed effects	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Observations	8,197	8,162	8,197	7,745	8,184	7,738
R ²	0.907	0.866	0.902	0.892	0.913	0.894
Adjusted R ²	0.900	0.855	0.894	0.883	0.906	0.885

Note: * p<0.1; ** p<0.05; *** p<0.01

period, we leverage historical data bond and equity issuances *Securities Data Company Platinum (SDC Platinum)*, which provides detailed information on bond deals, equity capital markets new issues, and global corporate loan transactions. For each firm-year pair in our regression sample, we collect all equity and debt issuances between 1990 and 2020, along with relevant contract characteristics, such as the type of security, the amount issued, the instrument's maturity (for bond issuances), where does the instrument was listed, among others. Overall, we were able to collect information for approximately 62% of the sample, totaling approximately 27,032 issuances over the studied period.

To expand our understanding of the growth differentials presented earlier, we first classify each issuance where we were able to match to our regression data as *equity* or *debt* based. Importantly, as the issuance instrument presented in *SDC* does not contain a standardized classification, we arranged all unique types of issuances in descending order and hardcoded until the 90% cumulative proportion threshold, assigning the value "Others" for the remaining portion.

Based on the previously mentioned exercise, approximately 60% of all issuances from our dataset were characterized by any equity instrument (*e.g.*, Ordinary & Common Shares, Units, while the vast majority of the remaining part was described as being some type of debt instrument, such as convertible bonds, senior bonds, unsecured loans, commercial papers, etc. Table 10 shows the distribution of the main types of securities from our sample.

To investigate how firms could boost their fundamentals *ex-post*, we first analyze what happens both before and after a banking crisis in terms of the amount (in \$) issued. For that, we run:

$$\begin{aligned} \log(1 + Amount_{i,t}) = & \beta_1 \times FC_{i,t} + \beta_2 \times Crisis_{i,t} + \beta_{DD} \times (FC_{i,t} \times After_{i,t}) \quad (1.6) \\ & + \gamma'_1 Controls_{i,t-1} + \gamma'_2 (Controls_{i,t-1} \times After_{i,t}) + \alpha_{i \times t} + \alpha_{c \times t} + \epsilon_{i,t}, \end{aligned}$$

Where $Amount_{i,t}$ is the dollar value of the principal amount issued by firm i in period t , and $Crisis_{i,t}$ is a dummy variable coded 1 if firm i has experienced a banking crisis in its home country in any period t , and zero otherwise. In words, we are analyzing whether firms with expiring debt maturities due to exact during banking crises increased the amount issued relative to prior periods. We also control for a vector of time-varying, target-firm fundamentals in $t - 1$, allowing for different coefficients pre/post banking crisis occurrence, and also include industry-time (Fama-French classification) and country-time fixed effects.

Additionally, for the subsample of targeted firms that have issued any debt instrument during the studied period, we also estimate an additional regression by seeking to

Table 10 – *Thomson SDC* Issuance Classification

This Table presents the tabulation of all security types issued from firms presented in the regression sample from 1990 to 2020. *Type of security* is the definition presented in *Thomson SDC* for the security type, % of Total is the proportion of a given type relative to the overall number of issuances, and Cum (%) is the cumulative proportion.

Type of Security	% of Total	Cum. (%)
Ordinary/Common Shares	41.79%	41.79%
Common Shares	11.49%	53.28%
Convertible Bonds	7.28%	60.56%
Fixed/Straight Bonds	6.42%	66.97%
Ordinary Shares	3.49%	70.47%
Units	3.23%	73.70%
Class A Ordinary Shares	2.43%	76.12%
Bonds	2.22%	78.34%
Guaranteed Bonds	2.05%	80.39%
Medium-Term Notes	1.67%	82.06%
Debt	1.57%	83.63%
Senior Bonds	1.18%	84.82%
Senior Notes	0.97%	85.78%
Float Rate Notes	0.81%	86.59%
Commercial Paper	0.74%	87.33%
Par Val Com Stk	0.74%	88.07%
Senior Unsecured Notes	0.64%	88.71%
American Depositary shares	0.63%	89.33%
Class A Shares	0.61%	89.94%
Convertible Notes	0.54%	90.48%
Others	9.52%	100.00%

analyze the maturity of such instrument – *i.e.*, how long time firm i is expected to repay the debt:

$$\log(1 + \text{Maturity}_{i,t}) = \beta_1 \times FC_{i,t} + \beta_2 \times \text{Crisis}_{i,t} + \beta_{DD} \times (FC_{i,t} \times \text{After}_{i,t}) \quad (1.7)$$

$$+ \gamma_1' \text{Controls}_{i,t-1} + \gamma_2' (\text{Controls}_{i,t-1} \times \text{After}_{i,t}) + \alpha_{ixt} + \alpha_{cxt} + \epsilon_{i,t},$$

with all variables defined equally as Equation (6).

Table 11 provides the estimates of the *Issuance Amount* and *Maturity*, presented in Equations (6) and (7), respectively. As Column (1) shows, there is a statistically significant and positive relationship between the degree of exposure to credit supply shocks during banking crises, as measured by $FC \times \text{After}$, and the dollar amount of issuance. On average, more exposed firms grew 18% the amount of issuance after banking crises relative to its counterparts, which is both statistically and economically significant. Key to your results, Columns(2)-(3) show that these results are entirely driven by *debt*, and not *equity* issuances:

conditioning on debt issuances, more exposed firms presented 24% higher issuance levels than their counterparts, while the results do not seem to be qualitatively and statistically significant for the subgroup of equity issuances.

Table 11 – Issuance and Maturity levels pre/post Banking Crises, varying on Maturing Debt levels

This table presents the estimation results of the equations presented in Equations (6) and (7), for firms that were exposed to a banking crisis and matched in *Thomsom SDC*. All variables are defined in the previous regressions and described in Section 1.3. Issuance is defined as the dollar amount of issuances for a given firm in a given year. Maturity is the expected period (in years) for an issuance (in this case, Debt) to be repaid. Column (1) presents the estimates considering the full sample of issuances present in *Thomsom SDC*. Column (2) and (3) break out the full sample in Debt and Equity issuances, respectively. Finally, Column (4) focuses on the debt issuance sample. All regressions include time-varying controls (lagged by 1 period), allowing for different trends during pre/post banking crisis periods, industry-year, country-year, and deal fixed effects. Standard errors are clustered at the deal level and are presented in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>			
	log(1+Issuance)		log(1+Maturity)	
	(1)	(2)	(3)	(4)
<i>FC</i>	-0.128** (0.057)	-0.272*** (0.083)	0.062 (0.070)	0.0002 (0.030)
<i>After</i>	-0.078 (0.403)	-4.821*** (0.446)	-1.029** (0.411)	0.123 (0.133)
<i>FC × After</i>	0.188*** (0.071)	0.248** (0.110)	0.026 (0.089)	-0.005 (0.038)
Controls	✓	✓	✓	✓
Year x Industry FE	✓	✓	✓	✓
Year x Target Country FE	✓	✓	✓	✓
Deal fixed FE	✓	✓	✓	✓
Controls × Crisis	✓	✓	✓	✓
S.E Clustering	Deal	Deal	Deal	Deal
Sample	Full Sample	Debt	Equity	Debt
Observations	45,537	19,109	26,428	18,257
R ²	0.554	0.651	0.580	0.577
Adjusted R ²	0.448	0.532	0.435	0.447

Note:

*p<0.1; **p<0.05; ***p<0.01

All in all, these results are inherently linked to the estimates presented in Figure 2, where it was shown that more exposed firms grew on Debt (measured in accounting dollars), but not on Equity levels, and helps us overcome a potential concern about our results being driven by direct capital injection generated by the deal. Rather, our results are closer to the interpretation that exposed firms value M&A acquirers so as to certify investment opportunities that were *ex-ante* not feasible to be funded during a financial crisis.

1.6.1 From where did the money flow?

As a final piece of evidence, we now shed light on the understanding of *how* the dynamics presented in Table 11 are occurring. As discussed before, a hypothesis that can rationalize such results is that firms more exposed to a credit supply shock may be willing to become targets in M&A transactions in such a way as to bond from reputational advantages while also decreasing the degree of information asymmetry relative to the overall financial market.

While testing such causal link is an empirically daunting task, we can still provide additional empirical evidence using the firms' countries as a proxy for differences in institutional and legal landscapes. To that matter, we leverage the information regarding the Exchange where each issuance from our sample was listed, map these to its corresponding countries in such a way that we can trace back whether the issuance was made domestically or internationally.

To that matter, we compute the number of issuances in our sample by each issuer country and collect the top 10 countries in terms of the number of issuances, in descending order⁸. With that, we classify each pair of *issuer* country as *issuance* country in terms of being part of this referred group, yielding a total of 4 mutually exclusive combinations of issuer-issuance country pairs. This 2×2 quadrant highlighting all possibilities is depicted in Figure 4. On the one hand, the vertical axis on Figure 4 refers to whether or not the country where the instrument was effectively put into market is in the top 10 countries with the highest historical volume issuance volume. On the other hand, the horizontal axis relates to whether or not the firm that is issuing the instrument (which, in our case, was previously a target of a M&A transaction) is from a country that belongs to the top 10 countries with the highest historical issuance.

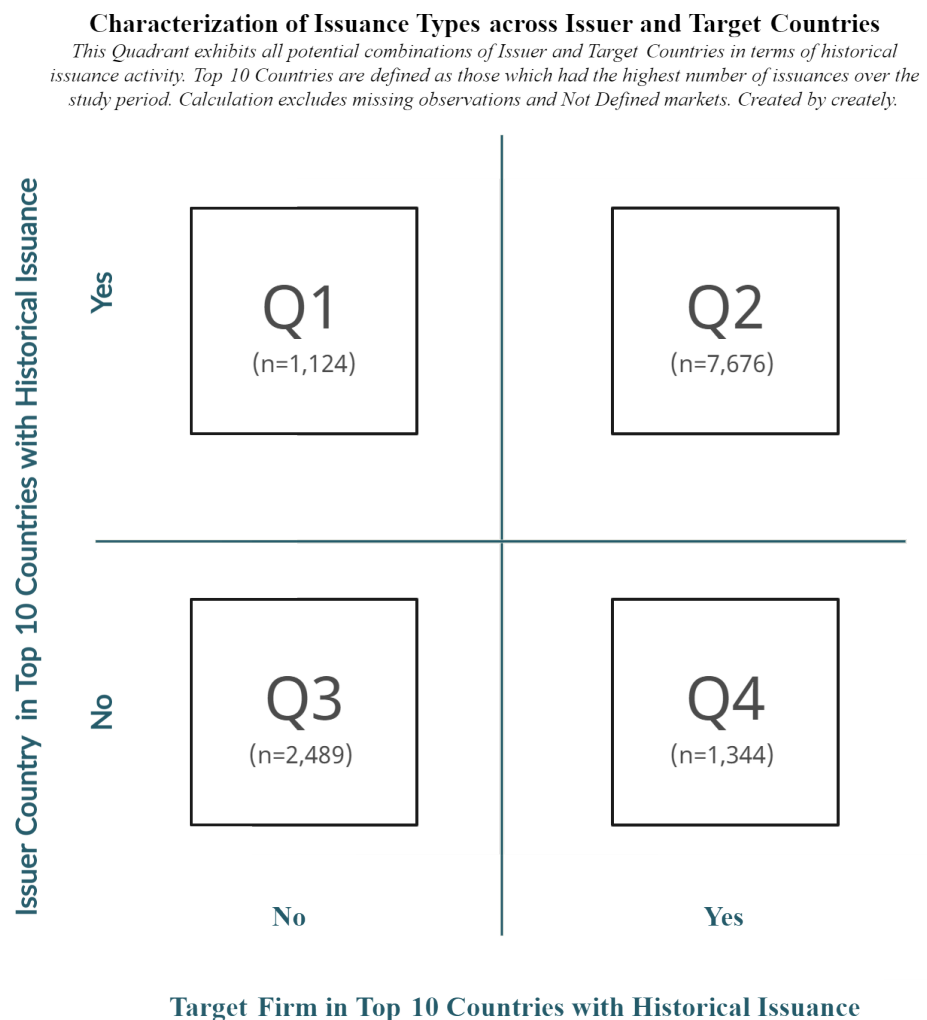
Of special interest to our certification hypothesis, *Q1* denotes the subset of firms located in countries that do not have high issuance activity *and* that underwent a cross-listing operation – *i.e.*, listed an instrument in an exchange that does not belong to its headquarter country. These firms constitute the smallest subset of the four quadrants, representing approximately 9% of the overall issuances that we were able to trace back the country where the security was effectively issued.

Moving to the higher quadrant, *Q2* denotes the subset of firms located in countries with intense issuance activity, which concentrate the vast majority of the country pairs from the sample. This is expected, as not only one should observe firms from higher issuance volume countries to be more active in issuing instruments, but also that such instruments are likely to be put in place in exchanges that concentrate the highest volumes. Finally, *Q3* and *Q4* represent the country pairs where the issuance has been done in

⁸ The countries (from highest to lowest) are: United States, Canada, Australia, United Kingdom, South Korea, Japan, China, France, Germany, and Italy.

Figure 4 – Characterization of issuance types according to inclusion in the top 10 countries with historically higher issuance volumes.

This figure presents a 2×2 characterization of the country pairs regarding firm's country of origin and the country of issuance for a given instrument present in our sample of *Thomson SDC* issuances. Issuances are classified according to the inclusion of a given country in the top 10 countries with the highest issuance volume from our sample (*Top10*). *Q1* represents the subsample of issuances where the issuer firm's country is not included in *Top10*, but the country where the issuance has taken place is included. *Q2* represents the subsample of issuances where both issuer firms' country and the country of issuance are part of *Top10*. *Q3* represents the subsample of issuances where none of the countries belong to *Top10*. *Q4* represents the subsample where the firms' country is in *Top10*, but the issuance has been made in a country outside of *Top10*. Subsample sizes are presented in parenthesis.



exchanges from countries with the lowest issuance volume. For the same reasons stated before, these are likely to be small in overall participation.

To that matter, for the hypothesis that more exposed firms benefit from reputational and institutional landscapes to hold true, one would expect the interaction term, $FC \times After$, to be positive and statistically significant for the subset of firms that does *not* belong to a country with high issuance activity, but issues in a country with historically high issuance. It is important to highlight that the unconditional likelihood of having a domestic issuance – *i.e.*, an issuance in an exchange that belongs to the same country as of the issuer firm – is 45%.

Table 12 provides the results of estimating Equation (6) across each of the subsamples $Q1$, $Q2$, $Q3$, and $Q4$. As shown in the estimates presented in Column (1), the interaction term is positive and statistically significant, indicating that firms more exposed to credit supply shocks did increase the amount of issuance after the banking crisis hit the domestic economy. Such phenomenon does not appear to drive the results in the other subsamples, as Columns (2) and (3) did not show statistically significant results. Finally, Column (4) shows an inverse relationship, with a negative and statistically significant estimate, indicating that more exposed firms did reduce the amount of issuance in countries with lower historical issuance volume. Interestingly, looking at the subsample presented in $Q4$, the percentage of domestic pairs – *i.e.*, situations where the issuer country is the same as of the firm – is 62%. In this sense, our results show that firms are, in its vast majority, shifting from domestic issuances to cross-border issuances in countries with high issuance activity.

All in all, the results from Columns (1) and (4) provide a clearer picture of the dynamics of debt issuance presented in our sample: firms more exposed to credit supply shocks from countries with lower historical issuance activity are increasing cross-border issuance activity *ex-post* banking crisis occurrence, and such issuance is concentrated in markets marked by high issuance volume. Analogously, these firms are also reducing issuances in countries with lower historical issuance volume, which happens to be, in its vast majority, domestic issuances. These results can be interpreted as firms being able to reduce information asymmetries as they access new financial markets, which can be thought of a certification effect from the deal. In this sense, our results are closer to the interpretation that exposed firms seek value in M&A transactions to exploit reputational and legal bonding (Burns; Francis; Hasan, 2007), while also being possible to exploit new markets that were otherwise inaccessible due to a certification channel (Liao, 2014).

Table 12 – Issuance and Maturity levels pre/post Banking Crises, varying on Maturing Debt levels and Issuer Countries

This table presents the estimation results of the equations presented in Equations (6), for firms that were exposed to a banking crisis and matched in *Thomson SDC*, as shown in Table 11, by the subsamples described in Figure 4. All variables are defined in the previous regressions and described in Section 1.3. Issuance is defined as the dollar amount of issuances for a given firm in a given year. Maturity is the expected period (in years) for an issuance (in this case, Debt) to be repaid. Columns (1)-(4) represent the estimate of running Equation (6) on the subsamples Q1-Q4, respectively. All regressions include time-varying controls (lagged by 1 period), allowing for different trends during pre/post banking crisis periods, industry-year, country-year, and deal fixed effects. Standard errors are clustered at the deal level and are presented in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>			
	log(1+Issuance)			
	(1)	(2)	(3)	(4)
<i>FC</i>	-0.788*** (0.288)	-0.055 (0.065)	0.121 (0.084)	0.802*** (0.255)
<i>After</i>	2.925*** (0.753)	0.096 (0.512)	- (0.000)	- (0.000)
<i>FC</i> × <i>After</i>	0.451** (0.227)	0.096 (0.079)	-0.125 (0.145)	-0.839*** (0.315)
Controls	✓	✓	✓	✓
Year x Industry FE	✓	✓	✓	✓
Year x Target Country FE	✓	✓	✓	✓
Deal FE	✓	✓	✓	✓
Controls × Crisis	✓	✓	✓	✓
S.E Clustering	Deal	Deal	Deal	Deal
Sample	Q1	Q2	Q3	Q4
Observations	4,218	29,392	5,569	6,358
R ²	0.702	0.616	0.739	0.364
Adjusted R ²	0.591	0.519	0.600	0.225

Note:

*p<0.1; **p<0.05; ***p<0.01

1.7 How do target firms attenuate the effects of liquidity constraints?

The results provided in the last two sections reinforce the interpretation of the results as a consequence of liquidity issues: firms with higher expiring debt maturities, when faced with severe credit supply conditions, opt to sell equity stakes to other parties in M&A transactions as a way to relieve their financing constraints. To that point, our additional set of findings reinforce that other potential mechanisms that are likely to be triggered during M&A episodes are unlikely to explain the patterns presented before.

Notwithstanding, even though these results are indicative of target firms selling equity stakes due to *liquidity* reasons, they tell little about the *how* they effectively relieve such constraints *ex-post*. Therefore, we now shed light on the specific mechanisms by which firms, when selling equity stakes, are able to boost their lending capacity and avoid postponing future investments due to credit shortages.

First, it is interesting to understand how the results vary within domestic and cross-border acquisitions. For example, (Rossi; Volpin, 2004) analyzes the determinants of cross-border and domestic acquisitions by focusing on differences in laws and regulations across countries and find that target firms in cross-border acquisitions are generally from countries with poorer investor protection, suggesting that M&As can play a governance role by imposing higher governance standards from acquirer countries to the target firm. Relatedly, (Aggarwal et al., 2011) analyze institutional investor ownership around 23 countries from 2003-2008 and find that institutional shareholders can improve firm-level governance. As such, firms with higher institutional ownership have increased ability act effectively monitor the managers, which translates into a higher probability of firing poorly-performing Chief Executive Officers (CEOs).

To the extent that these results corroborate our findings, Table 13 presents the *ex-post* differential results for exposed firms that underwent M&As as targets separately the domestic and cross-border subsamples. As the results show, *ex-post* differentials are stronger for cross-border relative to domestic acquisitions, which goes in line with the findings on (Rossi; Volpin, 2004) and (Aggarwal et al., 2011) that cross-border acquisitions may be useful for target firms to bond on better investor protection at the country-level.

More specifically, while the *ex-post* differentials are generally positive both for domestic and cross-border acquisitions, the *net* effect for cross-border firms after a deal has taken place during the banking crisis period is *positive*. That is, cross-border targeted firms have presented growth in their fundamentals (*Assets*, *Cash Holdings*, *Total Debt*, and *CAPEX*) even in the presence of a negative credit supply shock, while domestic targeted firms, at best, were able to attenuate the adverse effects induced by the crisis, which is expected as the acquirers of domestic deals are also suffering from a banking crisis in the

Table 13 – *Ex-Post* Effects - Cross-border and Domestic Deals

This table presents the estimation results based on different subsamples for domestic and cross-border acquisitions of the *ex-post* deal effects, presented in Equation (3) and described in Section 1.3, for firms that were exposed to a banking crisis during the studied period and classified as financially constrained in the crisis year. *Panel A* presents the estimation results for acquisitions where the acquirer's and target's headquarters are in the same country - *i.e.*, *domestic acquisitions*, whereas *Panel B* presents the same set of results for acquisitions where the acquirer's headquarter differs from the target's *i.e.*, *cross-border acquisitions*. Similar to table 6, $Deal_i$ is a binary variable that assigns 1 if firm i belongs to the subsample of firms that have been targeted in an M&A transaction during any period of the study, and zero otherwise. *After* assigns 1 if the observation is measured in the same year of after the banking crisis hits the firm's headquarters. Dependent variable definitions are presented in Table 1. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

<i>Panel A: Only Domestic Acquisitions</i>							
	log(Assets)	log(Cash Holdings)	log(LT Debt)	log(ST Debt)	log(CAPEX)	log(PPE)	log(Equity)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Treated</i>	1.527* (0.789)	1.557** (0.787)	1.578* (0.830)	1.623** (0.788)	1.094 (0.807)	1.580** (0.782)	1.622* (0.834)
<i>After</i>	-0.057*** (0.018)	-0.143*** (0.032)	-0.786*** (0.042)	0.562*** (0.038)	-0.175*** (0.039)	-0.045** (0.022)	-0.037* (0.022)
<i>Treated × After</i>	0.034* (0.020)	0.076** (0.035)	0.082* (0.045)	0.035 (0.037)	0.005 (0.042)	0.021 (0.025)	-0.013 (0.025)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	58,040	57,671	53,376	56,557	45,972	57,796	54,262
R ²	0.978	0.947	0.929	0.938	0.942	0.977	0.967
Adjusted R ²	0.975	0.940	0.919	0.930	0.932	0.974	0.962
<i>Panel B: Only Cross-border Acquisitions</i>							
	log(Assets)	log(Cash Holdings)	log(LT Debt)	log(ST Debt)	log(CAPEX)	log(PPE)	log(Equity)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Treated</i>	0.952 (0.796)	0.963 (0.787)	0.946 (0.813)	0.989 (0.824)	0.756 (0.782)	0.975 (0.791)	1.022 (0.835)
<i>After</i>	-0.072*** (0.021)	-0.085** (0.036)	-0.835*** (0.051)	0.590*** (0.046)	-0.211*** (0.039)	-0.060** (0.023)	-0.054** (0.024)
<i>Treated × After</i>	0.123*** (0.029)	0.141*** (0.049)	0.202*** (0.063)	0.089* (0.052)	0.084* (0.048)	0.109*** (0.036)	0.068** (0.033)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓	✓
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	34,230	33,982	31,398	33,294	28,780	34,042	31,867
R ²	0.975	0.944	0.925	0.932	0.944	0.974	0.966
Adjusted R ²	0.971	0.935	0.912	0.921	0.934	0.970	0.960

Note:

*p<0.1; **p<0.05; ***p<0.01

time of the transaction.

Finally, the results from the issuance-level regressions highlight the potential role that better institutional and legal landscapes can provide for firms in enabling access to the financial markets. More specifically, 45% of all issuances are domestic, while less than 9% of issuances are in a setting where the issuer firm's country does not have historically higher issuance volume, but the issuance is made in an exchange situated in a country with high issuance volume. Notwithstanding, the results from Table 12 provide additional evidence that firms can benefit from bonding on better institutional landscapes and access markets that would otherwise be prohibitively costly.

Taken together, our results provide a clearer picture of why and how firms exposed to credit supply shocks circumvent the adverse effects of liquidity shocks: when selling

minority equity stakes to outside investors, acquirer firms can extend the reach of which target firms can access credit markets by certifying their investment opportunities and thereby decreasing information asymmetry, consistent with minority acquisitions relieving firms' financial constraints through a *certification effect* (Wruck, 1989; Hertzfel; Smith, 1993).

1.8 Conclusion

Much has been discussed in the prior literature about the adverse effects of credit supply shocks on firms' investments. However, less is known about how and why firms can actually withstand such shocks. This paper provides empirical evidence that M&A transactions can serve as leeway for financially constrained to smooth out negative credit supply shocks during (and after) banking crisis periods by means of increasing access to international financial markets that were not *ex-ante* explored.

Our empirical results show that while deal activity substantially decreases during periods marked by credit supply contractions, firms with expiring debt maturities firms are approximately 15% more likely to sell equity stakes during such periods. These effects are robust to the definition of financial constraints, remain significant even after including a wide set of controls and fixed effects, and are also qualitatively similar across a wide range of tests and alternative specifications.

Importantly, we find strong evidence that conditional on selling equity stakes, while targeted firms with expiring debt maturities invest more, issue more debt, and reduce the dependence on cash holdings after the deal, there is no change in the equity levels *ex-post*. These effects are statistically and economically significant, and highlight that the adjustment that firms more exposed to credit supply shock induced by banking crises occur through increases in debt, and not equity, levels. Importantly, we show that our results are mainly driven by cross-border, minority acquisitions where the acquirer firm is a financial firm, which helps alleviate concerns that operational synergies driven by a reorganization post-takeover are driving our results.

Finally, using transaction-level data, we confirm that the increase in issuance activity for exposed firms during banking crises is mainly driven by debt, and not equity issuances, and although most of the activity is marked by domestic issuances, our results show that exposed firms are increasing the amount issued internationally, especially in countries with historically higher issuance volume, while decreasing the amount issued domestically. All in all, these results not only are suggestive of such transactions as an effective way to relieve firms' liquidity shortages during periods of a market decline in the supply of credit but highlights a *certification effects* by acquirer firms as a mechanism that drives this change.

While we recognize the potential avenues that can still be explored towards the understanding of the interplay between M&A transactions and corporate liquidity, the results extend the findings on the credit supply channel ([Almeida et al., 2012](#); [Duchin; Ozbas; Sensoy, 2010](#)), providing evidence for the relevance of M&A as a liquidity device when credit market imperfections are more prevalent, complementing the earlier literature on the firm's financial policies during periods of banking crises ([Garcia-Appendini; Montoriol-Garriga, 2013](#)).

2 The Real Effects of Capital Requirements on the Brazilian Healthcare Industry

Abstract:

In this paper, I show that the introduction of the solvency margin, a capital requirement aimed at limiting Brazilian healthcare insurance firms from excessive risk-taking, has led to adverse effects on firms' growth prospects, affecting firms' fundamentals, and ultimately increasing market concentration. By exploring firms' *ex-ante* exposure to the capital requirement rule and variation across multiple local markets, I use a *differences-in-differences* approach to show that more exposed firms grew their customer base 12% less, on average, than their counterparts, and that this effect persists even after three years of the solvency margin implementation. When it comes to firm-level prospects, I show that this higher exposure also affects firms' future financial fundamentals, firms' likelihood of being delisted, and is negatively correlated with changes in the median price levels for customer healthcare plans. Finally, to the extent that this differential growth trend is capable of shifting aggregate industry fundamentals, I show that states with a higher portion of exposed firms saw their market concentration surge 22% more than their counterparts. The baseline results continue to hold even after performing several robustness checks and employing alternative specifications. Overall, this study enhances the understanding of the trade-offs involved with the implementation of capital requirement rules outside of the financial sector.

2.1 Introduction

The private healthcare system is central to guaranteeing access to healthcare in Brazil, being responsible for the healthcare assistance of almost a quarter of the population. Along with the creation, in 1988, of the *Sistema Único de Saúde* (SUS), access to public health was ensured for all Brazilian citizens. However, despite the consolidation of Brazilian healthcare as a public good, the precariousness of the public healthcare services prompted a massive entry of private players (Pinheiro; Savóia; Securato, 2015). Over time, the development of the private healthcare industry in Brazil initiated a growing concern regarding the proper functioning of the industry, which made the ground for the beginning of the Brazilian healthcare insurance industry regulation. As a consequence, Law n^o 9,656¹ was enacted in an attempt to reduce the industry's distortions, minimize

¹ [Lei dos Planos de Saúde](#)

resource expropriation, enhance the transparency of public and private players, and define mechanisms that ensure a proper financial equilibrium between healthcare insurance firms and consumers.

All in all, such historical developments made the ground for the establishment of the country's regulatory health insurance agency, *Agência Nacional de Saúde Suplementar* (ANS), created through the Law nº 9,961², in 2000. As an autarchy linked to the Brazilian Ministry of Health, ANS seeks to promote the defense of the public interest regarding healthcare services, regulate the relationship between private players and its consumers, and foster actions aimed at the development of the country's healthcare system. However, despite the massive growth of the healthcare industry, concerns about the solvency of healthcare insurance firms called the attention of policymakers and regulators.

The country's dependency on private healthcare assistance, however, became clear only after the liquidation of one of the country's largest healthcare plan, *UNIMED Paulistana*, in 2015, leaving more than 740,000 customers without healthcare assistance³. The company's net debt, which grew more than four times between 2007 and 2009, over more than R\$ 2.5 bi, culminated in a series of managerial hurdles that were transmitted over to healthcare suppliers and customers that rely on private healthcare insurance. Ultimately, these issues led to the company's liquidation by the regulatory agency, in 2015, where *UNIMED Paulistana* had to transfer all of its customer base to other healthcare insurance firms.

Since its creation, several measures were put in place by ANS seeking to promote its mission of the public interest regarding healthcare services, which special attention to several resolutions related to the *Rol de Procedimentos em Saúde*, the main reference regarding minimum coverage from healthcare insurance providers as well as resolutions aimed at enforcing the the accounting recognition of technical provisions related to healthcare insurance activity. Within this context, among the several measures seeking to ensure adequate financial sustainability standards within the industry and safeguard customers from the risk of insolvency by health insurance firms⁴, the regulatory agency has introduced capital requirements rules – that is, financial policies aimed at mitigating insolvency risks – through a series of technical and financial provisions and warrants, with the introduction of the Solvency Margin, in 2012, as its most profound regulatory action.

Through such regulation, Brazilian healthcare insurance firms were obliged to gradually constitute financial buffers based on their historical operational costs and/or revenues, being susceptible to regulatory action in case of non-compliance. In such situations,

² *Lei nº 9.961, de 28 de janeiro de 2000*

³ See the article "*Detalhes exclusivos sobre a quebra da Unimed Paulistana*", published in 2015 in a Brazilian national newspaper, for a detailed discussion.

⁴ See *Resoluções Normativas ANS* for a detailed description of all regulations created by the Brazilian regulatory agency.

penalties such as the impossibility of launching new healthcare plans, and eventually the regulatory intervention for liquidation could be put in place by the regulatory agency.

As a result, the industry's financial assets, defined as Cash, Cash Equivalents, and Short-Term Investments, saw a surge of almost 4 (four) times the level previous to the enactment of the solvency margin, from R\$ 5.9 bi to more than R\$ 23 bi. On the one hand, if establishing capital requirements as an indirect control over firms' leverage decisions act as benefiting stakeholders by potentially reducing firms' insolvency risk, on the other hand, however, it is not clear if such action may have adverse welfare consequences. In this sense, since such requirements force firms to adjust their capital structure either by raising equity or directing resources towards less risky assets, such as high-liquidity financial instruments and cash, they may have a direct effect on the availability of financial resources for firms' operating business activities, which in turn can impact future investment decisions.

To that point, although regulatory action may act towards protecting the ultimate customers' interests, it also can generate second-order adverse effects. Anecdotal evidence⁵ indicates that as the solvency margin formulation takes the form of a "one-size-fits-all" approach, by requiring a fixed percentage of capital retention applicable to firms' operations, it may have disincentivized future investments by health insurance firms in expanding their customer base, as a correspondent increase in the equity level is needed to comply with the capital requirement rule. In this sense, the higher the size of firms' healthcare operations, the more warranties are required, thereby dampening the returns from growth prospects in face of positive investment opportunities. Furthermore, firms may also be unwilling to invest in verticalization strategies, such as the construction of hospitals and healthcenters, as it would decrease the availability of internal funds that could be used to fund such growth opportunities.

Even though the effects of the introduction of capital requirements have been widely studied in the banking sector, especially after the 2008 crisis (Hanson; Kashyap; Stein, 2011; Admati et al., 2013), there is still little evidence of its real implications outside of the financial sector. In addition to that, from a practitioner standpoint, despite the prominence of the private healthcare insurance industry in Brazil, there is still no empirical assessment of the introduction of the Solvency Margin in the sector.

Given all the above, in this paper, I analyze the real implications of the introduction of the Solvency Margin in the Brazilian healthcare insurance industry. Specifically, I investigate whether the decrease in the availability of internal funds due to the enforcement of the capital requirement rule affects firms' investments in tangible assets and growth in their customer base, as well as assess its potential spillover effects on market structure, competition, and service quality.

⁵ ANS has new rule for provisions. *Valor Econômico*, 2019.

By means of a *differences-in-differences* approach, this paper uses an extensive database that links healthcare firm's financial and operational data from between 2009 and 2019 to customer data at the firm-month-state level to compare the growth in the customer base of healthcare firms that were *ex-ante* more exposed to the capital requirement rule – *i.e.*, the ones which had more financial leverage prior to the rule – against those where the capital requirement rule was not binding – *i.e.*, firms with high capital buffers previously to the enactment of the solvency margin.

To be able to tease out the effect of the solvency margin rule, the sufficiency of solvency margin – *i.e.*, how much equity firm would need to integralize in order to comply the capital requirement rule – is calculated for each firm in the sample. Based on firms' financials two years *before* the actual enactment of the rule, this measure of exposure takes into account firms would have been considered constrained as if the capital requirement rule was in place in that year, thereby alleviating some endogeneity concerns due to firms adjusting their actual equity levels. Moreover, as adjustments in capital structure are costly, firms may be unable to freely scale up to the desired equity levels *ex-post* the solvency margin implementation.

In line with the capital requirement rule having second-order adverse effects, results show that even though more exposed firms tend to have higher growth in their customer base, on average, there is a negative and statistically significant effect of the exposure to the capital requirement rule after it took place: exposed firms – *i.e.*, those where the sufficiency of solvency margin relative to total equity is higher than the median – grew, on average, approximately 12% less than their counterparts during the period post implementation of the solvency margin, which is both statistically and economically significant. This effect is robust to different specifications and to the inclusion of a wide set of covariates and controls, both time-invariant, such as firm fixed effects, as well as time-varying controls, such as state-year fixed effects.

With the solvency margin designed to be implemented gradually over time, one would expect that, if any, the stringency of the effect should increase over time. By analyzing the dynamics of the solvency margin rule over time, it is possible to confirm this pattern: at the end of the first year when the solvency margin was put in place, there was no difference in growth levels between treated and control firms. However, between 2013 and 2017, treated firms grew monotonically less than their counterparts, with the effects being marginally significant in 2018, strengthening to the argument that the introduction of the solvency margin led to effects that do not dissipate over a short period of time.

If firms could tap into new resources frictionlessly, as in a (Modigliani; Miller, 1959) framework, then there is no reason to believe that solvency needs could affect their growth prospects – *i.e.*, faced with a positive NPV opportunity, a firm could issue equity at market value and fund the project. Why, then, do we observe differential

trends over time for some firms? With firms facing different costs of issuing equity due to asymmetric information, some firms may be willing to forego profitable growth opportunities anticipating difficulties in issuing equity in the realization of a bad state. The aforementioned results suggest that lower levels of solvency margin sufficiency are related to lower growth levels in the customer base. However, these results implicitly assume that the cost of issuing equity is homogeneous across firms, which is unlikely to hold in a scenario with more than 1,200 active firms. In special, the presence of *UNIMED*, the largest active health cooperative group of its kind, with organizational characteristics that are strikingly different from limited-liability-companies (LLC), may indicate that even with the group of more exposed firms, the effects can be heterogeneous across several dimensions.

In line with the latter discussion, by employing the baseline specification in a sub-sample that excludes health cooperatives, I show that the differential growth trend that affects the solvency margin rule is entirely driven by this sub-group of non-health cooperatives. In terms of magnitude, I observe an effect of approximately two times the magnitude of the baseline effect, from 12% to 24%, with results that are statistically significant in all specifications and after employing several robustness checks. Interestingly, I do not find statistically significant effects for health-cooperatives, where non-limited-liability is present.

Even though these results may indicate that this subset of firms trades off positive growth opportunities against complying with mandatory equity levels due to the capital requirement rule, several endogeneity concerns could harm the interpretation of these results as induced by the solvency margin implementation. In special, as managers observe the state and choose the equity levels to maximize value, those that issue more equity to comply with the solvency margin rule may be exactly the ones potentially more affected by a liquidity shock. In such a situation, higher equity levels are positively correlated with the degree of (unobserved) investment opportunities, which if not controlled, may bias the previous estimates upwards.

To provide even further evidence of the previous results, I exploit the fact that not only do more than 80% of operational revenues come from *employee-sponsored* contracts but also that markets tend to be *locally* concentrated to analyze what happens when treated firms get hit by a positive employment shock versus a negative shock. As such, if the previous results are due to the fact that some firms are willing to forego positive growth opportunities to comply with the solvency margin, one would expect these results to be concentrated within the realization of "good" states of the economy - *i.e.*, positive employment shocks in the region that the firm concentrates its operations, which are plausibly correlated with the firms' investment opportunities. By splitting the sample according to the employment growth levels at the state level), however, it becomes clear

that more exposed firms located in states with positive employment growth are the ones driving the results.

More specifically, looking only at the sub-sample of state-year pairs that had positive employment growth in a given period ("good realizations"), there is a negative and statistically significant effect of -17.3% in the growth of more exposed firms, with effects being indistinguishable from zero for the sub-sample of state-year pairs with negative employment growth in the period ("bad realizations"). In other words, even though more exposed firms are sensitive to positive demand shocks induced by positive employment growth in their regions, negative demand shocks (as proxied by negative employment growth in a given state-year pair) do not seem to be driving adjustments in these firms' customer base. This asymmetric response to different employment shocks helps overcoming alternative narratives for why these firms are growing less year-over-year.

What do these results tell about firms' adjustments due to the changing nature of market conditions? Seeking to understand how firms adapt to the changes induced by the introduction of the solvency margin, I test whether such exposure is also capable of affecting several firms' outcomes. More specifically, the results show that changes in investments and revenues are fully driven by reductions in operational, and not financial, activity. Furthermore, more exposed firms saw their delisting probability increase by approximately 7.6% relative to the overall delisting probability. Finally, using information regarding reference prices for all commercialized healthcare plans, results show that healthcare firms that were negatively hit by higher capital standards presented price adjustments that were 5.8% lower relative to their competitors within the same region.

All in all, these results provide evidence that, when faced with a positive employment shock in their regions, not only firms more exposed to the capital requirement rule benefit less from such market growth relative to their counterparts but also firms less exposed to the solvency requirement were able to adjust prices in a more pronounced manner. However, are these changes capable of shifting market concentration? In a final set of results, I aggregate the data at the state level to show that states that have been more exposed to the capital requirement rule (by having a higher concentration of customers from more exposed firms) saw their market concentration (as measured by the *Herfindahl-Hirschman Index - HHI*) increase by 21.7%, although there hasn't been any statistically significant spillovers in health-outcomes, such as the number of complaints filed by private healthcare customers and/or increases in public healthcare service provision.

This paper contributes to the growing literature on capital requirements in several ways. First and foremost, it adds relevant contributions to the understanding of the economics of life insurance markets, which have implications for the economy as a whole due to its relevance. In the United States, for example, the healthcare sector constitutes almost a fifth of the US economy, making clear that the functioning of this industry has a

tremendous impact on the welfare and well-being of the population - even if consumers are heavily insured - due to losses in consumer surplus (Gaynor; Ho; Town, 2015). For example, employers may tunnel higher healthcare costs to workers through reduced wages and/or reducing benefits, as well as reducing or dropping insurance coverage entirely. Moreover, the competitive environment of this industry may affect the quality of care, which in turn may have substantial effects on several health outcomes.

Moreover, this paper also contributes to the study of capital regulation in insurance markets. In recent years, the study of the effects of capital regulation has focused on analyzing changes induced by the implementation of several financial stability mechanisms aimed at mitigating risks of widespread distress within the banking industry. For that matter, the gradual implementation of Basel I, II, and III, for example, has set grounds for the recent empirical research aimed at understanding the consequences of such changes in the financial regulatory agenda (Demir; Michalski; Ors, 2017; Gropp et al., 2019). Consequently, the bulk of the empirical results in the literature lies in analyzing the responses due to credit supply shortfalls induced within the financial industry, which in turn can generate spillovers to the real economy (Kashyap; Stein; Wilcox, 1993; Kashyap; Stein, 2000; Paravisini, 2008; Peek; Rosengren, 1997).

On the other hand, for the healthcare industry, understanding the role of capital requirements in improving welfare for the economy as well as empirical evidence on the real economic effects of such regulations is much less prevalent (Lorent, 2008). Although such regulations are generally aimed at controlling risk-taking, reducing the insolvency risk, and insulating policyholders, it is not clear whether such regulations emerge as a welfare-improving policy within the insurance industry, since they may also alter the structure of the market, constrain firms' and consumers' choice sets, and induce additional costs on firms (Gaganis; Liu; Pasiouras, 2015). For example, capital regulations may be relevant given the high social costs related to healthcare provider failures when suddenly a significant mass of *ex-ante* insured individuals are no longer insured for health-related claims. However, understanding the potential side effects of such regulations in the industry remains an open question.

In this sense, what are the mechanisms by which the introduction of capital requirements in the healthcare industry can improve welfare? Relatedly, how do firms respond - *i.e.*, if anything, how managers adjust their decisions? Answers to this question are still limited in the capital requirements literature. In light of that, the richness of the data allows for a deep understanding of key managerial implications in the presence of leverage regulation. Therefore, this paper sheds light on novel mechanisms by which firms respond to liquidity shocks within the real economy, such as competition, investments, asset composition, and service quality, paralleling previous studies that focused on the study of leverage regulation and credit markets (Benetton, 2018; Benetton et al., 2020).

Furthermore, the results from this paper also have key contributions in terms of practical relevance for at least three motives. First and foremost, health insurance is, in recent years, among one of the country's most fast-growing industries, presenting an annualized growth rate of 2.3% in the customer base and 13.47% in revenues over the last two decades, reaching roughly one-quarter of the overall Brazilian population. Not only the expectancy of a higher demand for healthcare services due to the country's population aging trend but also a shortage in supply of public healthcare by *SUS*, the country's universal healthcare access system, contribute to the upswing in the investment level within the health insurance industry. Despite the favorable institutional framework, concerns about financing constraints – namely due to leverage regulations – may play a key role in determining whether healthcare firms can effectively be able to benefit from such investment opportunities.

Additionally, within the last two decades, healthcare assistance costs are rising sharply: from 2001 to 2019, healthcare firms' operating margin fell, on average, 5.3 percentage points, a substantial drop of approximately 25% from 2001 levels, from 21% to 15.6%. While threatening the financial sustainability of the industry, increasing operating costs also have indirect effects on the capital requirement amount, which in turn may dampen investments aimed at mitigating risks of financial distress – *e.g.*, internalizing healthcare support services, such as hospitals and health centers.

Finally, concerns regarding the stringency of the solvency margin by practitioners and representative entities were a common reason to question the regulatory issues concerning industry's financial sustainability. Of special interest for this research, the adoption of a risk-based approach that is arguably better suited to provide enough incentives for investments has been intensely debated in the *ANS*'s bulletins. To that matter, anticipating a need for capital resources during the COVID-19 pandemic, the regulatory agency anticipated the firms' decision for adopting the risk-based capital rules, which otherwise would have been put into practice only in 2023. All things considered, such evidence reinforces the need for a careful investigation of the adverse effects of the solvency margin implementation on the development of the Brazilian health insurance industry.

All in all, tracing the impact of such capital requirement rules not only enhances the understanding of the real economic effects of such policies but also provides a framework for practitioners to understand how to effectively design financial regulation rules that accurately trade off benefits and costs. More importantly, from an academic perspective, by teasing out the effects of capital regulation rules, this paper contributes to the growing literature on healthcare markets by filling a gap in understanding the industry's welfare effects and the role of policy interventions.

The rest of this paper is organized as follows. Section 2.2 provides a high-level

overview of the Brazilian healthcare industry during 2000-2019. Sections 3.2 and 3.3 describe the data, the descriptive statistics of the sample considered in the analysis, while solvency margin implementation, while Section 3.4 provides a detailed discussion on the implementation of the solvency margin. Section 3.5 discusses the empirical strategy adopted in the study. Sections 3.6 and 3.7 discuss the results. Finally, Section 3.8 concludes and provides directions for future research.

2.2 Empirical Context

When assessing the potential adverse effects of the solvency margin, two key contemporary facts highlight the relevance of the analysis. First, even though there is a massive growth in the number of health insurance users within the last two decades, the number of active healthcare firms fell dramatically (ANS, 2020). Excluding exclusively dental coverage, while the number of healthcare customers increased almost 51% from 2000 to 2019, reaching almost 47 million individual customers, health insurance firms tumbled by almost 54% during the same period, from 1,970 to 920 active firms.

Furthermore, there is a notable increase in concentration towards medium and large players. During the decade, medium (50,000-500,000 clients) and large-sized firms (up to 500,000 clients) market shares increased more than 5.2 percentage points, from 78% to 83.3% of the total market. Concurrently, small to mid-sized firms (1-50.000 clients) saw their participation shrink from 22.06% to 16.64%. As such, understanding these points is also of practical importance for regulatory policy, as market concentration can lead to higher insurance premiums and consumer welfare losses, as presented in (Ho; Lee, 2017) when analyzing the United States private healthcare industry.

Importantly, it is also not clear whether the capital requirement regulation brought by the rule disproportionately affected the returns from small firms, which account for approximately 17% of the overall Brazilian health insurance market as of 2020. As it is expected that is more costly for small firms to issue equity due to informational frictions, such leverage regulation could potentially affect them to a greater extent through a higher cost of capital. When considering liquidity shortages induced by leverage regulation, such change can lead to large real effects if firms are unable to withstand such shortfalls by tapping into internal cash reserves or issuing equity.

Finally, despite the importance of the private healthcare industry on a national basis, there is no empirical evidence regarding the potential adverse effects of the Solvency Margin within the industry and, ultimately, on the consumer side. On the one hand, ultimate customers can benefit from a decrease in the likelihood of default, a situation that could potentially undermine their access to health assistance. On the other hand, however, not only due to market concentration towards larger and fewer health insurance

firms but also from the change in firms' investment prospects, such regulation can produce spillover effects in terms of consumer service quality given the increase in firms' market power. As such, the net benefit of the regulation for ultimate customers is non-trivial.

To that matter, the empirical literature on healthcare markets has focused on the different interactions between firms affecting variables that are directly related to consumers' welfare, such as prices, quality, treatment decisions, and insurer premiums. As such, a multistage approach, proposed in (Gaynor; Ho; Town, 2015), highlights the main steps related to the determination of welfare in healthcare markets: **I**) first, healthcare providers and workers decide on their quality; **II**) given their quality levels, these providers negotiate with insurers to determine the insurers' networks and set the prices paid for the services; **III**) with that, insurers choose their premiums to maximize the objective function, taking into account their characteristics as well as those from their competitors; **IV**) consumers observe each insurers' provider networks, premiums, and other characteristics, optimally selecting their insurers; and **V**) some consumers get sick and effectively use the insurers' network.

In empirical terms, very few papers try to assess more than two stages, with the healthcare markets (stages I-II) gaining most of the attention from the literature. Our work specifically adds to the international literature on healthcare markets by providing empirical evidence on multiple stages by analyzing not only healthcare-insurer networks but also insurer-employer and insurer-individual (directly) relationships. For example, identifying the effect of capital regulation on insurers' outcomes can lead to adverse effects in competition, thereby directly affecting insurers' price setting decisions (stage III), but also changing their choice for network quality (II) and affecting consumers' choices (stage IV). To that matter, our work adds to the earlier literature on the effects of competition on insurers' premiums (Dafny, 2010; Dafny; Duggan; Ramanarayanan, 2012; Dranove; Gron; Mazzeo, 2003) by shedding light on the potential unintended consequences of policy-making that lead to changes in the functioning of healthcare markets.

As expected, identifying the effect of capital requirements on firms' outcomes is not straightforward, as it is likely that firms' behavior can simultaneously react to demand-side shocks induced by a reduction in the degree of investment opportunities. For that, our identification strategy will benefit from a unique setting in the Brazilian health insurance industry that enables us to partly control for demand-side effects. On average, 80% of health insurance customers is originated from employer-sponsored contracts (ANS, 2020), where individuals have access to health insurance plans through their employer, which in turn negotiates the terms of the contract and bears the majority of the insurance costs generated from her pool of employees. Furthermore, aside from large health insurance conglomerates, the vast majority of health insurance players' operations and commercial activities is locally concentrated: firms have most of their health insurance customers concentrated in

a few, neighboring municipalities. As a consequence, variations in health insurance firms' investment opportunities are plausibly correlated with the local unemployment level where the firm concentrates its operating activities. This distinctive setting allows one to use measures of unemployment levels in the neighboring regions that each firm operates as plausible controls for investment opportunities.

Altogether, to disentangle the leverage regulation effect from possible investment opportunities shocks, the empirical design adopted in this study will use exogenous exposure to the solvency margin in a *differences-in-differences* (D-D) approach, seeking to pin down the size of the frictions caused by the enforcement of the rule while controlling for time-varying demand factors that are likely to affect firms' willingness to invest. As such, the results discussed in the next sections contribute to the growing literature on the effects of capital requirements and the health insurance industry in several ways.

2.3 Data

A distinctive feature of studying the Brazilian healthcare industry is the availability of publicly available granular data through Brazil's national open-access initiative, *Programa de Dados Abertos*. With the several pieces of open-data contained in this program, I construct an extensive dataset of firm-state-year observations that comprises, on average, 87% of all Brazilian healthcare insurance firms (in terms of the number of customers) between 2010 and 2020. More specifically, I collect information regarding health insurance firms' financials, market, service quality, and local economic conditions. Table 5 provides a detailed description of the available data and how the design of the final database to used in the empirical analysis.

Figure 5 – Raw Data and Final Dataset Description

This figure provides detailed information on the raw data inputs considered in the study, as well as the final dataset used throughout the multivariate analyses. All information used throughout the study is publicly-available. Detailed information about the consolidation procedures can be obtained upon request.

<i>Source</i>	<i>Data</i>
<i>Agência Nacional de Saúde Suplementar (ANS)</i>	<i>Financials</i> : Full disclosure of firms' financials (balance-sheet statements, cash-flow statements, and income statements). This data will be essential for understanding firms' financial conditions <i>ex-ante</i> the introduction of the solvency rule, as well as to assess possible <i>ex-post</i> effects. Data is at the end-of-year format and spans from 2006 to 2019.
	<i>Customer</i> : Detailed information regarding the number of firms' ultimate customers (individuals) over time, by month, and municipality. Data is at the firm-municipality-month level and spans from December 2014 to December 2019.
	<i>Service Quality</i> : Historical information regarding <i>ANS</i> 's periodic evaluation of health insurance firms, <i>Índice de Desempenho da Saúde Suplementar (IDSS)</i> . Information regarding financial sustainability, internal processes and compliance, ease of access, and healthcare quality. Data is in a yearly format and spans from 2009 to 2019.
	<i>Firm Characteristics</i> : Categorical information regarding firms' entity type (non-profit, private for-profit, cooperative), State of incorporation, date of incorporation, date of dissolution.
<i>Cadastro Geral de Empregados e Desempregados (CAGED)</i>	<i>Net inflow of formal contracts</i> : Information regarding the net inflow (hires minus dismissals) of formal employment contracts. Data is at the municipality-month level and spans from 2000 to 2019.
<i>Relação Anual de Informações Societárias (RAIS)</i>	<i>Job characteristics</i> : Firm-specific information regarding detailed characteristics of each job contract. Data is in yearly format and spans from 2010 to 2019.
<i>Final Dataset</i>	At the end of the merging process, the final database will consist of a unique set of firms' financials, market, service, and employment characteristics, as well as their corresponding exposure to local employment conditions. Data will be aggregated on a firm-year basis and will span from 2006 to 2019.

I start by collecting information on healthcare firms' financials during the study period. *ANS* provides detailed income statement and balance sheet information for all active healthcare firms in Brazil on a quarterly basis, following its customized accounting standards - for more details, see [Plano de Contas da ANS](#). Due to changes in accounting standards throughout the study period, information regarding the financials for the income statement and balance sheet was hard-coded following its respective accounting identification names.

To ensure that financial information is consistent over time, for every firm in the sample, I map the changes in accounting standards for all relevant variables of the study and match them accordingly by imposing a unique internal identification number ⁶. I

⁶ Specific accounting standards applicable to Brazilian healthcare firms were enacted in 2000 through *Resolução da Diretoria Colegiada – RDC N° 38*, establishing how these firms should provide accounting information for reporting and fiscal matters. Notwithstanding, seeking to accommodate the changing

then collect end-of-year financial information between 2009 and 2019 and map all relevant accounts to a common identifier to ensure that all financial variables are defined the same way throughout the sample period. At the end of this process, it is possible to fully reconstruct firms' general balance sheet and income statement information for all years of the sample, yielding an unbalanced panel of 1,655 unique firms.

Additionally, since the study aims to investigate the effects of capital requirement rules mainly on the basis of firms' future investments in healthcare operations, I drop all observations where firms are classified as *Administradora de Benefícios*, *Autogestão* and *Seguradora de Saúde*, as these firms have notable distinct business operations than other healthcare firms and, in its vast majority, do not invest in healthcare operational assets. Additionally, I also drop all observations where the firm is focused in dentistry healthcare (*Cooperativa Odontológica* and *Odontologia de Grupo*)⁷. Finally, I also exclude all healthcare cooperative firms characterized as federations ("*Federações*"), since these entities are mainly established for operating commercial alliances and do not constitute a clear operating healthcare insurance firm.

Additionally, a potential caveat when considering firms whose incorporation date occurs after the promulgation of the *Solvency Margin* is that these firms were not *ex-ante* exposed to the rule. For that reason, I drop all firms where the date of incorporation occurs after the implementation of the rule. Finally, I consider only firms whose assets in place in the first year of the sample (2010) were greater than or equal to R\$ 1MM.

At the end of this process, I am able to reach a total of 479 unique healthcare firms throughout the study period, with 3,085 firm-year observations over the study period. Relative to the overall market of healthcare firms within the considered categories, however, this sample represents, on average, 87% of the total number of customers, providing clear evidence of the informativeness of our results to the broader market. Considering this final sample, I winsorize all the numeric variables at the 1st and 99th percentiles.

Next, considering this sample of firms, I use *ANS*'s unique identifier (*Registro ANS*) to collect information on the number of customers for each firm over the study period. More specifically, for each firm, *ANS* provides the number of customers across several characteristics, such as gender, age, whether the plan is employee-sponsored or not, and healthcare coverage characteristics, among others, at the *city-month* level. As such, I am able to construct a panel of *year* \times *firm* \times *city* observations that tracks the evolution of market-share at the municipality level.

As such, for a municipality *m* in period *t*, I define the market share of a given

nature and better reflect their financial and accounting conditions of these firms, several amendments were put in place in the subsequent years of its enactment, with direct effects on the industry's accounting standards

⁷ For more information on the distinct types of healthcare firms in Brazil, see [Resolução da Diretoria Colegiada 39](#).

firm i as the number of customers held by firm i , $Cust_{i,m,t}$ relative to the total number of customers in municipality m and period t :

$$Share_{i,m,t} = \frac{Cust_{i,m,t}}{\sum_i Cust_{i,m,t}} \quad (2.1)$$

$Share_{i,m,t}$ is calculated for all firms in my sample throughout the study period, aggregated at the *state* level. Unfortunately, *ANS* does not provide access to customer-detailed data at the municipality level prior to January 2014, which hinders the use of municipality level data prior to the promulgation of the capital requirement rule ⁸.

Finally, I also merge this data to firms' categorical information, such as the date and state of incorporation, the entity type, the date of dissolution (for delisted firms), as well as information on healthcare service quality from *ANS*'s public servers, which comprises of *ANS*'s performance assessment of each active healthcare firm over time, and measures of customer's complaints over time. More specifically, I collect historical information regarding *ANS*'s periodic evaluation of health insurance firms, *Índice de Desempenho da Saúde Suplementar (IDSS)*, which seeks to evaluate and monitor, at the annual level, the performance of healthcare firms, providing benchmarks in terms of overall quality and reduce information asymmetry on the customer's end. *IDSS* Information regarding financial sustainability, internal processes, compliance, ease of access, and healthcare quality. Data is in *end-of-year* format and spans from 2009 to 2019. In addition to this data, I also collect the yearly number of complaints made by customers regarding several aspects of healthcare firms' operations, such as commercial, contractual, and healthcare-related issues.

2.4 Descriptive Statistics

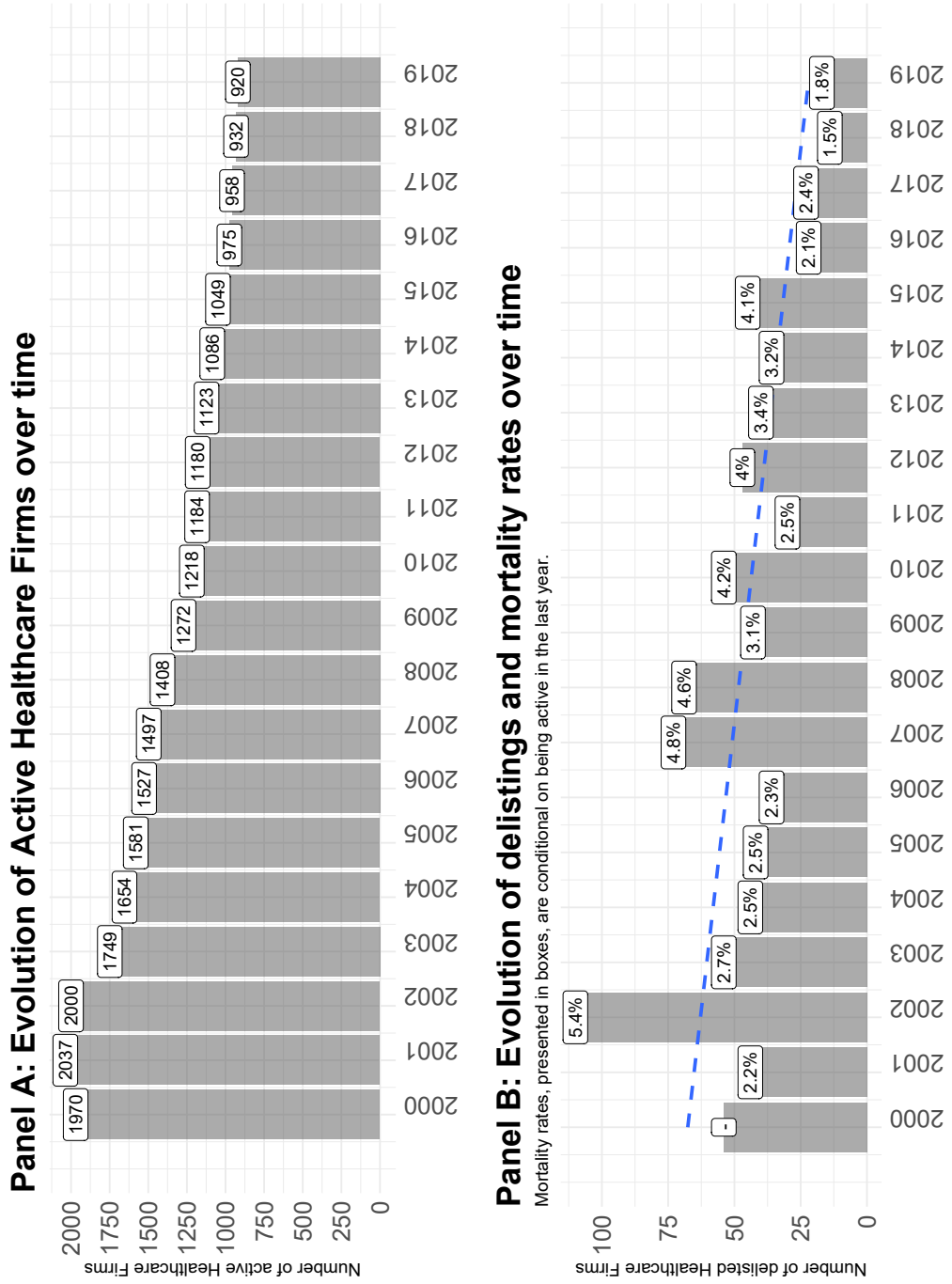
Figure 14 shows the evolution of the number of active healthcare firms over the study period⁹. As shown in Panel A of Figure 14, the number of active healthcare has been steadily decreasing: beginning in 2000, the number of all active healthcare firms was 1,970. In 2019, however, this number is 920, a decrease of approximately 53% - or 3.92% on a yearly basis.

⁸ On February 25th, a request for proprietary *ANS* data was made through *Lei de Acesso à Informação (LAI)*. This data request seeks to complement the information that is already published as a way to provide further evidence for the results. In the document, *ANS* acknowledges the existence of such information but, as of this study date, there has been no update in *ANS*'s public folders with the requested data.

⁹ Active healthcare firms are those that are allowed by *ANS* to operate as healthcare firms in the Brazilian territory and are thereby authorized to sell healthcare plans. To be considered an active healthcare firm, these firms must comply with a series of financial and operational established by *ANS*, reviewed on a quarterly basis.

Figure 6 – Number of active private healthcare firms over time

This figure provides detailed information on the number of active healthcare firms in the Brazilian healthcare industry during 2000 and 2019. Panel A plots the number of active healthcare firms for each period presented in the x-axis, whereas Panel B plots the number of delisted firms in each year on the y-axis. Labels presented in the top of the bar chart shows the ratio of delisted firms to the number of total active firms at the beginning of each year.



Source: Agência Nacional da Saúde Suplementar (ANS)

Conversely, Panel B of Figure 14, shows that the number of delistings - conditional on being considered an active healthcare firm in the previous period - is around 2.5%, being considerably stable over time. Together, these can imply that there is a tendency towards market concentration, where a reduced number of firms operate in the market over time. To shed more light on this finding, Figure 7 shows that the number of active customers in the private healthcare market is steadily growing, which corroborates with the evidence presented before. Panel A shows that the number of active healthcare customers has grown by almost 50% relative to the 2000 levels, or approximately 2.16% on a yearly basis. These numbers, in absolute terms, represent approximately 47 million private healthcare customers in 2019. In other words, this implies that almost a quarter of the Brazilian population relies on private healthcare insurance, which reinforces the relevance and representativeness of this market.

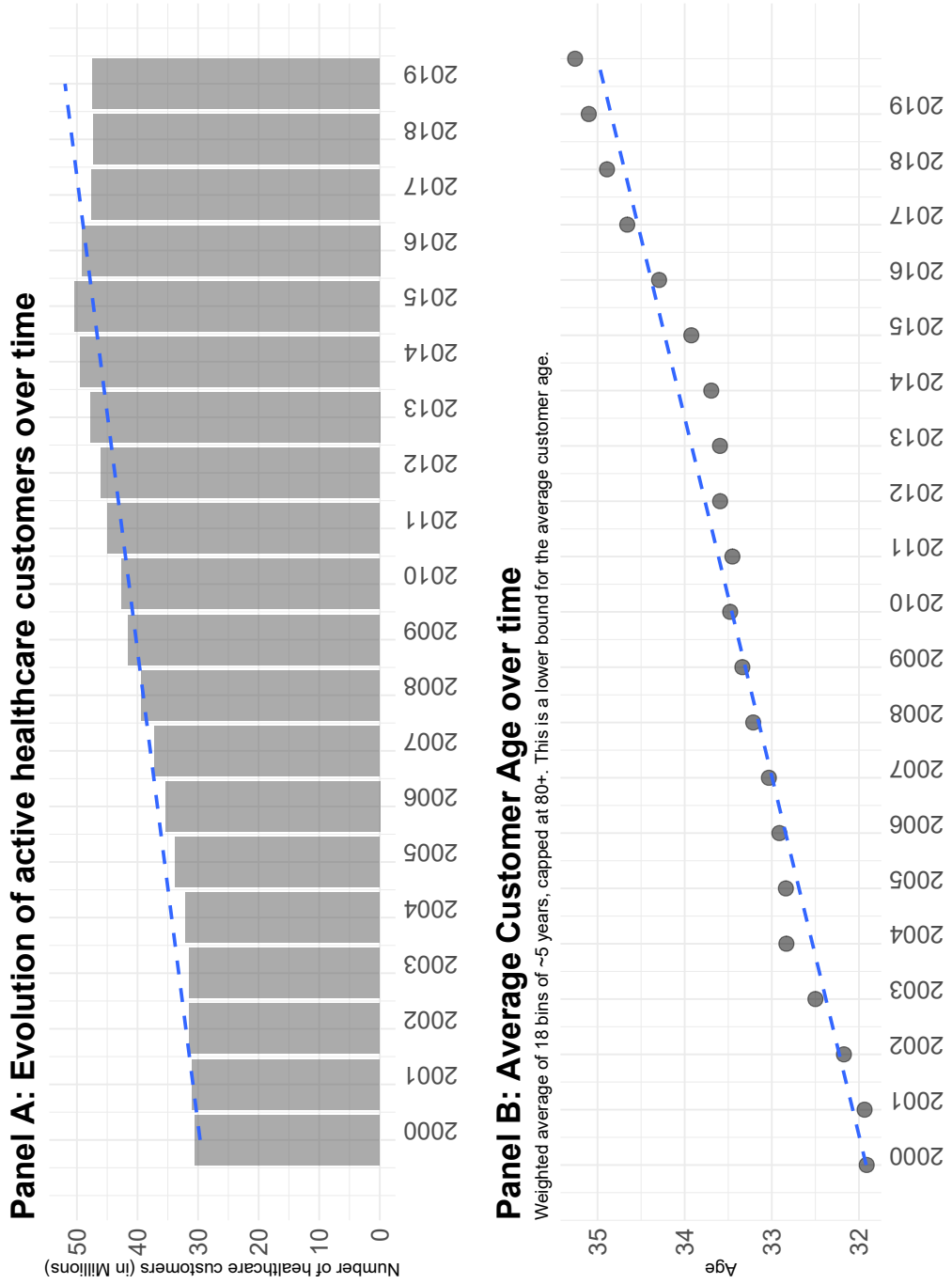
Additionally, the average age of the healthcare customer has also increased: between 2000 and 2019, the average customer became 10% older, with the average age going from 31.91 in 2000 to 35.95 in 2019. Panel B of Figure 7 shows that there is a steadily increasing tendency in the average age across time, which reflects not only the change in demographic characteristics of the Brazilian population but also the sorting of customers and private healthcare plans. A more detailed view of the portfolio distribution of customers by healthcare firms will be given in Section 3.4.

Given all of the above, it is key to understand how healthcare firms' financials have evolved over time. Figure 8 plots the evolution of the average hazard ratio (1 - Gross Margin) over time for all active healthcare firms. By considering only revenues and costs that are related to healthcare operations, it is possible to have a view of the operational nature of the healthcare business, letting aside any effects from financial decisions such as interest expenses, non-operational revenues/costs, and accruals. As the figure makes clear, healthcare firms' operational costs are rising sharply: while in 2001 this ratio was approximately 77.5%, it has since been increasing on an yearly basis, reaching approximately 82% in 2019, an increase of 4.5 percentage points. In other words, it means that, after covering all the costs related to providing healthcare assistance to its customers, the average healthcare firm in 2019 has a margin of approximately 17.5% left to cover all costs that are not directly hazard-related, such as administrative expenses, interest expenses, non-operational expenses, among others.

All in all, consistent increases in the healthcare customer's average age, together with reductions in operational margins and a reduced number of active healthcare firms may create a more challenging competitive environment, which hinders less-efficient firms to operate in this market. To get a better understanding of how the industry concentration behaved during the same period, define HHI_t as the Herfindahl-Hirschman Index (HHI) of market concentration for the period t as:

Figure 7 – Number of active private healthcare customers and average age over time

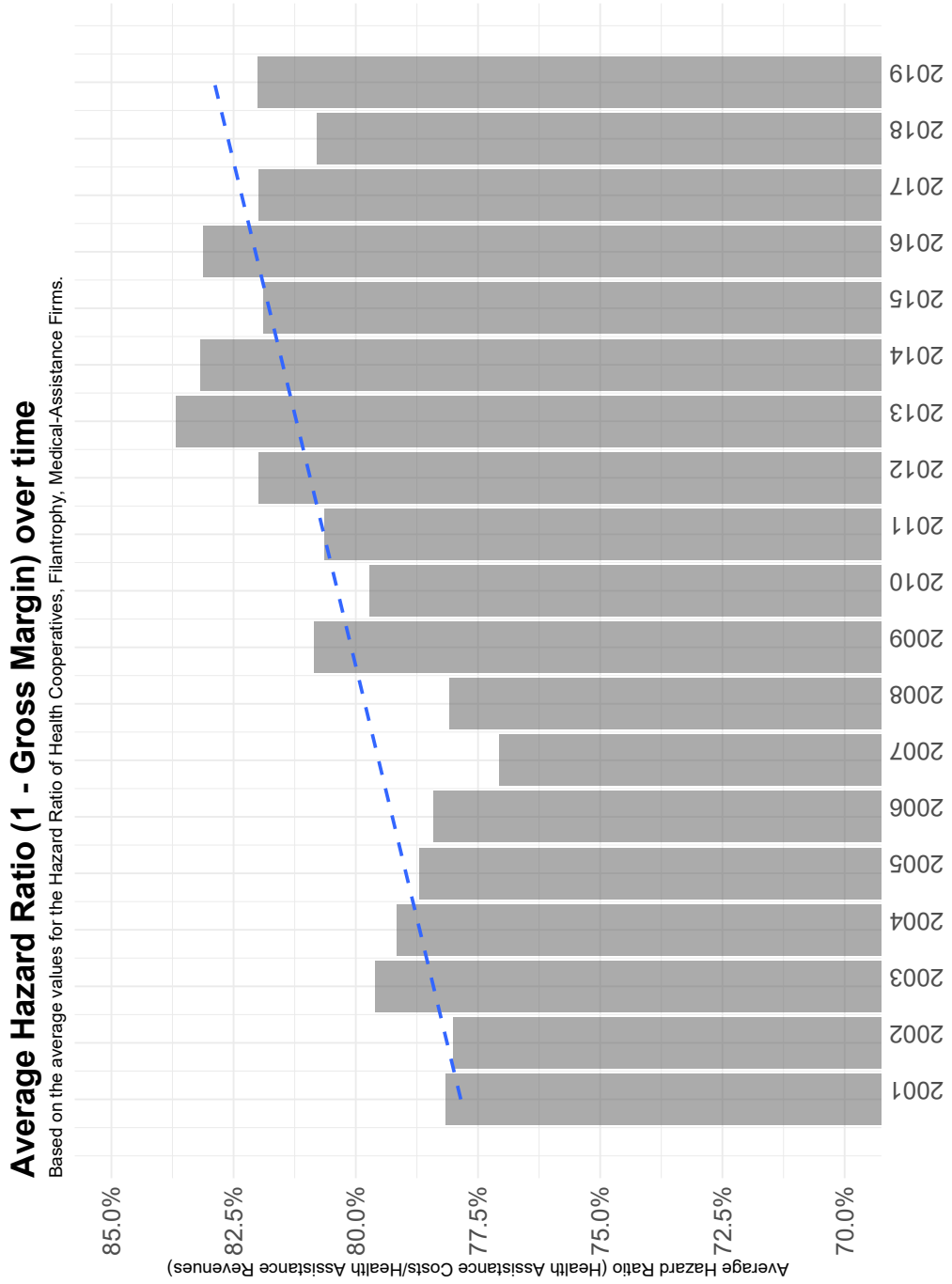
This figure provides detailed information on the number of active healthcare customers between 2000 and 2019 and the average customer age throughout the same period. Panel A shows the number of active healthcare customers (in billions) during each period between 2000 and 2019. Panel B plots the average age of active healthcare customers between 2000 and 2019.



Source: Agência Nacional da Saúde Suplementar (ANS)

Figure 8 – Evolution of private healthcare firms’ operational costs over time

This figure plots the evolution of the Hazard Ratio for active healthcare firms between 2001 and 2019. Hazard Ratio is defined as 1 - Gross Margin. Calculations are made according to ANS’s accounting standards described in the *Plano de Contas Padrão da ANS* and account for changes in accounting standards occurred throughout the study period.



Source: Agência Nacional da Saúde Suplementar (ANS)

$$HHI_t = \sum_i Share_{i,t}^2, \quad (2.2)$$

where $Share_{i,t}$ defined as before. Figure 9 plots the evolution of the aggregate HHI considering only both the overall healthcare industry market, and the market considered in the sample. As clearly highlighted in the figure, concentration across the whole healthcare market has increased substantially between 2011 and 2019, with an average increase of approximately 45% in the HHI. Notably, the period with a markedly higher increase in market concentration - between 2011 and 2013 - coincides with the period where the solvency margin was effectively put in place.

To the extent that the industry-wide changes previously shown are related to the introduction of stricter capital requirement rules, the introduction of the solvency margin may have created additional difficulties for more exposed firms to increase their participation in the markets that they operate. Before showing further evidence of this relationship, the next section provides a detailed description of the *Solvency Margin*, the capital requirement rule introduced by *ANS* that has established minimum equity levels for healthcare firms to operate in the Brazilian healthcare industry.

2.5 The introduction of the solvency margin

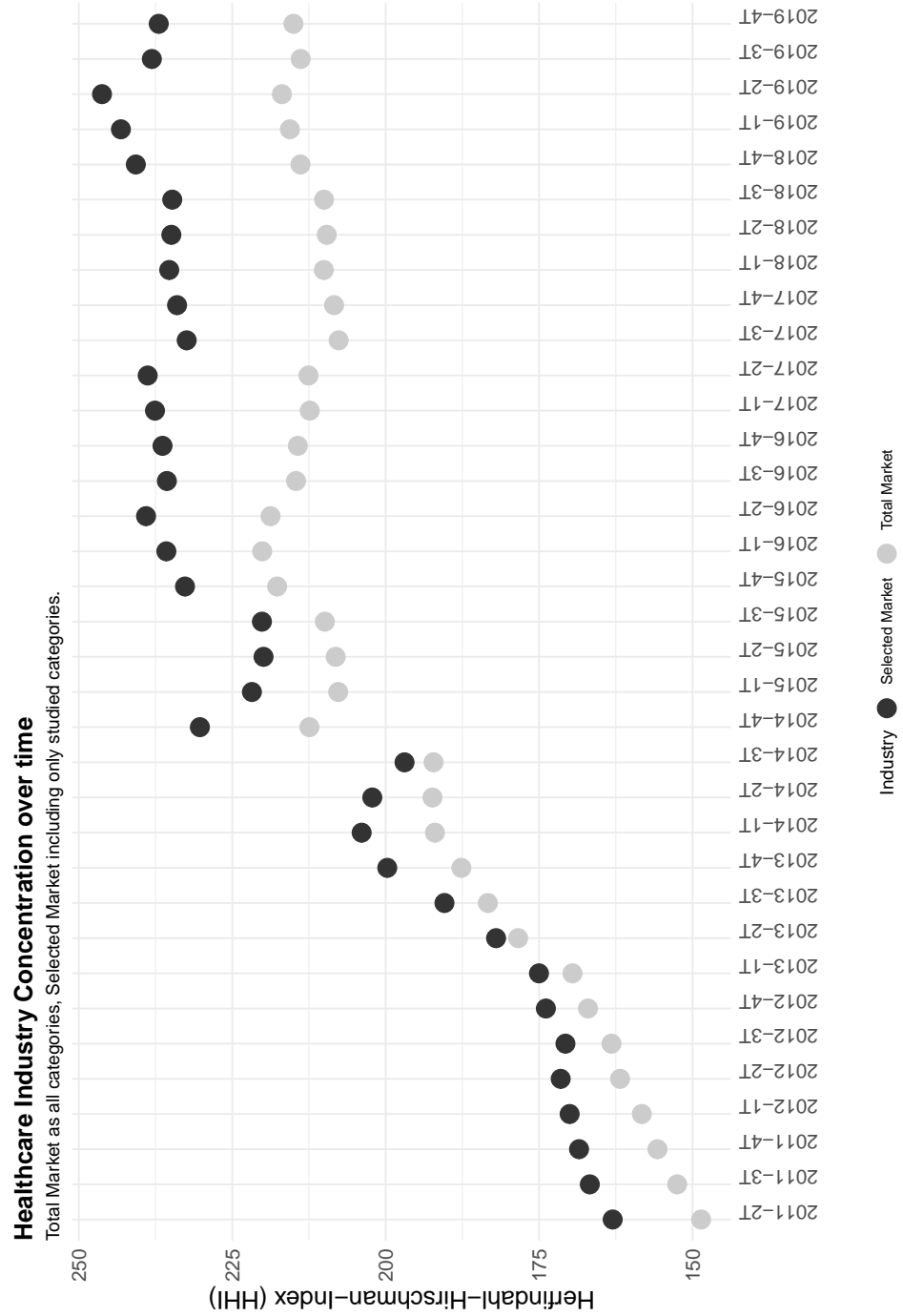
Motivated both by the dependence of the Brazilian healthcare system upon private sector services and the growing concern regarding the risks of financial distress in the industry, the solvency margin was established in 2009, effectively being put into practice at the beginning of 2013 through the *RN 209/2009*. In practical terms, the solvency margin is defined as the mandatory amount of equity (adjusted for economic purposes) to cover the maximum of of:

$$SM_{i,t} = \max \left\{ \begin{array}{l} 20\% \times \left[\frac{\left(\sum_{i=j}^{12} 100\% \times Premium_{Pre} + 50\% \times Premium_{Post} \right)}{12} \right], \\ 33\% \times \left[\frac{\left(\sum_{i=j}^{36} 100\% \times OpCost_{Pre} + 50\% \times OpCost_{Post} \right)}{36} \times 12 \right] \end{array} \right\}, \quad (2.3)$$

where $Premium_{Pre}$ refers to the monthly premium received in pre-established health plans, and $Premium_{Post}$ refers to the monthly premium received in post-established health plans. While pre-established premiums are the pecuniary costs incurred by customers calculated before the usage of the healthcare insurance assistance, post-established premiums are those calculated after the assistance costs have been effectively incurred. Relatedly, $Op.Cost_{Pre}$ and $Op.Cost_{Post}$ are the costs incurred for health assistance in

Figure 9 – Brazilian private healthcare industry concentration over time

This figure plots the evolution of the Herfindahl-Hirschman-Index (HHI) of the Brazilian healthcare industry between the second quarter of 2011 and 2019. HHI is calculated following Equation (2). Gray dots represent the HHI estimate across the whole set of active healthcare firms in each period, whereas black dots represent the HHI estimate considering only the subset of categories included within the regression sample.



Pre/Post contracts for the last j months, respectively. From the latter, the required solvency margin that health insurance firm i must attain in each period t follows:

$$\text{RequiredSolvencyMargin}_{i,t} = \text{Adj.Equity}_{i,t} - K_t \times \text{SM}_{i,t}, \quad (2.4)$$

where $\text{Adj.Equity}_{i,t}$ is the firms' equity adjusted for economic purposes: book equity minus non-current intangible assets, tax credits from losses, ownership interest in regulated entities, deferred sales expenses, and prepaid expenses. Importantly, the Solvency Margin was structured in such a way that firms' capital requirement ratio grows linearly by a factor K_t . More specifically, at the end of 2013, the first period when the rule is effective, $K_{2013} = 0.35$, growing proportionally each month until December 2022, when the solvency margin coefficient is fully applicable – *i.e.*, $K_{2022} = 1$.

On a monthly basis, health insurance firms must assess and disclose the sufficiency of the solvency margin following ANS proceedings to the regulatory agency. When in deficit – *i.e.*, $\text{RequiredSolvencyMargin}_{i,t} < 0$ –, firms are obliged to raise equity to comply with the minimum equity postulated by ANS, where non-compliance with the required procedures can ultimately lead to liquidation.

Seeking to understand the potential effects of the introduction of a capital requirement rule in the industry, Figure 10 shows the evolution of healthcare firms' operational leverage before and after the solvency margin was in place. As Panel A makes clear, after the introduction of the solvency margin, firms' operational leverage has steadily decreased. To get a better understanding of the motives behind the decrease in leverage, Panel B shows that the period after the solvency margin was in place was marked by a substantial increase in firms' financial buffers: while before the solvency margin was in place, the average amount of short-term financial assets was about 35% of Total Assets, this number has grown to almost 55% in 2019. In other words, this means that more than half of firms' resources in 2019 were allocated to financial, and not operational, assets.

To get a better sense of the overall magnitude of these financial buffers on an industry-wide level, Figure 11 shows the evolution of financial assets before and after the introduction of the solvency margin by aggregating all active firms' financial assets year over year. As the figure shows, the overall financial buffer held by healthcare firms in 2019 was approximately R\$ 23 billion, an increase of almost four times relative to the 2010 levels.

As a consequence, firms' assets devoted to operational activities have decreased over the period substantially. Importantly, according to the solvency margin rule, a firm that increases its customer base by 10% must also increase the amount of financial buffers proportionally to the increase in premiums or costs, according to the solvency margin rule calculation. If this shift was not uniform across firms, which may indicate that some

Figure 10 – Evolution of private healthcare firms’ leverage and financial buffers costs over time

This figure provides information on the evolution of financial buffers held by Brazilian healthcare firms before and after the introduction of the solvency margin. Panel A shows the evolution of the average Leverage ratio of active Brazilian healthcare firms between 2010 and 2019, whereas Panel B shows the evolution of the Financial Assets (in % of Total Assets) held by these firms. Leverage is defined as the ratio of Total Assets to Total Equity. Financial Assets are defined as Cash, Cash Equivalents, and Short-Term Investments, according to ANS’s accounting standards described in the *Plano de Contas Padrão da ANS*.

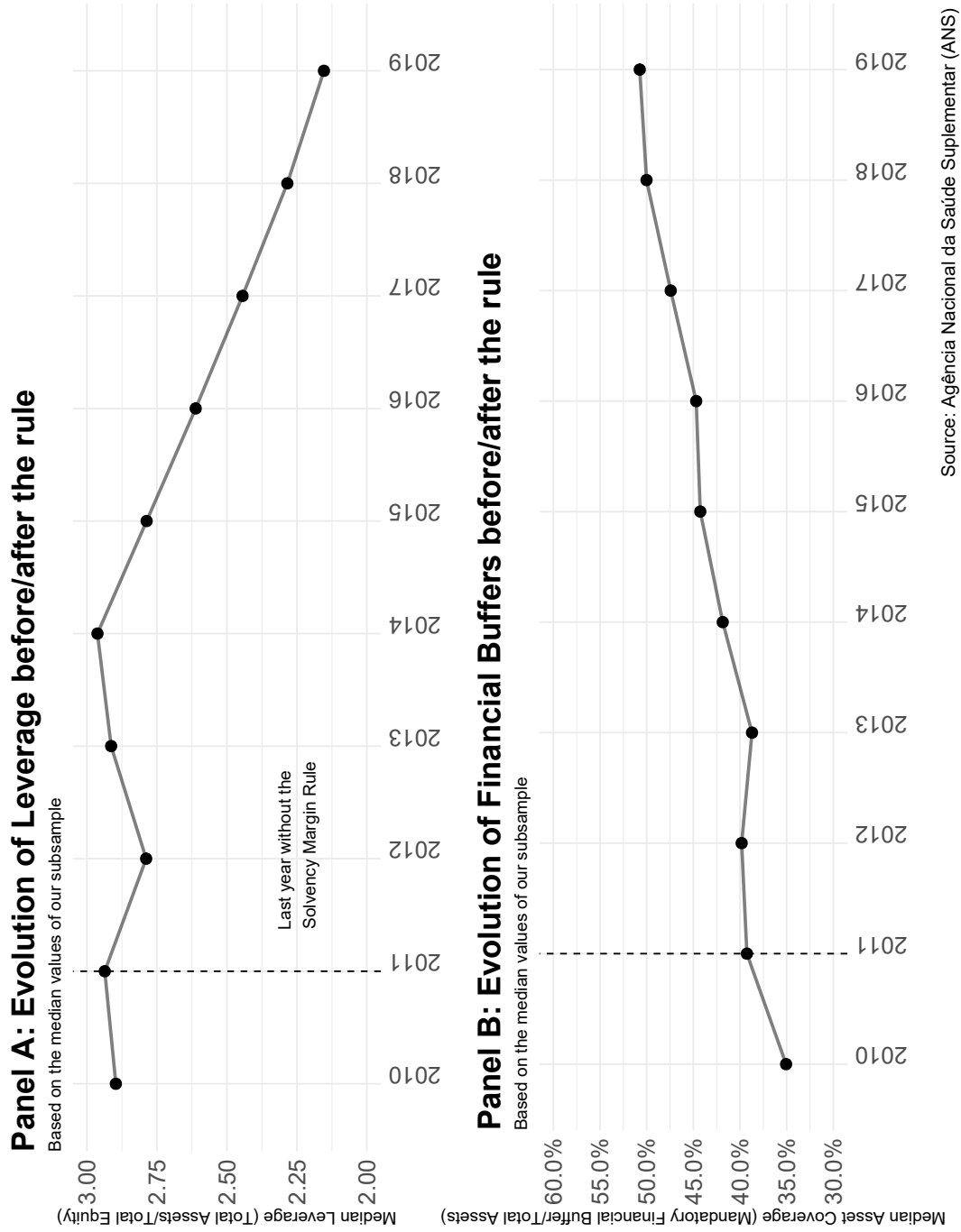
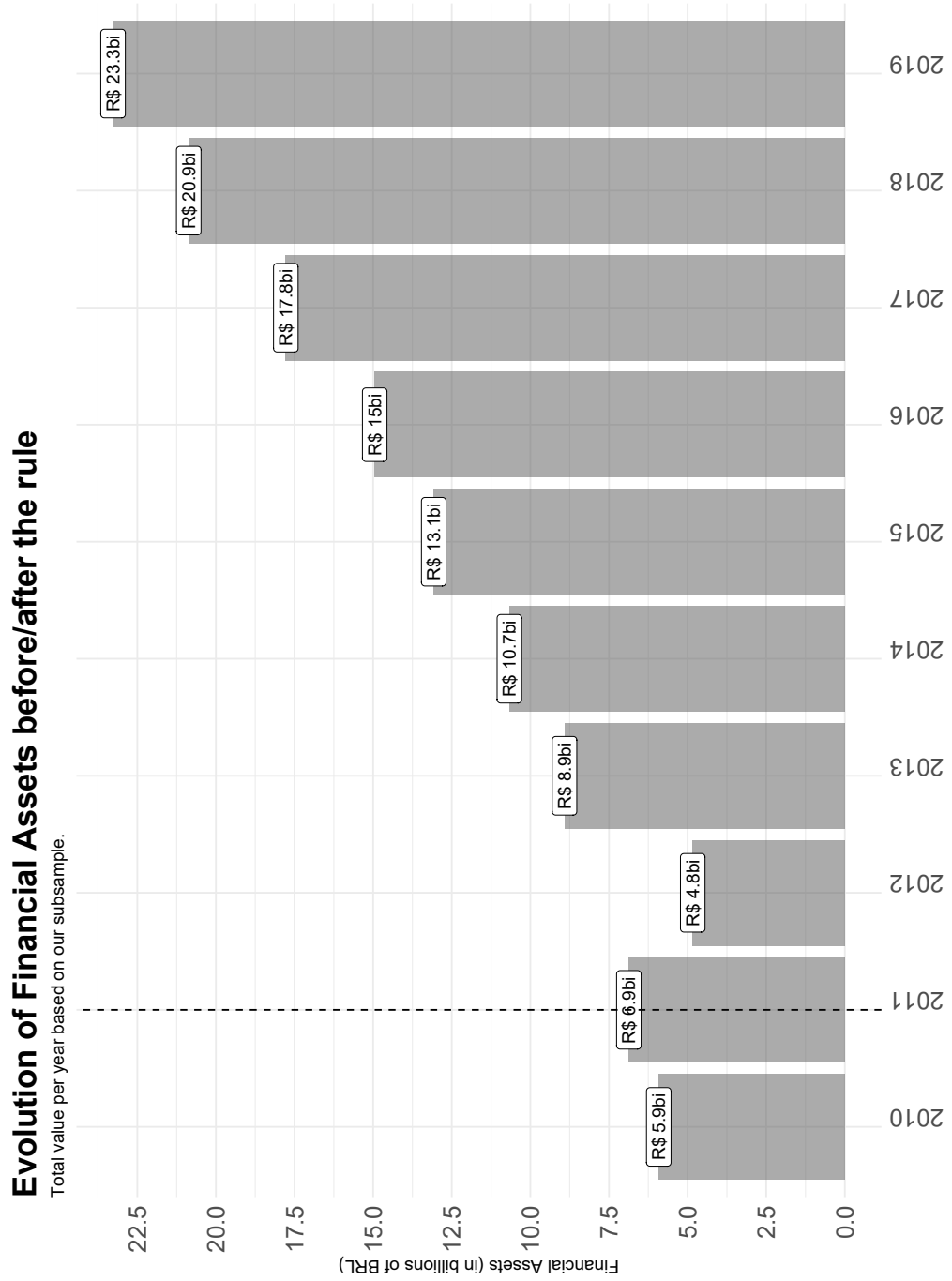


Figure 11 – Evolution of private healthcare firms’ financial assets before/after the Solvency Margin rule

This figure provides information on the evolution of financial assets held by Brazilian healthcare firms before and after the introduction of the solvency margin. Financial Assets are defined as Cash, Cash Equivalents, and Short-Term Investments, according to ANS’s accounting standards described in the *Plano de Contas Padrão da ANS*. The y-axis plots the amount (in R\$ billion) of Financial Assets held by all active healthcare firms between 2010 and 2019.



Source: Agência Nacional da Saúde Suplementar (ANS)

firms are relatively less capable of funding growth opportunities, a potential explanation for the increase in the market's overall concentration is that firms more exposed to the solvency margin had a higher marginal cost for investing in operational assets, while firms less exposed to the capital requirement rules.

Notwithstanding, identifying a causal relationship between the introduction of the solvency margin and the increase in the market concentration has several caveats. As such, it is not clear, only from these results, that the introduction of the solvency margin had a direct effect on the market's concentration. To provide an empirically convenient way to understand the effects of the introduction of the solvency margin in this industry, the next section provides a deep dive through the identification strategy employed in Section 3.6.

2.6 Identification and Empirical Design

As in most of the empirical corporate finance and financial intermediation literature, assessing the effect of capital requirements on firms' market performance is not straightforward, as there is a variety of unobservable confounding factors that are likely to be related to both dependent and independent variables. For example, a lack of investment opportunities may drive firms into a situation where future market performance is poor, but at the same time may harm firms' financial conditions, which in turn determines its exposure to the solvency margin rule. If this is the case, a naïve ordinary least squares (OLS) regression of the growth in market share on the exposure to the capital requirement rule would yield biased estimates of the desired effect due to omitted variable bias.

Of special interest to this study, a common concern is how one can disentangle the effects of the capital requirement rule on future market prospects – *i.e.*, supply-side factors — from those related to unobservable investment opportunities that firms may face – *i.e.*, demand side factors. As such, any study that aims to assess the effect of the introduction of solvency margin on future growth prospects, which is not exogenous to firms' characteristics, should guarantee that any confounding factors are properly controlled for in the regression specification.

One notorious approach to assessing the effects of liquidity shocks in a clean identification strategy is found in (Aiyar et al., 2014), which study the transmission of shocks induced by increases in the United Kingdom's (UK) bank-specific capital requirement rules on cross-border credit supply. By analyzing an international sample of multiple loan relationships with UK-resident banks, the authors show that cross-border lending is negatively affected by more stringent capital requirement rules: a 100 basis-point increase in the capital requirement from a UK-resident bank is associated with a 5.5 percentage points decrease in the growth rate of cross-border credit amount. Furthermore, the effects are heterogeneous conditional on bank and relationship characteristics, as banks

tend to favor their “core” country relationships, which are shown to have the smallest decreases in credit supply. Finally, when analyzing separately between bank and non-bank lending - *i.e.*, directly to households and firms, respectively -, results shed light on the bank relationship as the main channel of liquidity transmission, as decreases in cross-border non-bank lending are statistically insignificant.

Parallelling (Aiyar et al., 2014), (Khwaja; Mian, 2008) assess the impact of liquidity shocks induced by bank balance sheets on firms’ loan amounts. Using a dataset comprised of firm-bank relationships at the loan level, the authors exploit unanticipated nuclear tests in Pakistan as a proxy for liquidity shocks on Pakistani banks’ balance sheets. Results show that for the same firm borrowing from two different banks, the loan level from banks that were hit by the liquidity shock drops an additional 0.6 percent for each 1 percent decline. One noteworthy feature of this empirical approach is that as the data is presented at the loan level, one can control for factors that are common for each loan-firm and/or loan-country pair, thereby relieving concerns about endogeneity coming from the demand channel, such as investment opportunities.

In this paper, I use the introduction of the solvency margin in the Brazilian health insurance market as a shock that impacts the marginal cost of equity of healthcare firms in a heterogeneous way. The empirical strategy goes in line with the most recent advances in the capital requirements literature within the financial industry, similar in spirit to (Aiyar et al., 2014), who studies the transmission of shocks induced by increases in the United Kingdom’s (UK) bank-specific capital requirement rules on cross-border credit supply, and (Khwaja; Mian, 2008) which assesses the impact of liquidity shocks induced by bank balance-sheets into firms’ loan amounts.

Even though the rule was widely enforced across healthcare players, due to the different distribution of equity levels and firms’ fundamentals prior to its enactment, some firms were *ex-ante* closer to the threshold for capital requirement margin calls than other firms - *i.e.*, more constrained. To the extent that i) such implementation was not anticipated by firms’ managerial decisions; ii) the regulation reduces the available supply of internal funds *ex-post* implementation; and ii) adjustment costs on firms’ capital structure are present, one can investigate whether if firms more exposed to the rule at the onset of the implementation reduce their future investments and growth prospects.

Still, a potential concern regarding this empirical design is related to omitted variables: investment opportunities, on the one hand, directly affect firms’ demand for capital, whereas on the other hand may also be related to firms’ financial conditions, which are plausibly correlated with the exposure to the *Solvency Margin* rule. For example, poor investment opportunities may negatively affect firms’ financial conditions, whilst also reducing firms’ demand for investment. Consequently, omitting investment opportunities is likely to produce biased estimates of the introduction of capital requirement rules .

Seeking to partially insulate the identification strategy from demand-wide factors, the strategy adopted in this paper leans on a specific feature of the Brazilian industry: historically, approximately 80% of all healthcare insurance revenues are *employer-sponsored*, with the vast majority of firms' customers concentrated within *neighboring* regions. Consequently, such setting allows inferring that health insurance firms' investment opportunities are closely related to variations in local employment conditions. Therefore, variations state-level conditions and, in special, local employment conditions – which are arguably exogenous to healthcare firms' decisions – can be used in the regression specification seeking to control for unobserved demand-wide factors such as investment opportunities. As expected, the correlation coefficient between variations in aggregate unemployment growth rates and aggregate health insurance customer growth during 2000-2015 is -0.87 , which is in line with the argument that variations in local employment conditions predict customer growth in the health insurance market.

Within this framework, the empirical strategy is designed as follows. Since the solvency Margin rule was announced in December 2009 and enacted in January 2013, I define $DistSolvency_{i,2009}$ as the distance to the mandatory *Solvency Margin* of firm i at the end of 2009 (in percentage terms), assuming $K = 1$ - *i.e.*, considering the full extent of equity to be integralized until 2022:

$$DistSolvency_{i,2009} = \frac{Adj.Equity_{i,t} - SM_{i,t}}{SM_{i,t}} \quad (2.5)$$

Intuitively, $DistSolvency_{i,2009}$ measures the relative stringency of the *Solvency Margin*, which is firm-specific but fixed over time. In this sense, the more negative the distance is, the higher the level of equity to be integralized by the firm until 2022. We divide our sample of firms in quintiles of the distribution of $DistSolvency_{i,2009}$ and define our exposure variable, $Exposure_i$ as 1(0) if $DistSolvency_{i,2009}$ is below (above) the median.

Based on that, the main specification of the empirical design follows a *differences-in-differences* (D-D) approach of the form:

$$\log(Cust_{i,s,t+1}) = \beta_{DD} \times (Rule_t \times Exposure_i) + \Theta' Controls_{i,t} + \alpha_i + \alpha_{s \times t} + \varepsilon_{i,s,t+1}, \quad (2.6)$$

where $\log(Cust_{i,m,t+1})$ is the (log) number of customers that firm i has in state s in $t + 1$, $Rule_t$ is an indicator variable that assigns 1 (one) after the *Solvency Margin* implementation (2012), and zero otherwise. $Controls_{i,t}$ is a vector of firm time-varying characteristics, such as size, profits, and profitability, and α_i , $\alpha_{s \times t}$ refers to firm and state-year fixed effects, respectively. Note that $Exposure_i$ and $Rule_t$ are subsumed by the firm and state-year fixed effects and therefore are omitted from the specification.

As the data is at the firm-state-year level, the inclusion of state-year fixed effects ensures a direct comparison between the growth in market share between similar firms subject to the same state-time trends, thereby alleviating concerns about endogeneity issues induced by unobservable investment opportunities.

Finally, the underlying identifying assumption of the model is that in the absence of the solvency margin, future outcomes for firms more/less exposed to the rule would have evolved in parallel. In other words, conditional on observables (firm, time, and local economic conditions), higher exposure to the rule affects future outcomes only through its direct effect on the availability of internal cash, and not by any other indirect channel that affects the growth in the customer base. Formally, let Γ denote the set of covariates included in the baseline regression. Therefore, it must be that:

$$E[Rule_t \times Exposure_i | \Gamma] = 0 \quad (2.7)$$

If this condition is satisfied, β_{DD} will measure the differential effect on future outcomes for firms that were more constrained by the Solvency Margin rule. As such, based on the above discussion, it is expected β_{DD} to be *negative*. Along with the main results, several robustness checks will be conducted to rule out possible alternative explanations. Furthermore, we investigate the sensitivity of the results through (i) different measures for growth, such as capital investments and labor; (ii) different levels of past firms' quality assessment; and (iii) the stringency of the solvency margin over the years after the rule was put in practice. Finally, baseline estimates will be used to assess the aggregate change attributable to capital requirements, tracing its contribution to the overall increase in market concentration *ex-post* implementation period. The next section provides a detailed discussion of the main results of the econometric estimation.

2.7 Firm-level Analysis

2.7.1 Summary Statistics

Table 14 provides the summary statistics of the sample used throughout the multivariate analysis. As expected, firms more/less exposed to the capital requirement rule are different across a wide set of dimensions: even though more exposed firms present a higher return on Equity, mainly due to leverage - even though not statistically significant -, they present lower levels of operational returns (as shown by lower EBITDA, Net Margins, and Hazard Ratio). These results are expected, as more firms more exposed to the capital requirement rule, by definition, rely more on financial leverage to sustain their operations.

Additionally, lower levels of operational returns not only shed light on the additional riskiness of these exposed firms to the aforementioned industry trends, such as rising

Table 14 – Summary Statistics - Regression Sample

This table presents the summary statistics for the sample used throughout the analysis conducted in Section 3.4. Column 2 shows the average values for firms in which the sufficiency of solvency margin is greater than or equal to the median value (more exposed firms), whereas Column 3 shows the same calculations for the subsample of firms with sufficiency margin above the median. Finally, columns 4 and 5 present the differences between columns 1 and 2 and its corresponding p-values, respectively. EBITDA (%) is calculated as the ratio of net operational income to gross revenues. Net margin is the ratio of profits to gross revenues. PPE (%) is the ratio of Property, Plant and Equipment to Total Assets. State Market Share (%) is the market share of a firm in the state where it hosts the majority of its customers. Hazard Ratio is defined as $1 - \text{Gross Margin}$. Size is defined as the natural logarithm of firms' Total Assets. *DistSolvency* (%) is defined as in Equation (5).

Variable	<i>DistSolvency</i> < Median	<i>DistSolvency</i> \geq Median	$\Delta(1 - 2)$	p-val
EBITDA (%)	0.013	0.030	0.018	0.012
Net Margin	0.012	0.041	0.029	0.000
PPE (%)	0.193	0.338	0.145	0.000
Return on Equity	0.171	0.117	-0.054	0.416
State Market Share (%)	0.027	0.010	-0.017	0.003
Hazard Ratio	0.781	0.712	-0.069	0.000
Size	16.6	16.3	-0.3	0.093
SSM (%)	-0.924	1.930	2.854	0.000

healthcare assistance costs but also relate to the dependency of these firms on returns from non-operational activities - *i.e.*, returns from financial instruments. To this point, it is worth noting that the *SELIC* rate - *i.e.*, the Brazilian federal funds rate, has varied substantially over the study period, reaching its peak in 2016 at approximately 14.25% yearly, and dropping to 5% in 2019, close to the lowest levels for this benchmark since the Brazilian Central Bank started to disclose the *SELIC* rate for monetary policy related issues, in 1999. As such, firms relying more on the returns of financial instruments to sustain net margins faced additional difficulties during the period after 2016 to deliver positive accounting profits.

Furthermore, more exposed firms present lower investment in operational assets (as shown by lower Property, Plant, and Equipment levels). Investing in operational assets, - such as hospitals, healthcare centers, etc - has been a key practice in this industry to decrease or sustain the rise in healthcare costs. As Table 14 shows, more exposed firms show lower levels of operational assets relative to less exposed ones, providing another dimension by which this subsample of firms may induce customers to additional insolvency risk.

All in all, it is relevant to consider such differences when estimating the effect of the solvency margin on firms' growth prospects in order to control for confounding factors that may arise due to differences in financial performance, which are plausibly positively correlated with growth prospects. In the next subsections, I provide multivariate results that show that more and less exposed firms had different trends in terms of customer growth after the solvency margin was put in place.

2.7.2 The effect of higher exposure to capital requirements on future growth

Table 15 provides the estimates of equation (6) considering the full sample of healthcare firms across different states. The coefficient of interest, $Rule \times Exposure$, is negative and statistically negative in all specifications, providing evidence that the introduction of solvency margin has led more exposed firms to show lower growth in their customer base, relative to other firms that were not substantially exposed to the rule. More specifically, Column (1) shows that not only do more exposed firms typically have less growth, the wedge between these firms and less exposed ones in terms of growth terms widens. In columns (2) and (3), the inclusion of year, state, and firm fixed effects shrink the coefficient of $Rule \times Exposure$ by almost 50% of the value presented in column (1), since it is expected that firms more exposed to the capital requirement rule may also grow less than their counterparts, irrespective of the rule being in place. Finally, to rule out any potential confounding factor coming from unobservable trends at the state level, Column (4) adds State \times Time fixed effects to the regression.

In other words, firms that were below the median in terms of sufficiency of solvency

Table 15 – OLS - Growth in Customer Base and Solvency Margin Sufficiency

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the whole sample of healthcare firms across states. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1+Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	0.909*** (0.094)	0.909*** (0.094)	-	-
<i>Rule</i>	-0.911* (0.513)	-	-	-
<i>Exposure</i> × <i>Rule</i>	-0.219*** (0.060)	-0.240*** (0.062)	-0.125** (0.050)	-0.117** (0.051)
Firm Controls	✓	✓	✓	✓
Firm Controls × Post	✓	✓	✓	✓
Year FE	No	✓	✓	No
State FE	No	No	✓	No
Firm FE	No	No	✓	✓
State-Year FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	3,085	3,085	3,085	3,085
R ²	0.703	0.716	0.962	0.964

Note:

* p<0.1; ** p<0.05; *** p<0.01

margin grew their customer base 11.7% less, on average, relative to other firms less exposed to the capital requirement rule, on an yearly basis. The effects remain statistically significant (at the 5%) level even after controlling for firm-fixed effects and state unobservable trends, indicating that two similar firms, subject to the same state shocks, have a wedge of 11.7% in their annual growth. Furthermore, this effect is attributed to the fact that one of these firms has been more exposed to the capital requirement rule. In all estimates, we also include controls firm-level controls such as Size, defined as the natural logarithm of the firm's Total Assets, the market of firm i in state s for the period t ($Share_{i,s,t}$), the percentage of customers from firm i that are in state t relative to the overall number of customers from firm i , while also controlling for pre/post trends before/after the introduction of the solvency margin rule.

In sum, these results show that the solvency margin rule has affected firms in a heterogeneous way, with some less exposed firms being able to increase their market share at the expense of the more exposed ones having lower customer growth. Intuitively, by showing a higher marginal cost for funding their customer growth, more exposed firms had to bypass potential growth opportunities in such a way that was profitable for less exposed firms to exploit.

Notwithstanding, one can argue whether these results may vary across different types of firms in our sample. For example, there might be situations in which firms, even with very low (or negative) levels of solvency margin sufficiency, are still able to raise equity more efficiently than their counterparts due to other factors unrelated to their exposure to the capital requirement rule. Of special interest to this study, health cooperatives, mostly represented by UNIMED, the world's most widespread health cooperative group and the largest player in private healthcare player in Brazil, which are considered non-limited liability companies (non-LLC) in Brazil, have clear governance regimes than limited liability companies.

Being formally characterized as a health-cooperative group, UNIMED is a decentralized entity, held by health-care professionals, with equal-voting characteristics. Accounting for more than a third of the overall private healthcare market as of 2019, UNIMED raises equity via i) the integralization of current profits; ii) the approval of new health-care professionals inside the cooperative; and (or) iii) through the actual network of healthcare professionals, approved in board meetings.

As such, one would expect that, if anything, health cooperatives should have a different response to the introduction of the solvency margin, relative to other similar firms that operate in a limited liability setting. To get a better understanding of these differences, Tables 16 and 17 provide the results of estimating Equation (6) to different subsamples of non-health cooperatives and health cooperatives only, respectively.

The results from Tables 16 and 17 make clear that the adverse effects of the

Table 16 – OLS - Growth in Customer Base and Solvency Margin Sufficiency - Only Health Cooperatives

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the subsample of healthcare cooperatives across states. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1 + Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	0.408*** (0.100)	0.408*** (0.100)	-	-
<i>Rule</i>	0.009 (0.675)	-	-	-
<i>Exposure</i> × <i>Rule</i>	0.007 (0.065)	-0.017 (0.065)	-0.037 (0.048)	-0.031 (0.048)
Firm Controls	✓	✓	✓	✓
Firm Controls × Post	✓	✓	✓	✓
Year FE	No	✓	✓	No
State FE	No	No	✓	No
Firm FE	No	No	✓	✓
State-Year FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	1,530	1,530	1,530	1,530
R ²	0.776	0.800	0.984	0.987

Note:

* p<0.1; ** p<0.05; *** p<0.01

Table 17 – OLS - Growth in Customer Base and Solvency Margin Sufficiency - Excluding Health Cooperatives

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the subsample of healthcare firms excluding health-cooperatives across states. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1 + Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	1.224*** (0.133)	1.224*** (0.133)	-	-
<i>Rule</i>	-1.158 (0.707)	-	-	-
<i>Exposure</i> × <i>Rule</i>	-0.308*** (0.091)	-0.326*** (0.094)	-0.239*** (0.088)	-0.241** (0.094)
Firm Controls	✓	✓	✓	✓
Firm Controls × Post	✓	✓	✓	✓
Year FE	No	✓	✓	No
State FE	No	No	✓	No
Firm FE	No	No	✓	✓
State-Year FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	1,555	1,555	1,555	1,555
R ²	0.694	0.701	0.954	0.959

Note:

*p<0.1; **p<0.05; ***p<0.01

introduction of the capital rule requirement are coming from the subsample that excludes health-cooperative firms, with the coefficient of interest being negative, statistically significant at the 1% level, and almost twice the magnitude as the one presented in Table 15, Column (4). Column (4) of Table 17 shows that conditional on being an LLC company, more exposed firms have 24% less growth in their customer base relative to similar, less exposed firms. Looking at Table 16, however, it is possible to see that, regardless of the specification used, conditional on being a health cooperative, there is no differential growth trend associated with firms less/more exposed to the capital rule.

2.7.3 The stringency of the *Solvency Margin* over time

The results from the previous section that not only the capital requirement rule has adverse effects in terms of market growth, but more importantly, these effects are

concentrated among the group of limited liability (LLC) firms. After analyzing these effects, I now extend the specification presented in Equation (6) to analyze how the effect presented in Tables 2-4 evolves over time. In other words, does the exposure to the capital requirement rule promote differential growth trends over time?

To shed light on this issue, I estimate the following dynamic *differences-in-differences* equation:

$$\log(Cust_{i,s,t+1}) = \sum_{t'=2010}^{2018} \beta_t \times (1[t = t'] \times Exposure_i) + \Theta' Controls_{i,t} + \alpha_i + \alpha_{s \times t} + \varepsilon_{i,s,t+1}, \quad (2.8)$$

where $1[t = t']$ is a set of indicator variables that equals one if $t = t'$, with t' is defined between 2010 and 2018, $t' = 2011$, the first year where the capital requirement rule was effectively put in place, as the reference category, and all other variables defined as before. I repeat the specification presented in Equation (8) in three different panels: i) the full regression sample; ii) the subsample of health cooperatives, and iii) the sample excluding health-cooperatives.

The results from these estimations are presented in Figure 12. In line with the results presented in Tables 2-4, the adverse effects of the introduction of the solvency margin are mostly driven by the subsample excluding health cooperatives, presented in Panel B. With regards to timing patterns, even though the effect is not indistinguishable from zero during the first year that the capital requirement rule was put in place, results from Panels A and B show that the effect becomes negative and statistically significant, with increasing magnitudes over time.

More specifically, for the subsample shown in Panel B (without health cooperatives), the estimated effects range from -13% in 2012 to -55% in 2016, which is in line with the timing pattern regarding the stringency of the solvency margin over time (K_t), described in Section 3.4. Relevant to this investigation, the differential trends in growth patterns between more/less exposed firms not only seem to increase over time but also show to be persistent throughout the study period.

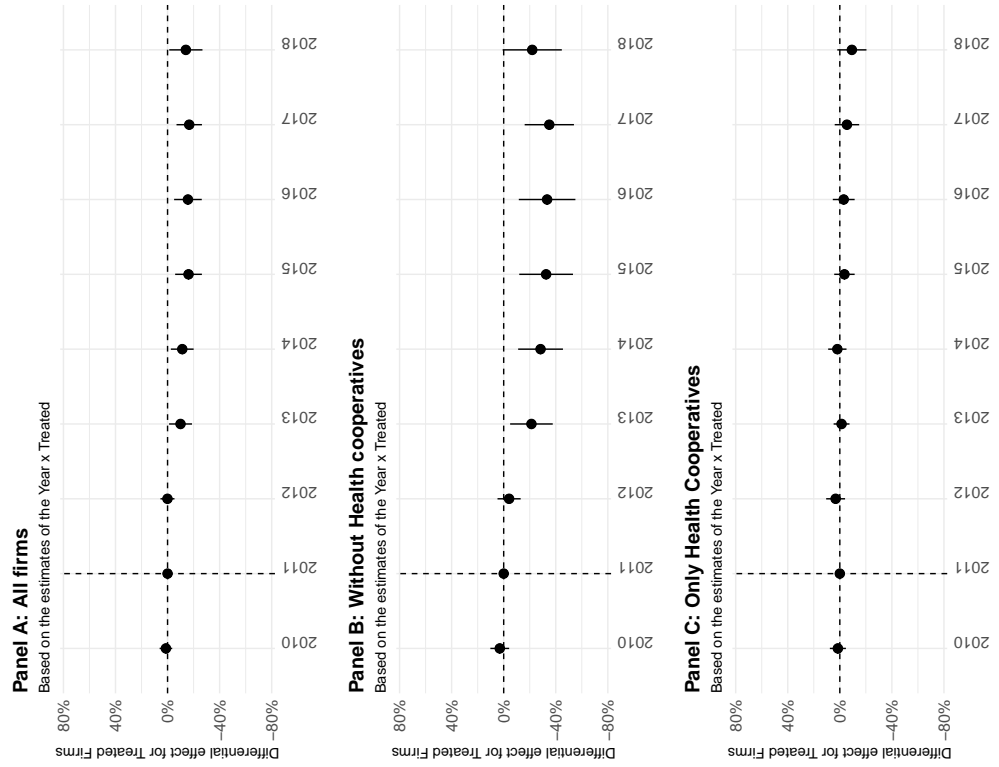
2.7.4 Robustness checks

The results from the previous subsection highlight that there is a statistically significant wedge between firms more and less exposed to the solvency margin rule. In other words, firms more exposed to the capital requirement rule presented lower future growth in their customer base. Moreover, these effects seem to be concentrated in the sub-sample of non-health cooperative firms and do not dissipate over time.

To shed further evidence that the estimated effects stem from differences in the

Figure 12 – Dynamic *differences-in-differences* for different subsamples of firms.

This Figure presents the estimation results of the dynamic *differences-in-differences* specification, presented in Equation (8) and described in Section 3.6. Panels A-C plot the point estimate and the 90% confidence interval of β_t on the y-axis, with t varying on the x-axis. The reference category considered in the estimations is $t = 2011$, the first year when the solvency margin was effectively put in place.



exposure to the capital requirement rule, and not due to any other confounding factor, I discuss a series of robustness checks that reinforce the intuition that the channel that explains the wedge between these subsets of firms is the exposure to the solvency margin rule.

2.7.4.1 Employment Flows and Investment Opportunities

An important concern with the specification presented in Equation (6) relates to investment opportunities and their relationship with firms' growth prospects. As in most empirical corporate finance settings, firms' investment opportunities are plausibly correlated with future outcomes, and failing to account for such variation may induce biased estimates of the desired effects. Relatedly, the inclusion of firm-fixed effects, in general, does not solve the endogeneity issue, as there might have time-varying trends that are plausibly correlated with the dependent variable, but are unobservable to the econometrician. As a consequence, naïve estimates can be capturing demand-side effects related to the available set of investment opportunities that each firm is confronted with, and not supply-side effects related to the availability of capital to invest in operational activities.

In this specific setting, however, industry-specific characteristics play a relevant role in attempting to control for a firm's investment opportunities. As discussed in Section 2.1, historically, approximately 80% of all healthcare insurance revenues are originated from *employer-sponsored* contracts. As a primary consequence of this fact, firms' unobserved investment opportunities are plausibly correlated with local employment flows, which are exogenous to healthcare insurance firms' characteristics.

That said, one would expect that, if the estimates presented in Tables 2-6 are related to the exposure to the capital requirement rule, and not by other demand-side factors that could explain firms' growth decisions, then it should be the case these effects are stronger in regions that experienced positive employment flows.

To test for this, I use municipal employment flow data from *CAGED* and rerun Equation (6) by subsamples of positive and negative employment flow shocks: for each pair of firm-state-year i, s, t in the sample, I calculate the variation in employment for state s between $\{t - 1, t\}$, $EmpFlow_{s,t}$, classifying this observation based on $EmpFlow_{s,t} > 0$.

Tables 18 and 19 consider the subsample of non-health cooperative firms, which seen to drive the majority of the effects, and present the estimates from Equation (6) in subsamples of firm-state-year tuples based on $EmpFlow_{s,t} > 0$ and $EmpFlow_{s,t} \leq 0$. As the results clearly show, the interaction term, $Rule \times Exposure$ is statistically significant only for markets with positive employment shocks during the period.

Assuming that these employment flows are not induced by firms' unobservable

Table 18 – OLS - Growth in Customer Base and Solvency Margin Sufficiency - Only for state-year pairs with positive employment flows and and excluding health-cooperatives.

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the subsample of healthcare firms excluding health-cooperatives and state-year pairs with $Employment_{s,t} > 0$. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1 + Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	1.237*** (0.140)	1.236*** (0.140)	-	-
<i>Rule</i>	-0.554 (0.861)	-	-	-
<i>Exposure</i> × <i>Rule</i>	-0.248*** (0.094)	-0.242** (0.097)	-0.173** (0.085)	-0.173** (0.086)
Firm Controls	✓	✓	✓	✓
Firm Controls × Post	✓	✓	✓	✓
Year FE	No	✓	✓	✓
State FE	No	No	✓	No
Firm FE	No	No	✓	No
State-Time FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	681	681	681	681
R ²	0.724	0.730	0.964	0.965

Note:

* p<0.1; ** p<0.05; *** p<0.01

Table 19 – OLS - Growth in Customer Base and Solvency Margin Sufficiency - Only for state-year pairs with negative employment flows and excluding health-cooperatives.

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the subsample of healthcare firms excluding health-cooperatives and state-year pairs with $Employment_{s,t} \leq 0$. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1 + Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	1.082*** (0.319)	1.063*** (0.333)	-	-
<i>Rule</i>	-3.417 (2.729)	-	-	-
<i>Exposure</i> \times <i>Rule</i>	-0.234 (0.276)	-0.240 (0.300)	-0.349* (0.182)	-0.292 (0.224)
Firm Controls	✓	✓	✓	✓
Firm Controls \times Post	✓	✓	✓	✓
Year FE	No	✓	✓	✓
State FE	No	No	✓	No
Firm FE	No	No	✓	No
State-Time FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	874	874	874	874
R ²	0.691	0.697	0.964	0.971

Note:

* p<0.1; ** p<0.05; *** p<0.01

characteristics, this evidence further reinforces the claim that the estimates presented before relate to supply, and not demand-wide, effects. Importantly, since the regression sample is at the firm-state-year level, the same firm-year pair can be in both samples. In practical terms, it means that the wedge between more and less exposed firms in terms of customer growth increase only in the regions that, in fact, experienced a potentially higher level of investment opportunities.

2.7.4.2 Local vs. Distinct Markets

Another concern with the previous results relates to *where* this decrease in customer growth is occurring. Another potential explanation for the results presented herein is the relocation of more exposed firms to some specific markets. As stated below, the Brazilian healthcare industry market is generally seen to be geographically segmented, with health insurance firms concentrating the vast majority of their customers in regions neighboring their headquarters.

As such, an alternative explanation for the decrease in customer growth is that these previous estimates are simply capturing a reallocation between regions that a firm operates seeking to increase operational efficiency. For example, a healthcare insurance firm might be more prone to focus on growing in local markets, where it is easier to adopt cost-reduction strategies than in other markets where such strategies are not value-enhancing¹⁰.

To rule out this alternative explanation, I rerun the dynamic plot presented in Figure 12, Panel B, for subsamples of local/non-local markets. I classify a market for a firm i as $Local_i = 1$ for the state in which the firm historically holds the vast majority of its customers, and zero otherwise. The results, presented in Figure 13, show that this alternative explanation is unlikely to hold since the decrease is mainly driven by local, and not non-local, markets.

2.7.5 Observable confounders at the firm-level

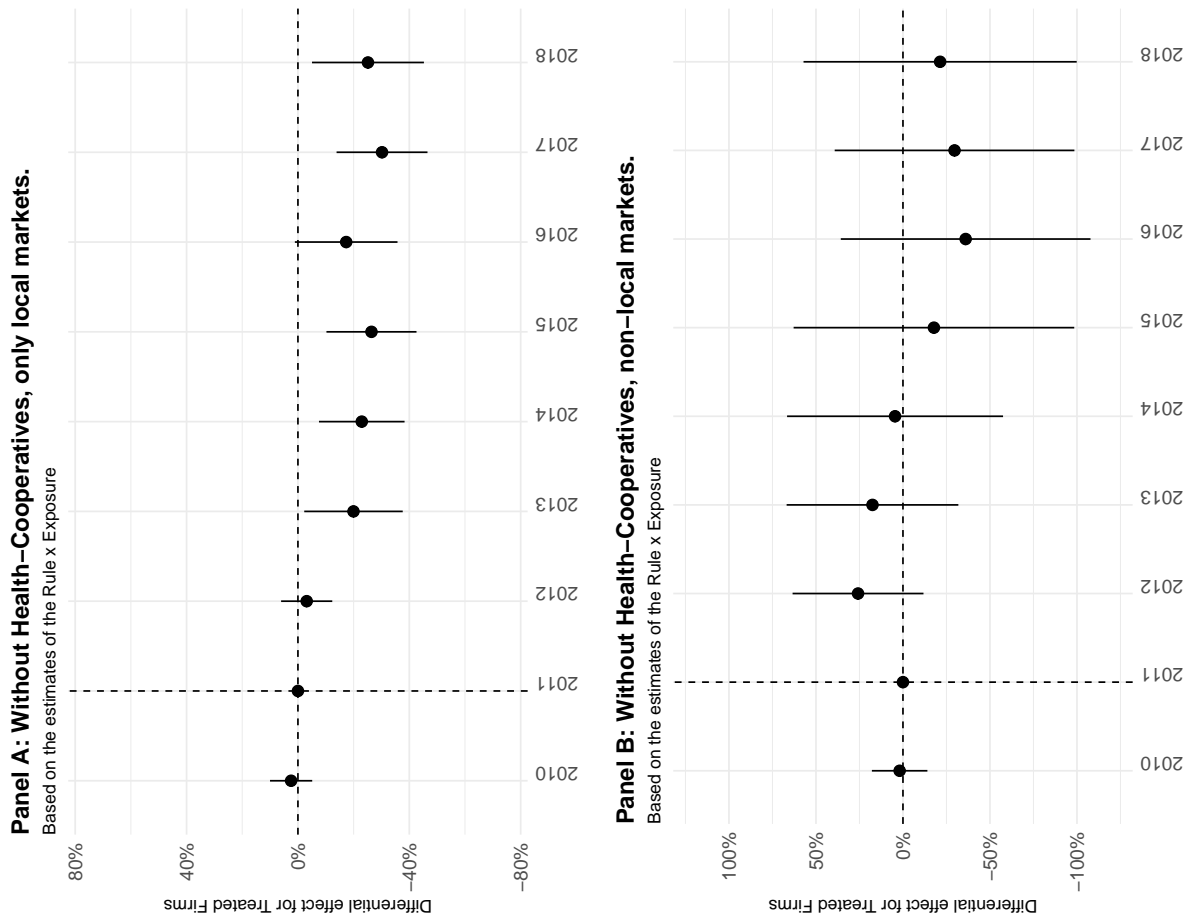
Lastly, I tackle the issue of the estimates being confounded by time-varying confounders at the firm level. As shown in Table 14, firms more exposed to the solvency margin are different across a wide set of dimensions relative to their less exposed counterparts. If the heterogeneity across these dimensions is not captured by the inclusion of firm fixed effects, then the desired effects may be capturing variation induced by time-varying financial characteristics¹¹.

¹⁰ For example, a firm may opt to verticalize costly operations, such as hospitals and specialized health centers, only if a certain number of customer threshold is achieved.

¹¹ Since these covariates can also be affected by higher exposure to the solvency margin rule - an example of "bad controls", as in (Angrist; Pischke, 2009) -, I opted not to include this set of covariates in the baseline regressions.

Figure 13 – Dynamic differences-in-differences for different subsamples of non-healthcare cooperatives, based on local and non-local markets.

This Figure presents the estimation results of the dynamic differences-in-differences specification, presented in Equation (8) and described in Section 3.6. Panel A (B) plots, for the subsample of observations where $Home = 1$ ($Home = 0$), the point estimate and the 90% confidence interval of β_t on the y-axis, with t varying on the x-axis. The reference category considered in the estimations is $t = 2011$, the first year when the solvency margin was effectively put in place.



To ensure that the estimates are not an ultimate outcome of the heterogeneity observed between more/less exposed firms in terms of financial characteristics, I extend the main specification, presented in Equation (6), adding *PPE*, *ROE*, *Net Margin*, *Leverage*, *Current Ratio*, and the *Hazard Ratio* as controls. The estimates, shown in Table 20, confirm that our results remain statistically significant, even after adding a wide set of time-varying, firm-level controls to the baseline specification.

Table 20 – OLS - Growth in Customer Base and Solvency Margin Sufficiency - Additional controls

This table presents the estimation results of the *differences-in-differences* specification, presented in Equation (6) and described in Section 3.5, for the whole sample of healthcare firms across states. The dependent variable, $\log(1+Customers_{i,s,t})$, is the natural logarithm of $(1+Customers_{i,s,t})$, where $Customers_{i,s,t}$ is the number of customers that a health cooperative i has in state s during year t , and zero otherwise. $Rule_t$ is an indicator variable that equals one if the observation relates to periods during or after 2011. $Exposure_i$ is an indicator variable that assigns one if firm i presented a solvency margin sufficiency during 2009 below the median, and zero otherwise. All specifications include clustered standard errors at the firm level, as well as firm-level controls interacted with pre and post trends relative to the first year of the year of the capital requirement rule (*i.e.*, 2011). Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: $\log(1 + Customers_{i,s,t})$			
	(1)	(2)	(3)	(4)
<i>Exposure</i>	0.726*** (0.111)	0.734*** (0.110)	-	-
<i>Rule</i>	-1.299*** (0.484)	-	-	-
<i>Exposure</i> × <i>Rule</i>	-0.183*** (0.061)	-0.205*** (0.062)	-0.120** (0.050)	-0.108** (0.050)
Ext. Firm Controls	✓	✓	✓	✓
Ext. Firm Controls × Post	✓	✓	✓	✓
Year FE	No	✓	✓	✓
State FE	No	No	✓	No
Firm FE	No	No	✓	No
State-Time FE	No	No	No	✓
Cluster	Firm	Firm	Firm	Firm
Observations	3,067	3,067	3,067	3,067
R ²	0.715	0.728	0.963	0.966

Note:

*p<0.1; **p<0.05; ***p<0.01

2.8 The adverse effects of capital requirements

The results so far provide evidence that firms more exposed to the capital requirement rule did show lower growth in their customer base relative to less exposed firms, especially in markets characterized by having positive investment opportunities.

In practice, the results indicate, on an overall basis, 24% less growth year over year, on average, which is persistent even after three years of the rule introduction.

To this point, how do these estimates translate to potential effects across the industry? Although exposed firms are expected to adjust some of their fundamentals seeking to accommodate the effects of such change, it is still not clear whether these changes have the potential to impact market-wide trends, such as market concentration indices and state-level health outcomes, such as public healthcare service provision and overall private healthcare service quality.

To shed further light on the effects of capital requirements in the Brazilian healthcare industry, this last section explores the adverse effects of the introduction of the capital requirement rule by focusing on firm-level and state-level implications. More specifically, the role of firm-level responses is analyzed by exploring potential spillovers in terms of firms' financial fundamentals, survival probability, and, finally, pricing conditions. Lastly, market-wide trends are by aggregating the data at the state level and investigating whether more states more exposed to the capital requirement rule present different fundamentals *ex-post*.

2.8.1 Firm-level responses to changes in local market conditions

How do firms more exposed to the capital requirement rule accommodate the changes induced by lower growth levels and constraints on their investment levels? While the results from the previous section provide evidence that these firms are indeed growing less, there is still not clear *how* or *whether* these firms adjust to these market-level changes.

To shed light on the potential firm-level spillovers from the lower growth levels induced by the exposure to the solvency margin, I use a similar version of Equation (6) to investigate whether changes induced by more exposure to the solvency margin are related to changes in firms' fundamentals. More specifically, I run:

$$\mathbf{Y}_{i,t+1} = \beta_{DD} \times (\text{Rule}_t \times \text{Exposure}_i) + \Theta' \text{Controls}_{i,t} + \alpha_i + \alpha_{s \times t} + \varepsilon_{i,s,t+1}, \quad (2.9)$$

where $\mathbf{Y}_{i,t+1}$ is a vector of firm-level characteristics at $t + 1$, such as financial fundamentals and whether the healthcare plan was active or not as of 2021. As firm-level fundamentals are the same irrespective of the market being considered, I aggregate the number of customers of each firm across states s .

2.8.1.1 Firm-level fundamentals

Table 21 presents the results of the specification presented in Equation (9), focusing on a specific set of firms' financial fundamentals at $t + 1$. In line with the argument that

more exposed firms had lower incentives to invest in operations *ex-post* the solvency margin implementation, Columns 1-3 show that, while the change (expressed as $\Delta i = \log(i)$) in customers did not drive overall assets differently, the change is fully concentrated in operational assets portion – *i.e.*, assets related to promoting healthcare assistance, such as hospital and healthcare centers –, while changes in financial assets, such as short-term, low-risk financial instruments, cash and cash equivalents, did not show to be related to changes in the customer base.

In line with this previous result, Column 4 shows that this effect is also pronounced in terms of Operational Revenues: firms more exposed to the capital requirement rule are decreasing operational revenues – *i.e.*, revenues related to healthcare assistance activity. Interestingly, Columns 5-6 show that the adjustment seems to be concentrated in terms of revenue, as more exposed firms did not show to adjust in terms of gross margins (Column 5) and/or EBITDA (Column 6). Interestingly, the non-statistically significant results regarding gross margins and EBITDA may indicate that there were no other adjustments in the firms' operational structure other than the lower activity due to foregone investment opportunities.

2.8.1.2 Survival probabilities

Are the firms characterized by losing market due to the capital requirement rule riskier than the ones that are being benefited by such policy? While the results from Table 21 may indicate that some firms' financial fundamentals are changing, these are not sufficient evidence to argue that there are different trends in terms of survival probabilities.

In order to shed additional light on such issue, I leverage information from *CADOP – Sistema de Cadastro das Operadoras* – and collect information about all healthcare insurance delistings between 2004 and 2020. Overall, delistings can occur due to i) regulatory enforcement (*Deliberação da Diretoria Colegiada*), cancellation (*Cancelamento*), incorporations (*Incorporações*), and liquidations (*Liquidações*). The average delisting rate of the sample (# of firms delisted relative to the overall number of firms) is about 11.04%.

Table 22 shows the results of a regression in the likes of Equation (9), where the dependent variable is a dummy variable *Delisted_i* that assigns 1 (one) if firm *i* is Delisted during the end of the sample period (2020), and zero otherwise. Column 1 shows that, on average, exposed firms did show a lower survival probability during the sample period. However, when looking at the individual classifications for delistings, results from Columns 2-5 show that the increase in delisting probability has been surging especially due to the Regulatory Agency Enforcements (*RAE*), defined as situations when the regulatory agency decides to intervene and prevent the healthcare plan from performing its operational activities, and *Incorporations*, where the given healthcare plan transfers its customers to another already regulated and established healthcare plan. Interestingly, column (5) shows

Table 21 – Second-order effects on firms' outcomes - *ex-post* Financial Fundamentals

This table presents the estimation results of the *ex-post* effects specification, presented in Equation (9) and described in Section 3.6, for each of the firms' financial fundamentals. $\log(\text{Assets})$ is the natural logarithm of firms' total assets, while $\log(\text{Financial Assets})$ and $\log(\text{Op. Assets})$ are the firms' short-term financial securities (financial instruments, cash, and cash equivalents) and assets related to healthcare operations, respectively. $\log(\text{Operational Revenue})$ is the natural logarithm of firms' revenue that is accrued to healthcare operations (excludes any gains from financial assets). Hazard Ratio is defined as the firms' gross margin (cost of healthcare assistance for firms' customers divided by the total revenue from customers' healthcare installments). EBITDA is defined as earnings before interest, taxes, depreciation and amortization. *Exposure* and *Rule* are defined as in previous tables. All specifications include clustered standard errors at the firm level, presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable:					
	Δ Assets (1)	Δ Fin. Assets (2)	Δ Op. Assets (3)	Δ Op. Revenue (4)	Hazard Ratio (5)	Δ EBITDA (6)
<i>Exposure</i>	0.056*** (0.019)	0.249* (0.127)	0.084 (0.060)	0.586*** (0.057)	0.063*** (0.014)	-0.016 (0.148)
<i>Rule</i>	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>Exposure</i> \times <i>Rule</i>	-0.032 (0.020)	0.035 (0.100)	-0.132*** (0.042)	-0.242*** (0.049)	-0.027** (0.012)	-0.061 (0.153)
Full Firm Controls	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
State-Year FE	✓	✓	✓	✓	✓	✓
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
Observations	2,616	2,616	2,616	2,616	2,614	1,610
R ²	0.984	0.751	0.895	0.912	0.156	0.570

Note: * p<0.1; ** p<0.05; *** p<0.01

that the likelihood of a *Liquidation* goes in the opposite direction.

2.8.2 Pricing outcomes

When confronted with changes in market conditions, do more/less exposed firms react by setting prices differently? Although previous results shown in Table 21 show that firms adjusted operational revenues due to the changes induced by the solvency margin implementation, it is not clear whether such change is driven solely by the change in the customer base, or whether it is in conjunction with changes in prices. Importantly, although changes in the customer base do not necessarily affect the ultimate customer, price adjustments can directly impact customer welfare.

To better investigate this issue, I leverage information from *ANS's* database on commercial pricing references – *Valor Comercial de Referência*. These values form the basis for the pricing of Brazilian healthcare plans, and must be provided by each firm in a document that justifies price setting for each healthcare customer plan of health plans through actuarial calculations. Values are shown in monthly installments, calculated using nominal current prices. It is important to stress that this reference price of a given healthcare plan may present differences in relation to the commercialization prices in practice. The prices effectively practiced for contracting the products must be within the commercialization limits established in the regulations. More specifically, the upper bound for the effective price is 30% above the reference price, while the lower bound is the maximum value of the estimated assistance cost and 30% below the reference price.

I proceed by collecting, for each year of my sample, all firm \times plan \times age bracket¹² reference prices that are available. Since I cannot observe where a plan is actually commercialized, averaging out the values for each combination can skew the price distribution if there are geographical differences in price setting, which is likely to be the case. In this sense, I calculate, for each tuple, the median value for the reference price. This price reflects, for a given firm, the median price that forms the basis of its pricing throughout all plans commercialized in a given year and for a given age bracket. I then use a similar strategy as of Table 21 and estimate the following specification:

$$\log Price_{i,a,t+1} = \beta_{DD} \times (Rule_t \times Exposure_i) + \Theta' Controls_{i,t} + \alpha_i + \alpha_{s \times t} + \alpha_a + \varepsilon_{i,s,t+1}, \quad (2.10)$$

where $\log Price_{i,t+1}$ is the natural logarithm of the reference price for firm i , in period $t + 1$, for an age bracket a . As before, for each firm, I use the subsample of state-year observations corresponding to the state where the firm hold the majority of its customers.

¹² *ANS* considers 10 different age brackets for pricing purposes: [0,18], [19,23], [19,23], [24,29], [30,33], [34,38], [39,43], [44,48], [49,53], [54,58], and [59,∞).

Table 22 – Second-order effects on firms' *ex-post* outcomes - Delisting Motivations

This table presents the estimation results of the *ex-post* effects specification, presented in Equation (9) and described in Section 3.6, in terms of delisting status. *Delisted* is a dummy variable that assigns 1 (one) if firm *i* has been delisted throughout the sample period, and zero otherwise. *RAE*, *Cancellation*, *Incorporation*, and *Liquidation* are dummy variables that assign one if the delisting motivation is due its specific delisting motivation, and zero otherwise. Columns 2-5 use a subsample of firms conditional on *Delisted* = 1. *Exposure* and *Rule* are defined as in previous tables. All specifications include clustered standard errors at the firm level, presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable:				
	<i>Delisted</i>	<i>RAG</i>	<i>Cancellation</i>	<i>Incorporation</i>	<i>Liquidation</i>
	(1)	(2)	(3)	(4)	(5)
<i>Exposure</i>	-0.060 (0.050)	-0.459*** (0.134)	-0.055 (0.121)	0.023 (0.105)	0.491*** (0.123)
<i>Rule</i>	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>Exposure</i> × <i>Rule</i>	0.014 (0.025)	0.083* (0.049)	-0.043 (0.062)	0.118** (0.046)	-0.159*** (0.056)
Full Firm Controls	✓	✓	✓	✓	✓
State-Year FE	✓	✓	✓	✓	✓
Cluster	Firm	Firm	Firm	Firm	Firm
Observations	2,939	371	371	371	371
R ²	0.136	0.400	0.284	0.437	0.402

Note: * p<0.1; ** p<0.05; *** p<0.01

I include age bracket fixed effects (α_a), and cluster the standard errors at the firm, state, and age bracket levels.

Table 23 presents the results of a panel specification including all age brackets, while Table 24 estimates single equations for each age bracket (removing α_a and clustering the errors at the firm and state levels). As shown in the aforementioned tables, there is a statistically significant and positive relationship between exposure to the solvency margin and the reference price: firms more exposed to the solvency margin adjusted their prices approximately 5.8% less than their counterparts. Interestingly, as shown in Table 24, this result seems to be stronger in magnitude and statistical significance to lower age brackets.

Table 23 – Second-order effects on firms' *ex-post* outcomes - pricing effects

This table presents the estimation results of the *ex-post* pricing outcomes specification, presented in Equation (10) and described in Section 3.6. $\log(\text{Price})_{i,a,t+1}$ is the natural logarithm of the reference price calculated for firm i , age bracket a in period $t + 1$. *Exposure* and *Rule* are defined as in previous tables. All specifications include clustered standard errors at the firm, state, and age bracket level, presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable: $\log(\text{Price}_{i,a,t+1})$	
<i>Exposure</i> × <i>Rule</i>	−0.058*** (0.017)
Full Firm Controls	✓
Firm FE	✓
State-Year FE	✓
Cluster	Firm + UF + Age Bracket
Observations	20,107
R ²	0.831

Note: *p<0.1; ** p<0.05; *** p<0.01

Overall, pricing estimates depict a situation where firms less exposed to the solvency rule – and, as shown previously, able to exploit positive investment opportunities within their markets – are setting prices higher than their counterparts. While outside of the scope of this study, a potential explanation for such change can be related to changes in market power: as less exposed firms gain market-share in detriment of firms that are prevented from exploiting such opportunities, gains in bargaining power can provide firms with the option of setting higher prices.

2.8.3 Do Capital Requirement exposures pass through local markets?

The estimates presented in the previous section highlight the role of the solvency margin in explaining future growth outcomes in the Brazilian Healthcare Industry. In broader terms, these aforementioned results show that, among other factors, exposure to the capital requirement rule has a negative, statistically, and economically significant

Table 24 – Second-order effects on firms’ *ex-post* outcomes - Pricing effects, varying on Age Brackets

This table presents the estimation results of the IV specification, presented in Equation (10) and described in Section 3.6, varying on age bracket. Column 1-10 denote single regressions for each of the age brackets available. $\log(P_{price})_{i,t+1}$ is the natural logarithm of the reference price calculated for firm i in period $t + 1$. *Exposure* and *Rule* are defined as in previous tables. All specifications include clustered standard errors at the firm and state level, presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable:									
	[0,18]	[19,23]	[24,28]	[29,33]	[34,38]	[39,43]	[44,48]	[49,53]	[54,58]	[59,∞)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Exposure</i> × <i>Rule</i>	-0.064*** (0.021)	-0.064*** (0.022)	-0.065*** (0.019)	-0.060*** (0.019)	-0.057*** (0.019)	-0.054*** (0.018)	-0.050*** (0.016)	-0.037*** (0.017)	-0.039* (0.021)	-0.047*** (0.017)
Full Firm Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State-Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cluster	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF	Firm × UF
Observations	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056
R ²	0.731	0.716	0.727	0.712	0.719	0.714	0.715	0.726	0.735	0.729

Note: * p<0.1; ** p<0.05; *** p<0.01

effect on the growth of a firm's customer base. More than that, these results also have consequences in terms of firms' fundamentals, such as delisting probability, and seem to be a driver of price setting.

However, taken individually, these results do not shed light on the potential *aggregate* effects of the introduction of the capital requirement rule in the Brazilian healthcare industry. More specifically, it is not clear, from the aforementioned results, if the disproportionate effects of the solvency margin introduction across more and less exposed firms induced changes in market concentration and/or induce changes in health outcomes at the state-level.

To tackle this issue directly, I first focus on understanding the aggregate effects of the introduction of the solvency margin by estimating state-level regressions and testing whether states with high exposure to the capital requirement rule – *i.e.*, those were exposed firms concentrate their customer base – show different trends in terms of market concentration.

To test the claim that such changes induced variation in market concentration, I first aggregate the data at the state-year level by taking a weighted average of the solvency margin sufficiency (SSM_i) in 2010 across states, weighted by the size of each firm:

$$SSM_s = \frac{\sum_{i=1}^N Size_{i,2010} \times SSM_i}{\sum_{i=1}^N Size_{i,2010}} \quad (2.11)$$

With that, I run triple-differences specification at the state-year level:

$$\begin{aligned} \log(1 + HHI_{s,t}) = & \beta_1 \times Exposure_s + \beta_2 \times Rule_t + \beta_3 \times EmpFlow_{s,t} \\ & + \beta_4 \times (Exposure_s \times Rule_t) + \beta_5 \times (Exposure_s \times EmpFlow_{s,t}) + \beta_6 \times (Rule_t \times EmpFlow_{s,t}) \\ & + \beta_7 \times (Rule_t \times Exposure_s \times EmpFlow_{s,t}) + \varepsilon_{s,t}, \end{aligned} \quad (2.12)$$

where $Exposure_s$ is a dummy variable that assigns the value one if the state s level of solvency margin sufficiency, which is a weighted average of the solvency margin sufficiency of all firms that operate in s , is lower than the median, $Rule_t$ is a dummy variable that assigns one for observations after $t = 2012$. In words, Equation (10) estimates whether states that were more exposed to the capital requirement rules experienced changes in their market concentration levels, and if these changes are occurring in state-year pairs facing positive employment flows during that period.

The results, presented in Table 25, are in line with the argument that the introduction of the solvency margin has increased market concentration. As shown by the double interaction term, $Rule \times Exposure$, and the triple interaction term, $Rule \times EmpFlow \times$

Exposure, not only more exposed states are indeed having increases in market concentration after the introduction of the solvency margin was put in place, but this effect is mainly driven during years where these states faced *positive* employment shocks. In this situation, the differential effect for more exposed states is an increase in the market's HHI of 21%, on average, which is statistically and economically significant. All in all, these results show that capital requirement rules pass-through local market conditions, thereby increasing industry's concentration in more affected markets.

Table 25 – OLS - State-level Market Concentration and Solvency Margin Rule

This table presents the estimation results of the *DDD* specification, presented in Equation (10) and described in Section 3.7. $HHI_{s,t}$ is defined as the *Herfindhal-Hirschman* index of market concentration at the state level. All specifications include clustered standard errors at the state level, as well as state and year fixed effects. Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	$\log(1+HHI_{s,t})$		
	(1)	(2)	(3)
<i>EmpFlow</i>	-	-	0.012 (0.008)
<i>Exposure</i>	-0.102** (0.049)	-0.116** (0.053)	-0.128** (0.051)
<i>Rule</i> × <i>EmpFlow</i>	-	-	-0.004 (0.008)
<i>Rule</i> × <i>Exposure</i>	-	0.018 (0.020)	0.044** (0.016)
<i>EmpFlow</i> × <i>Exposure</i>	-	-	-0.154** (0.072)
<i>Rule</i> × <i>EmpFlow</i> × <i>Exposure</i>	-	-	0.214** (0.078)
Year FE	✓	✓	✓
State FE	✓	✓	✓
Cluster	State	State	State
Observations	249	249	246
R ²	0.968	0.968	0.968

Note:

*p<0.1; **p<0.05; ***p<0.01

Taken together with the results from Tables 23 and 24, these results provide evidence in line with the argument that the solvency margin rule has led to adverse

effects in the industry: not only markets became more concentrated, but firms gaining market-share due to the introduction of the solvency margin rule are setting higher prices.

In addition to this point, higher levels of market concentration can also manifest either by firms i) having higher bargain power, thereby dampening service quality and expropriating consumer welfare; or ii) offering better services due to gains stemming from scale efficiencies. Furthermore, of special interest to this study, higher levels of market concentration can also affect public healthcare service provision. Higher price adjustments and lower supply can screen out potential customers from using private healthcare services and, in turn, induce customers to lean on public healthcare assistance. To test these predictions at the state-level, I leverage *DataSUS* open-source based data and collect all information regarding the number of internations and medical procedures held by the Brazilian's public healthcare service at the state-level. I also complement this data with information on customer complaints regarding health insurance plans provided by *ANS*, with information about the location of the complainer and the specific firm that is the object of the complaint.

With that, I run equations similar to Equation (12) to understand whether more exposed states have shown changes in public service provision and private service quality after the introduction of the solvency margin. The results, presented in Table 26, do not show statistically significant changes in any of these health outcomes. Taken together, these results indicate that although market concentration has soared within more exposed states during periods of positive employment shocks after the introduction of the solvency margin, there is no evidence at the state-level that supports the argument of spillovers to public healthcare service provision or the service quality within the private healthcare sector.

2.9 Conclusions and directions for future research

The Brazilian private healthcare insurance is central to the country's health policy coordination, providing private healthcare assistance for one in each four citizens. Among the several measures taken by the industry's regulatory agency to insulate customers from the risk of insolvency by their healthcare insurance providers, the introduction of the solvency margin, enacted at the end of 2009 and put in place two years after, which enforce firms to gradually constitute capital buffers based on their assistance costs and revenues, imposed a cap in firms' leverage decisions, which in turn may have caused second-order effects in the industry.

Despite its relevance, there is still no empirical assessment of the introduction of the solvency margin in the Brazilian healthcare industry. In this paper, I fill this gap by showing that not only firms more exposed to the capital requirement rule grew their

Table 26 – State-level Health Outcomes according to Exposure to Solvency Margin

This table presents the estimation results of the *DDD* specification, presented in Equation (10) and described in

Section 3.7. $\log(\text{Internations})$ and $\log(\text{Outpatients})$ is the natural logarithm of internations and medical procedures held at the Brazilian Public Healthcare Service, respectively. $\log(\text{Complaints})$ is the natural logarithm of all complaints filled by private healthcare customers residing in a given state and year. All specifications include clustered standard errors at the state level, as well as state and year fixed effects. Standard errors are presented in parenthesis. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable:		
	$\log(\text{Internations})$	$\log(\text{Outpatients})$	$\log(\text{Complaints})$
	(1)	(2)	(3)
<i>EmpFlow</i>	−0.018 (0.027)	−0.058* (0.028)	0.214* (0.127)
<i>Exposure</i>	−0.066 (0.046)	−0.029 (0.115)	0.276 (0.227)
<i>Rule × EmpFlow</i>	−0.005 (0.020)	0.089** (0.034)	−0.216 (0.175)
<i>Rule × Exposure</i>	0.004 (0.032)	−0.036 (0.067)	−0.184 (0.223)
<i>EmpFlow × Exposure</i>	0.160 (0.132)	0.279 (0.329)	−0.934 (0.798)
<i>Rule × EmpFlow × Exposure</i>	−0.180 (0.151)	−0.226 (0.331)	0.570 (0.996)
Year FE	✓	✓	✓
State FE	✓	✓	✓
Cluster	State	State	State
Observations	237	246	246
R ²	0.994	0.982	0.958

Note:

*p<0.1; **p<0.05; ***p<0.01

customer base less than their counterparts, but also that this effect is mainly concentrated in the subsample of non health cooperatives, and does not dissipate over a short period of time.

The results presented in this paper show that, conditional on being more exposed by the capital requirement rule, non health cooperative firms grew, on average, 24% less than otherwise similar firms that have not been exposed. This effect is statistically significant even after including a wide set of covariates and fixed effects to control for confounders, and remains significant in all robustness checks performed.

Furthermore, when looking at the second-order effects of such changes, the results show not only that more exposed firms presented higher likelihood of delisting and lower levels of operational assets and revenues, firms that were positively hit by the effects of such policy adjusted prices 5.8% higher, on average, with statistically significant results across the whole sample and within almost all customer's age brackets.

To the extent that more exposed firms grew less than their counterparts after the implementation of the solvency margin, is this sufficient to have aggregate impacts in the

industry? By comparing states that concentrate a higher portion of customers from exposed firms, I show that the wedge between more and less exposed firms can explain the surge in the market concentration over time: more exposed states saw market concentrations increase 21%, on average, after the solvency margin implementation. Interestingly, this effect is only present in states with positive local employment flows, which are plausibly correlated with the market's investment opportunities. In addition to that, although there has been a notable increase in market concentration, there is no evidence of state-level changes in health-outcomes, such as influx of patients to the public healthcare service provision and/or changes in the level of complaints filed by users of private healthcare plans.

Notwithstanding, even though these results enhance our understanding of the effects of capital requirements outside of the financial sector, more investigation is still needed to understand the welfare consequences of such adoption. More specifically, even though market concentration has increased as a result of the solvency margin, understanding whether ultimate consumers are better off in welfare terms is still an open question, since market concentration can, on the one hand, can harm customers through increasing market power from the supplier side, but at the same time can have positive effects due to efficiency gains. To that matter, more investigation on such topics can enhance our understanding of the welfare consequences of introducing capital requirements outside of the financial sector.

In 2020, anticipating the difficulty of healthcare insurance firms to comply with the solvency margin rule while maintaining their core businesses amid the onset of the COVID-19 pandemic, *ANS* allowed firms to switch to a risk-based assessment for capital requirements, which otherwise would have been implemented only in 2023. I expect these results to be valuable insights to shed light on the trade-offs associated with implementing capital requirement policies, providing a clear understanding of their short and long-term aggregate consequences.

3 On the Study of Debt Structure Determinants

Abstract:

While the study of capital structure is widespread in the corporate finance literature, debt structure - how and why firms choose a specific setting for their debt - remains a puzzle. In this paper, I provide empirical evidence that changes in passive ownership have the potential to affect the choice of firms' debt structure over time. I do so by exploiting exogenous variation in mutual funds' passive ownership due to *Russell 1000/2000* index assignments between 2010 and 2019 in a regression-discontinuity-design setting. More specifically, I ask whether increases in passive ownership are related to changes in firms' debt concentration among different debt contract types. Estimates show that a one standard deviation increase in passive ownership is related to a 29% decrease in debt concentration. In a subsequent set of results, I show that these results are entirely driven by smaller firms, are mostly leaned towards increases in *Commercial Papers*, *Term Loans* and *Revolving Credit*, and are unrelated to other firms' *ex-post* fundamentals. The results remain robust after different specifications and after adding a wide set of controls. In the final section of the study, I discuss the implications of these results and how they relate to some of the hypotheses previously highlighted in the most recent literature on debt structure and its determinants. This work is the first to provide empirical evidence on the role of passive ownership in explaining debt structure decisions, and contributes to the growing literature on how and why do firms adjust their debt structure decisions over time.

3.1 Introduction

The study of capital structure has come a long way since the seminal work of (Modigliani; Miller, 1959), where perfect capital markets imply that capital structure decisions are irrelevant to firms' value. On the other hand, by relaxing the strong assumptions embedded in (Modigliani; Miller, 1959)'s work, several authors seek to identify the effect of capital structure on firms' value (Rajan; Zingales, 1995; Frank; Goyal, 2009). Despite a large body of research on this issue, capital structure remains one of the most contested issues in financial economics. For example, (Lemmon; Roberts; Zender, 2008) shows empirical evidence points that firms' fixed, unobserved characteristics are responsible for explaining a large portion of the cross-sectional variation in firms' capital structure. As such, high (low) leverage firms tend to remain high (low) leveraged for decades.

Leaning on that, what could explain capital structure persistence over time? Among other reasons, an explanation for the empirical pattern presented in (Lemmon; Roberts; Zender, 2008) and embedded in the assumptions of the main capital structure theories is that debt contracts are considered to be *uniform*. Notwithstanding, debt heterogeneity – in terms of several dimensions, such as maturity and convertibility – is a common feature of real-world capital markets.

In contrast, the study of firms' *debt structure* – *i.e.*, how and why firms choose the design of their debt contracts – has gained attention over the last decade (Colla; Ippolito; Li, 2020). (Rauh; Sufi, 2010) shows that as most of what has been done in capital structure studies treated debt as uniform, such studies miss a substantial and relevant component and are informative of firms' financial decisions. In this sense, studying the role of debt structure entails having a detailed glance at firms' balance sheets, seeking not only to recognize the different characteristics of firms' debt structure, such as maturity, types, sources, and priority, but also to understand *why* such heterogeneity is present.

While there is empirical evidence regarding debt specialization, there is no clear understanding of why some firms specialize in their debt structure to a higher degree than others. In this paper, I investigate a specific channel that seems to explain firms' debt structure decisions: ownership by passive investors. Stock ownership by passive institutional investors – *i.e.*, those that seek to match the performance of an index, such as the S&P 500, or a particular investment style – has grown rapidly over the last years in the U.S, having quadrupled their share in the U.S stock market over the last 15 years and representing now more than a third of all mutual fund assets.

As shown in (Appel; Gormley; Keim, 2018), the increased presence of passive ownership facilitates investor activism, as the large, concentrated shares of passive investors, along with their inability to sell poorly-performing stocks due to their mandate to track index constituents lessens the cost of coordinating efforts to engage in investor activism. For example, higher passive ownership is associated with greater success by activists in obtaining board representation, removing takeover defenses, and facilitating the sale of a targeted company. Overall, passive investors seem to mitigate the *free-rider* problem (Grossman; Hart, 1980), increasing activists' willingness to engage in costlier forms of activism, and thereby unlocking shareholder engagement actions that would not be incentive-compatible in the absence of highly concentrated ownership – either due to an increase in the campaign's credibility or through diluting coordination costs, as passive investors can proxy their large voting share in favor of the activist campaign.

Using a detailed dataset that allows me to analyze firms' debt structure through 10-K filings, I exploit exogenous variation in passive institutional holdings due to *Russell 1000/2000* index assignments to investigate whether exogenous increases in passive ownership by U.S firms are related to firms' debt structure movements away from bank debt

and/or other types of secured/collateralized debt. More specifically, I ask whether higher levels of passive ownership can affect firms' debt structure outcomes *ex-post* exogenous increases in the portion of equity held by large, passive shareholders, such as *ETF* funds. As such, by exploring such relationship, I am able to discuss potential channels related to debt structure dynamics related to the different hypothesis previously mentioned in the literature. For example, by bearing the coordination costs related to shareholder activism – or the threat of – can provide enough incentives for active monitoring, allowing firms to reap the benefits of multiple creditors and increased access to other types of debt, such as bonds.

By applying an identification strategy in the likes of (Appel; Gormley; Keim, 2018), I focus on the sub-sample of 250 firms in the bottom (top) of the *Russell 1000* (*Russell 2000*) the threshold that defines the assignment these indices right after the recalibration period. As *Russell* indexes are value-weighted, a firm in the 950th position of the *Russell 1000* index would have a much lower weight in the index portfolio than a firm in the 50th position of the *Russell 2000* index. As a consequence, index funds – also known as *exchange-traded funds* or *ETFs* – that track *Russell 1000/2000* recalibrate their portfolio based on the new theoretical portfolio weights of the indexes. This implies that a firm that was previously assigned to the bottom of the *Russell 1000* and has been assigned to the *Russell 2000* index will have an influx of passive ownership.

First, I show that the results obtained by regressing passive ownership on assignment to the *Russell 2000* index, after controlling for all determinants of index assignment, implies an increase of approximately 29%, which is in line with the estimates presented in (Appel; Gormley; Keim, 2018). Importantly, this discontinuous change in passive ownership near the threshold between the two indices is plausibly exogenous to firm's characteristics, as the main component that drives index assignment is stock market capitalization, which is not fully in the control of the manager. Even if that is the case, other important confounders, such as analyst coverage, tend to increase in the opposite direction - *i.e.*, whenever a firm is included in the *Russell 1000*–, as shown in (Appel; Gormley; Keim, 2018).

In a second stage, I use the sample estimates from the regression of passive ownership in a regression-discontinuity-design and analyze what happens to these firms' debt concentration among several types of debt structure *ex-post* changes in passive ownership. The results show that a one standard deviation increase in the level of passive ownership decreases debt concentration by 29%, and it is entirely driven by firms in the lowest tercile of asset size distribution. These results remain robust after including a wide set of fixed effects, different specifications for the running variable, and show that firms with increased passive ownership tend to move from a concentrated to a multi-tiered debt structure. Overall, the increase in the number of debt types considered is modest, with an average increase of 0.56 in the number of new debt types added to the firms' debt structure

ex-post index recalibration, and provides evidence that is in line with the argument that firms borrow predominantly from a very limited number of debt types.

If firms are adjusting towards a more multi-tiered debt structure, which types of debt are increasing due to shifts in passive ownership? To answer this question, I use the instrumentalized variation from my first-stage regression and analyze the *ex-post* effect on the (log) level of each debt type. The results show that the *Commercial Paper*, *Term Loans*, and *Revolving Credit* are the debt types that are receiving a larger financial share. Furthermore, the results are concentrated on firm that at least a minimum level of debt diversification – *i.e.*, at least two different debt types. Finally, additional results show that other firms' fundamentals do not have statistically significant changes *ex-post* increases in passive ownership, which rules out hypothesis regarding more broader channels that could indirectly affect debt structure.

This work relates to mainly two strands of the literature. First, this study extends the recent growing literature on debt structure (Rauh; Sufi, 2010; Colla; Ippolito; Li, 2013; Colla; Ippolito; Li, 2020) by providing empirical evidence on the potential possible channels by which debt heterogeneity manifests. Additionally, this study relates to corporate governance literature by studying the role of passive investors and their consequences on firms' corporate governance and future outcomes. Previous studies (Appel; Gormley; Keim, 2016; Appel; Gormley; Keim, 2018) show that institutional investors affect corporate governance by bearing the costs of monitoring managerial discretion, and the mechanism that enables such a link is related to an interplay between passive investors and activist shareholders.

The remainder of this paper is structured as follows. Section 3.2 provides a detailed discussion on the study of debt structure, its determinants, and the related literature. Section 3.3 provides a simple framework to illustrate the role of agency costs in financing decisions, and how debt structure decisions can manifest in such a way to lessen the agency costs. Sections 3.4 and 3.5 provides a detailed outlook on the data and information sources used throughout the analysis and the identification strategy used in this study. Section 3.6 presents the results of the econometrics estimation, and Section 3.7 translates the empirical results in terms of the hypothesis for debt structure determinants previously discussed in the literature. Finally, Section 3.8 concludes with a summary of the main contributions and directions for future research.

3.2 Capital Structure and Debt Structure

While different theories provide predictions on how capital structure may be informative of firms' financial decisions and relevant to maximizing shareholders' value, empirical evidence regarding the distinct capital structure theories provides, at best, mixed

results. In stark contrast to several papers on the determinants of capital structure, such as (Rajan; Zingales, 1995), (Lemmon; Roberts; Zender, 2008) have shown prominent empirical results that capital structure is fairly persistent over time: high/low levered firms tend to keep their leverage in similar levels for over two decades. These results suggest that variation in capital structure is primarily determined by (unobserved) factors that are held constant over time, as the inclusion of firm fixed effects implies that time-invariant, unobservable firm characteristics capture most of the variation in the cross-section.

To that matter, what could explain capital structure persistence over time? Among other reasons, an explanation for the empirical pattern presented in (Lemmon; Roberts; Zender, 2008) is embedded in the assumptions of the main capital structure theories – *i.e.*, the *trade-off* theory (Kraus; Litzenberger, 1973), the *pecking-order* theory (Shyam-Sunder; C. Myers, 1999), and the *market-timing* theory (Baker; Wurgler, 2002) – that debt contracts are uniform. In contrast, however, debt heterogeneity – in terms of several dimensions, such as maturity and convertibility – is a common feature of real-world capital markets.

As documented in (Colla; Ippolito; Li, 2013), debt specialization – when firms borrow predominantly from one type of debt – is widespread among U.S publicly-listed firms, and the extent to which firms specialize or diversify their debt across multiple types varies widely across different subsamples. For example, (Rauh; Sufi, 2010) shows that relative to high-credit-quality firms, low-credit-quality firms are more likely to have a multi-tiered capital structure consisting of both secured bank debt with tight covenants and subordinated non-bank debt with loose covenants.

As such, an explanation for why capital structure is surprisingly stable over time relates to the simplistic manner in which most of the previous studies have treated debt/equity decisions. When analyzing leverage ratios, an important shortcoming is that a focus on leverage ratios naturally leads to very strong assumptions about the underlying contractual characteristics of the securities. Notwithstanding, a detailed description of a debt claim is generally built, among other characteristics, on the following aspects (Rauh; Sufi, 2010):

1. **Maturity:** how long does the promised payment for the borrower is due for?
2. **Type:** does the debt contract consists of a payment at the end of the contract or multiple coupons throughout the contract?
3. **Priority:** in an eventual default, which debtor should be the first to receive his claims?
4. **Covenants:** are covenant terms present so that debtholders are able to takeover control rights in an eventual situation of covenant break?

5. **Convertibility:** is debt *convertible* to equity as a way to overcome possible *risk-shifting* problem due to the lack of managerial incentives?

As expected, abstracting away from the specifics of debt contracts may have important unfoldings for our understanding of firms' financial decisions that ultimately affect firms' overall capital structure. In this sense, despite the findings presented in (Lemmon; Roberts; Zender, 2008) that capital structure is stable over time, even though the total amount of debt (in % of Total Assets) is fairly stable over time, its *composition* may change significantly.

Seeking to shed light on this issue, (Rauh; Sufi, 2010) examine the types, sources, and the priorities of debt contracts using a sample of 305 randomly selected nonfinancial, rated public U.S. firms for the period 1996 to 2006. Contrasting to the "uniform" treatment of debt, almost three-quarters of firm-year observations employ more than two different debt instruments. More strikingly, a quarter of the sample experiences no significant year-over-year change in debt level but shows a significant change in debt composition. By providing a detailed analysis of debt heterogeneity among different firms' characteristics, their findings advance on important patterns for the study of debt structure: weaker firms are more likely to use secured debt (bank debt), and as firms move from higher to lower ratings, the likelihood of issuing secured or subordinated debt increases.

Adding to the findings presented in (Rauh; Sufi, 2010), (Colla; Ippolito; Li, 2013) take advantage of the debt structure database available through *Capital IQ* and complement their analysis by considering rated and unrated firms. By distinguishing debt structure in terms of seven categories of debt contracts – such as bonds and term loans, for example–, they examine the debt structure of public U.S. firms that are representative of the universe of *Compustat* firms.

In line with previous findings on debt structure, results show that most firms borrow predominantly with one type of debt, thus showing a tendency towards *debt specialization*. However, the degree of specialization varies widely across subsamples: while large, rated firms simultaneously employ multiple types of debt, all other firms, comprising the majority of listed firms in the United States, make use of *only one type* of debt.

Altogether, these results constitute a broader picture on the grounds of understanding how firms manage to choose debt contracts: traditional capital structure studies that ignore debt heterogeneity miss a substantial portion of the variation in firms' capital structure. This opens the possibility to explore why there exists heterogeneity in debt issuance, and how one can reconcile the evidence that firms simultaneously use different types of debt.

While suggestive of the potential mechanisms that explain the variability of debt specialization across several firm dimensions, the recent literature has not presented

empirical evidence of the grounds of establishing a *causal* relationship between any of these motives and firms' debt structure decisions. To that matter, this paper aims to bridge passive ownership and debt structure choices and discuss the hypothesis regarding the determinants of debt structure.

3.3 Debt structure decisions and its motivations

At a higher level, there is a strikingly historical persistence of debt issuance over equity: over 1946-1987, debt issues accounted for 87% of all external financing, while equity had only represented 7% (Bolton; Scharfstein, 1996). The vast prevalence of debt over equity has motivated studies seeking to understand the contractual framework of debt financing decisions over time.

Theoretically, in a (Modigliani; Miller, 1959) world, the lack of agency costs abstracts away any difficulty faced by shareholders and debtholders of the firm to reach out to the managers and pursue their interests and maximize the value of the firm. However, relaxing this assumption gives rise to a series of conflicts of interest between managers and investors - also known as the *Principal-Agent* problem. Accordingly, the seminal work of (Berle; Means, 1932) highlights the agency problems that arise from the separation of ownership and control, such as insufficient effort, wasteful investment, managers extracting private benefits through excessive salaries and perks, among others.

Ultimately, these concerns between managers and claimants entail a series of issues related to transaction costs and information asymmetry, such as moral hazard, free cash flow, risk-shifting, credit-rationing, among others, that ultimately affects shareholders' value maximization. The possibility of such problems being pervasive to firms' long-term value entails that stakeholders such as banks and investors take these agency costs into account when making decisions. As a consequence, financing – either through debt or equity – may be hindered due to a higher cost of capital, making firms to foregone otherwise profitable investment opportunities.

In this sense, as debtholders anticipate the need for incentivizing managers to exert effort and act on behalf of their best interests, the absence of monitoring efforts that guarantee that managers pursue actions in line with these goals may hinder lenders from financing profitable investments – either through credit rationing or by setting higher prices. As such, some firms would only obtain funding if monitoring by a third party takes place to guarantee that managers are acting as a way to safeguard debt payments.

On the other hand, looking at individual debtholder decisions and its relationship with agency costs may miss important practical questions when it comes to equity and debt financing. Leaning on that observation, (Bolton; Scharfstein, 1996) studies the optimal debt contracting framework of a firm. Their model proposes that an optimal debt structure,

from a contracting perspective, should be able to discourage firms from defaulting on their debt, while being able to minimize the losses conditional on the event of a liquidation. To that matter, their main point is that debt structure can influence the outcomes of a negotiation after a default, which can vary in the number of creditors involved, the allocation of security interests, and voting rules. In this sense, an optimal debt structure emerges from balancing-off default occurrence and the value of the firm following a default.

More recently, the emerging literature on debt structure determinants has focused on two important stylized facts: the substantial heterogeneity of debt structure characteristics *across* firms, and the within-firm debt structure persistence. Overall (Colla; Ippolito; Li, 2013) proposes three potential explanations for the cross-sectional heterogeneity in debt structure: i) bankruptcy costs; ii) lack of access (or prohibitively costly) to some market segments; and iii) economies in information collection costs and enhanced incentives to monitor.

First, the idea of trading benefits and costs of debt goes back to (Modigliani; Miller, 1963). Assuming that agency costs arising from conflicting interests between equity holders and debtors (Jensen; Meckling, 1976) or between different debt claimants (Welch, 1997; Hackbarth; Mauer, 2011) may induce costly coordination costs in the case of liquidation. As such, firms may be optimally choosing their debt structure to trade-off the benefits of debt with the (expected) bankruptcy costs: since a more concentrated debt structure can induce lower renegotiation costs across few lenders, low-quality firms are expected to have a more concentrated debt structure to maximize its liquidation value, whereas high-quality firms seek debt from multiple sources to minimize the probability of default. Theoretically, lowering (expected) bankruptcy costs goes back to (Bolton; Scharfstein, 1996), where theoretical predictions show that firms with lower prospects maximize the liquidation value by borrowing from a single creditor, while high prospect firms do so by contracting from multiple debtors.

Empirical studies, such as (Ivashina; Iverson; Smith, 2016) show that higher debt concentration increases the speed of restructuring under *Chapter 11* while lowering the likelihood of liquidation, which is in line with the argument that debt concentration act in lowering negotiation costs between debtholders. Furthermore, empirical evidence presented in (Colla; Ippolito; Li, 2013) shows that measures of bankruptcy costs, such as asset tangibility (Titman; Wessels, 1988) and cash-flow volatility (Rajan; Zingales, 1995) are in line with the interpretation of firms choosing debt structure to minimize bankruptcy costs: while firms with more tangible assets tend to employ a less concentrated debt structure, firms with more volatile cash-flows tend to concentrate towards only one type of debt.

Second, moving away from frictionless capital markets, market frictions may also induce some firms to credit rationing, either in the intensive margin – *i.e.*, limiting the extent to which firms can resort to debt financing through prices – or in the extensive

margin – by simply refusing to finance some types of firms (Almeida et al., 2012; Rauh; Sufi, 2010; Faulkender; Petersen, 2005). To this point, as market frictions induce some conditions previously mentioned – such as bankruptcy costs and information asymmetry – to make debt structure decisions relevant from the firm perspective, the lender perspective in terms of whether (and how much) to ration the amount of lending to a given firm can help explaining the persistence of within-firm debt specialization in the U.S.

For example, the lender’s decision of rationing certain firms’ access to capital may hinder these firms to seek for alternative financing sources, narrowing the set of financing choices available and increasing debt persistence on a given type of debt over time. Furthermore, lack of access and/or prohibitively higher costs for some debt alternatives, such as bond issuance, may hinder smaller firms to move away from traditional bank debt – for a detailed discussion on market and bank-based economies, see (Bats; Houben, 2020).

Finally, asymmetric information between managers and the different firm’s stakeholders implies that collecting information and monitoring managerial activity is costly. As such, debt structure and ownership can be chosen as a way to provide enough incentives to monitor. For example, not only blockholders, due to their increased equity stake in the firm, can have enough incentives to monitor (Edmans, 2014) but creditholders can also exert monitoring so as to guarantee that managerial action is in line with their interests. For example, much of the literature on relationship lending points to banks as effective monitors.

As such, a potential explanation for this heterogeneity in debt structure may be related to information collection costs and enhanced incentives to monitor: as monitoring is costly, for monitoring efforts to be incentive-compatible, the agent has to have a sufficiently large claim in the firm to circumvent the *free-rider* problem (Grossman; Hart, 1980). Therefore, opaque firms with higher information collection and monitoring costs are more likely to present a concentrated debt structure, whereas transparent firms with less monitoring should present a more widespread debt structure (Colla; Ippolito; Li, 2013).

Theoretical models of active monitoring, such as the one presented in (Tirole, 2006), highlights conditions where monitoring plays a role in providing conditions for firms to fund profitable investment opportunities – *i.e.*, entrepreneurs with weak balance sheets only obtain funding by hiring a monitor. As a consequence, monitoring has a role in financing by allowing *ex-ante* constrained entrepreneurs to fund their projects in the presence of a monitor. As a matter of fact, some general empirical patterns are consistent with the implications of such model. For example, (Porta et al., 1998) find that in legal systems with poor investor protection - and therefore a higher opportunity for insider private benefits - also exhibit concentrated ownership structures. Thus, as large shareholders are more likely to bear the costs of monitoring, such process is facilitated by concentrated ownership.

Crucially, however, monitoring management's actions is costly: time, effort, lawsuits, proxy representation, and other corporate-governance actions are needed to ensure that managers are aligned with shareholders' interests. Ultimately, the question of who bears the cost of monitoring gives rise to the commonly known *free-rider* problem, described in (Grossman; Hart, 1980): on the one hand, monitoring keeps managers in check, but on the other hand, the investor that monitors bears the full cost of the monitoring, but only receives a fraction of the benefit, while creating a positive externality on other investors. In this sense, the combination of dispersed benefits and concentrated costs may induce an underprovision of monitoring.

Theoretical models of active monitoring – see, for example, (Tirole, 2006) – often point to bank monitoring as a solution to reduce agency costs, as banks emerge as natural agents to have enough incentives to bear the costs of monitoring. While most of the empirical application focuses on banks as active monitors due to relational lending, the monitoring solution does not necessarily need to arise through banks: a large shareholder, which may have incentives to bear the costs of monitoring, may ensure that managers act in behalf of shareholders' interests, thereby alleviating concerns related to shareholder expropriation. As such, *blockholders* – investors with a large equity stake in the firm – can act as a type of investor with the necessary incentives to bear the cost of monitoring (for a detailed survey about the topic, see, for example, (Edmans, 2014)).

3.3.1 Passive Ownership and Debt Structure

The previous subsection highlighted the study of debt structure and the hypotheses outlined in the literature about its motivations. Although there has been increasing attention towards debt heterogeneity (and the firms' choice of debt characteristics) as opposed to a more high-level debt *versus* equity decision, there is still no empirical assessment of the motivations behind the stylized facts regarding within-firm debt specialization and the heterogeneity of debt structure across firms.

Of special relevance to this study, there has been no empirical evidence on how (or whether) the different stakeholders of the firm may influence debt structure decisions. In practice, however, one could think of several ways in which large shareholders, such as investment funds and trust corporations may exert influence over managers' debt decisions. For example, recent empirical evidence (Appel; Gormley; Keim, 2018) shows that increased passive ownership – *i.e.*, ownership by an investment vehicle that has no intentions of interfering in management decisions – lessens the costs of monitoring and coordination, which in turn facilitates investor activism. One can view this interplay as a shift in activist shareholders' actions after a decrease in monitoring costs, as passive investors, due to their lack of incentives to engage in management, can proxy their voting decisions to groups of activist investors. This, in turn, makes it optimal for them to oppose (or simply threaten

to) managerial policies that do not act on behalf of the shareholders' interests.

In the next sections, I discuss the data and the identification strategy adopted in this study aiming to bridge the gap between debt structure and passive ownership.

3.4 Data

I construct an extensive dataset at the *firm-year* level using information available from *Bloomberg*[®], *Standard and Poor's (S&P)*, and *Wharton Research Data Services (WRDS)* that comprises stock assignments for *FTSE's Russell 1000/2000* indexes, debt structure information, ownership characteristics, and firms' financials. In the next subsections, I provide a thorough description of the main steps to construct the data collected in order to construct the dataset for the implementation of the empirical framework described in Section 3.5.

3.4.1 Stock Index Assignments

First, I collect stock index assignments for the *Russell 1000* and *Russell 2000* indexes from *Bloomberg*[®]. *Russell* is a family of global stock market indexes from *FTSE Russell* that allows investors to track the performance of distinct market segments worldwide. In this sense, passive funds attempt to match the performance of a market index by holding securities of the market index in proportion to their weights in the index.

More specifically, the *Russell 1000* index comprises the 1,000 U.S. stocks that mostly reflect the largest 1,000 companies in terms of market capitalization, whereas the *Russell 2000* index comprises the *next* largest 2,000 stocks that are not included in *Russell 1000*. As discussed in (Appel; Gormley; Keim, 2018), since 2007, *Russell* indexes are reconstituted each year at the end of June using a combination of three factors, known as the "*banding criteria*"¹. This policy, implemented in 2007, intended to avoid index turnover on each reconstitution year, conditions assignment to the indexes based on i) the stock's market capitalization as of the last trading day in May of that year; ii) the stock's index assignment in the previous reconstitution year; and iii) the stock's market capitalization falls within a certain range of the cutoff between 1,000th and 1,001st largest stock market caps.

The fact that *Russell* indexes are value-weighted implies that index assignment has a significant effect on index weights and the extent to which a stock is owned by passive investors. For example, due to the value-weighting scheme, the 950th largest stock is more likely to be included in the *Russell 1000* and be given a very small weight in the index,

¹ For a detailed discussion about the banding criteria, see (Appel; Gormley; Keim, 2018).

while the 1,050th largest stock is more likely to be included in the *Russell 2000* and being given a much larger weight.

Key to the identification strategy adopted in this study, described in detail in Section 3.4, I collect the full list of firms and their respective index assignments, along with their identifying information such as ticker and CUSIP codes, for each reconstitution year from 2007 to 2019. This procedure yields a list of all components of *Russell 1000/2000* indexes in each year of our sample.

3.4.2 Debt Structure and Firms' Financials

As in (Colla; Ippolito; Li, 2013), I collect data regarding firms' key financials and debt structure information from *Capital IQ*, an affiliate of *S&P*. For each unique firm in the sample that has belonged to *Russell 1000/2000* in any reconstitution year from 2007-2019, I use their corresponding Ticker/CUSIP codes to collect information on financial characteristics, such as Assets, Cash-Flows, Liabilities, and other key performance measures, along with yearly information on its debt structure, being able to distinguish between several classifications of debt, such as commercial paper, credit lines, term loans, senior and subordinated bonds/notes, and capital leases.

3.4.3 Ownership Characteristics

Finally, for each unique firm that has belonged to *Russell 1000/2000* in any reconstitution year from 2007-2019, I use their corresponding Ticker/CUSIP codes to collect information on firms' ownership characteristics using S12 Mutual Fund Holdings data, available from *WRDS*. More specifically, since May 2004, mutual funds and exchange-traded funds (ETFs) that hold stocks traded on U.S exchanges are required to inform quarterly holdings to the *Securities Exchange Commission (SEC)* through N-CSR and N-Q forms.

Along with end-of-quarter information on stock prices, obtained from the *Center for Research in Security Prices (CRSP)* and also available at *WRDS*, I construct measures of Mutual Fund Ownership by classifying each fund as being either actively or passively managed. To that matter, I calculate a firm's total market capitalization by multiplying each end-of-quarter price by the firms' shares outstanding. After that, to assign fund holdings into actively or passively managed, I follow (Appel; Gormley; Keim, 2016) and classify a fund as "passively" managed if i) its fund name includes a string that identifies it as an index fund²; or ii) if *CRSP* Mutual Fund Database itself classifies it as an index

² The exact strings that were considered were for an fund to be considered as passively were: "Index", "Idx", "Indx", "Ind", "Ind ", "Russell", "S & P", "S and P", "S&P", "SandP", " SP ", "DOW", "Dow", "DJ", "MSCI", "Bloomberg", "KBW", "NASDAQ", "NYSE", "STOXX", "FTSE", "iShares", "Wilshire", "Morningstar", "100", "400", "500", "600", "900", "1000", "1500", "2000", "5000", and "3000".

fund.

Importantly, while *Bloomberg*[®]'s local provider provides the actual index composition and yearly rebalancing for each portfolio, it *does not* enable access to the exact portfolio weights on each stock. To circumvent this problem, for each firm in the sample, I also collect daily stock-price information from May to June in *CRSP* and follow the *FTSE Russell*'s guidelines for assigning index weights for each stock in *Russell 1000/2000* indexes.

While index assignment is made based on total market capitalization, after index assignments are determined, each stock's weight on the portfolio is calculated using its end-of-June-float-adjusted market cap – *i.e.*, considers only shares that are available to the public. To be able to determine portfolio weightings, I collect data on Institutional Ownership (Thomson 13F) and calculate $Float_{i,t}$ as the stocks' float-adjusted-market cap by subtracting the portion of shares held by institutional investors and use it to compute portfolio weights for each stock that belongs to the *Russell 1000/2000*.

3.4.4 Final Sample and Variable Description

After collecting and merging all the available sources of data, the final sample comprises information regarding 1,130 unique U.S publicly listed firms that have been included in the *Russell 1000/2000* indexes in at least one year over the sample period. In sum, for each firm in this sample, I observe its debt structure, ownership characteristics, and its assignment to any of the *Russell 1000(2000)* indexes across an (unbalanced) panel from 2007 to 2019.

To be able to analyze the extent to which stocks' shares are held by passive investors, I define $Passive_{i,t}$ as the percentage of a firm's total market capitalization that is held by passive mutual funds:

$$Passive_{i,t} = \frac{Price_{i,t} \times P.Own_{i,t}}{MKTCap_{i,t}}, \quad (3.1)$$

where $P.Own_{i,t}$ refers to the number of shares outstanding held by passive investors, and $MKTCap_{i,t}$ is the firm's total market capitalization in period t .

Additionally, to get a better understanding of the usage of different types of debt by firms, I follow (Colla; Ippolito; Li, 2013) and define a (normalized) Herfindahl-Hirschman Index (HHI) of debt usage. Specifically, let the total debt of a firm, denoted by $TD_{i,t}$, be divided into seven categories: Commercial Papers ($CP_{i,t}$), Drawn Credit Lines ($DC_{i,t}$), Term Loans ($TL_{i,t}$), Senior Bonds and Notes ($SBN_{i,t}$), Senior Unsecured Bonds ($SUB_{i,t}$), Capital Leases ($CL_{i,t}$), and Others ($Other_{i,t}$). By dividing by the firm's total debt, $TD_{i,t}$, I calculate the squared sum of the debt type ratios as:

$$SS_{i,t} = \left(\frac{CP_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{DC_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{TL_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{SBN_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{SUB_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{CL_{i,t}}{TD_{i,T}}\right)^2 + \left(\frac{Other_{i,t}}{TD_{i,T}}\right)^2 \quad (3.2)$$

With that in mind, I define $HHI_{i,t}$ as the normalized Herfindahl-Hirschman Index of debt type usage as:

$$HHI_{i,t} = \frac{SS_{i,t} - \frac{1}{7}}{1 - \frac{1}{7}} \quad (3.3)$$

Intuitively, $HHI_{i,t}$ measures the degree of a firm's debt specialization towards one type of debt: when $HHI_{i,t} \rightarrow 1$, then firm i shows a tendency towards *specialization*. Conversely, when $HHI_{i,t} \rightarrow 0$, then firm i presents a multi-tiered debt structure. In the limit, when $HHI = 1$, then the firm employs only one type of debt, whereas then $HHI = 0$, it means that the firm employs all the seven types of debt in the same proportion.

3.5 Empirical Strategy

Studying the effect of passive ownership on firms' debt structure is empirically challenging, as passive ownership is likely to be correlated with other (unobserved) factors that might also affect firms' debt decisions. For example, poor past performance might cause both a stock's removal from a popular index, thereby reducing passive ownership, but also increasing the issuance costs especially for non-secured contracts, such as subordinated and unsecured debt.

As a consequence, naïve estimates of the effect of passive ownership on the presence of firms' specific debt contracts may lead to biased estimates of the causal effect of passive ownership on debt structure outcomes. Therefore, one must consider ways to incorporate changes in passive ownership that are orthogonal to any firm's unobservable characteristics that might affect debt decisions, such as investment opportunities.

To shed light on the potential relationship between passive ownership and debt structure, I exploit the assignment in *Russell 1000/2000* indexes as a source of exogenous variation in passive ownership. Using *Russell 1000/2000* as an identification strategy has been widely applied to instrument passive ownership in several Corporate Governance studies (Appel; Gormley; Keim, 2016; Appel; Gormley; Keim, 2018; Schmidt; Fahlenbrach, 2017), as increases in passive ownership for firms *close* to the cutoff that distinguishes assignment to one of the indexes is related to discretionary mutual fund allocation rules, and therefore plausibly exogenous to unobserved confounding factors, such as investment opportunities.

Following the previous studies using index assignments, I use the inclusion in the *Russell 2000* as an instrument for passive ownership, while controlling for all the other factors that determine assignments. As such, since the index assignment is arbitrarily determined for firms near the threshold of *Russell 1000/2000* - *i.e.*, the bottom firms of *Russell 1000* and the top firms of *Russell 2000*- after controlling for the factors that determine firms' assignment, one can treat the change in mutual fund allocations as an exogenous source of variation in passive ownership.

Therefore, the baseline specification is comprised of a two-stage instrumental variable (IV) procedure, where the first stage instruments passive ownership considering all index assignment components:

$$\begin{aligned} \widehat{Passive\%}_{i,t} = & \eta + \lambda R2000_{i,t} + \sum_{n=1}^N \chi_n \ln MktCap_{i,t}^n + \sigma \ln (Float_{i,t}) \\ & + \phi_1 Band_{i,t} + \phi_2 R2000_{i,t-1} + \phi_3 (Band_{i,t} \times R2000_{i,t-1}) + \delta_t + u_{i,t} \end{aligned} \quad (3.4)$$

where $R2000_{i,t}$ is a dummy variable that assigns the value 1 (one) if stock i is in the *Russell 2000* for reconstitution year t , $MktCap_{i,t}$ is the end-of-May CRSP market capitalization of stock i in year t ; $Float_{i,t}$ is the float-adjusted market capitalization calculated by *Russell* when setting the portfolio weights during the end-of-June reconstitution; $Band_{i,t}$ refers to the banding criteria used to determine changes in index assignments. I also control for time fixed effects δ_t in order to account for within-year variation.

After that, the instrument is used in the second-stage regression:

$$\begin{aligned} \mathbf{Y}_{i,t+n} = & \alpha + \beta \widehat{Passive\%}_{i,t} + \sum_{n=1}^N \theta_n + \ln (MktCap_{i,t})^n + \gamma \ln (Float_{i,t}) \\ & + \mu_1 band_{i,t} + \mu_2 R2000_{i,t-1} + \mu_3 (band_{i,t} \times R2000_{i,t-1}) + \delta_t + \varepsilon_{i,t} \end{aligned} \quad (3.5)$$

where $\mathbf{Y}_{i,t+n}$ is a vector that contains the outcomes of interest for firm i in year $t+n$; $\widehat{Passive\%}_{i,t}$ is the (instrumentalized) percentage of a firm's shares held by passively managed mutual funds at the end of the end of September in year t (*i.e.*, in the first quarter after reconstitution in year t). All other variables are the same as in specification (1). Regarding the vector of outcomes, $\mathbf{Y}_{i,t+n}$ is a vector containing all the six debt classifications for firm i over time.

Intuitively, the identifying assumption is that inclusion in the *Russell 2000* has an effect on $\mathbf{Y}_{i,t+n}$ only through increases in passive ownership, and not by other indirect effects that are correlated with the inclusion in the *Russel 1000* or *Russel 2000* indexes. For example, a key concern regarding this identification strategy is that analyst coverage changes concurrently as firms are assigned to *Russell 2000* with a higher weight. Hence, it

is necessary to verify whether any other possible confounding factor embedded in ε also changes discontinuously within the *Russell 1000/2000* threshold.

As expected, due to the design of the empirical setting, this approach provides only a local identification of the effect, in the sense that a causal interpretation of the changes in debt structure due to increases in passive ownership can only be, at best, made for firms near the threshold between the two indexes. In our baseline specification, I follow the previous empirical literature and use a bandwidth of $\psi = 500$ firms for each index. In this sense, we restrict our attention to the 500th smallest firms in the *Russell 1000* index and the 500th biggest firms in the *Russell 2000* index in terms of portfolio weighting.

In the next section, I present clear evidence that not only index assignment is indeed related to increases in passive ownership, but also that such increases have a significant impact on firms' debt structure measures and debt specialization.

3.6 Results

As argued earlier, identification using exogenous variation due to *Russell 1000/2000* reconstitution relies on using local variation near to the threshold between the two indexes. In this sense, for each year, I only consider a bandwidth of $\phi = 500$ firms above/below the threshold. To get an graphical interpretation on how index assignments may induce exogenous variation in passive ownership, Figure 14 plots the portfolio weights for both indexes considering the smallest (largest) firms on *Russell 1000* (*2000*) index in the 2013 reconstitution year.

Similar to what is presented in (Appel; Gormley; Keim, 2018), as a result of *FTSE Russell's* rules, it is worth noticing that portfolio weights on *Russell 1000/2000* stock jump discontinuously around the assignment threshold when a firm is reclassified from the *Russell 1000* to the *Russell 2000* index³. Along with the information regarding the dollar value of passive mutual funds that track both indexes, this evidence is suggestive that, around the threshold, passive ownership should increase for firms that were marginally assigned to the *Russell 2000* index.

To shed light on the validity of using *Russell 2000* assignment as an instrument for passive ownership, Table 27 shows the results from employing the specification highlighted in Equation (4) by regressing passive ownership on the assignment to *Russell 2000* for the subsample of firms with available information on debt structure.

As Table 27 shows, regardless of the specification, assignment to the *Russell 2000* has a positive and statistically significant effect on the share of passive ownership: given that the average percentage of passive ownership in a firm for the sample is 12.56%,

³ The same pattern is found for any given reconstitution year of the sample.

This figure presents the relationship between the portfolio weight and rank position using the subset of firms from our sample included in the top/bottom 500 of the *Russell 1000/2000* indices as of 2013. The black dots indicate the bottom 500 firms included in the *Russell 1000*, whereas the gray dots indicate the top 500 firms included in the *Russell 2000* index. Firms are ordered on the x-axis in terms of their Float-Adjusted Market Capitalization following the rule for index assignment followed by the *Russell* family of indices. The dashed line at the 500th position indicates the threshold for assignment to the *Russell 1000* (left) and *Russell 2000* (right).

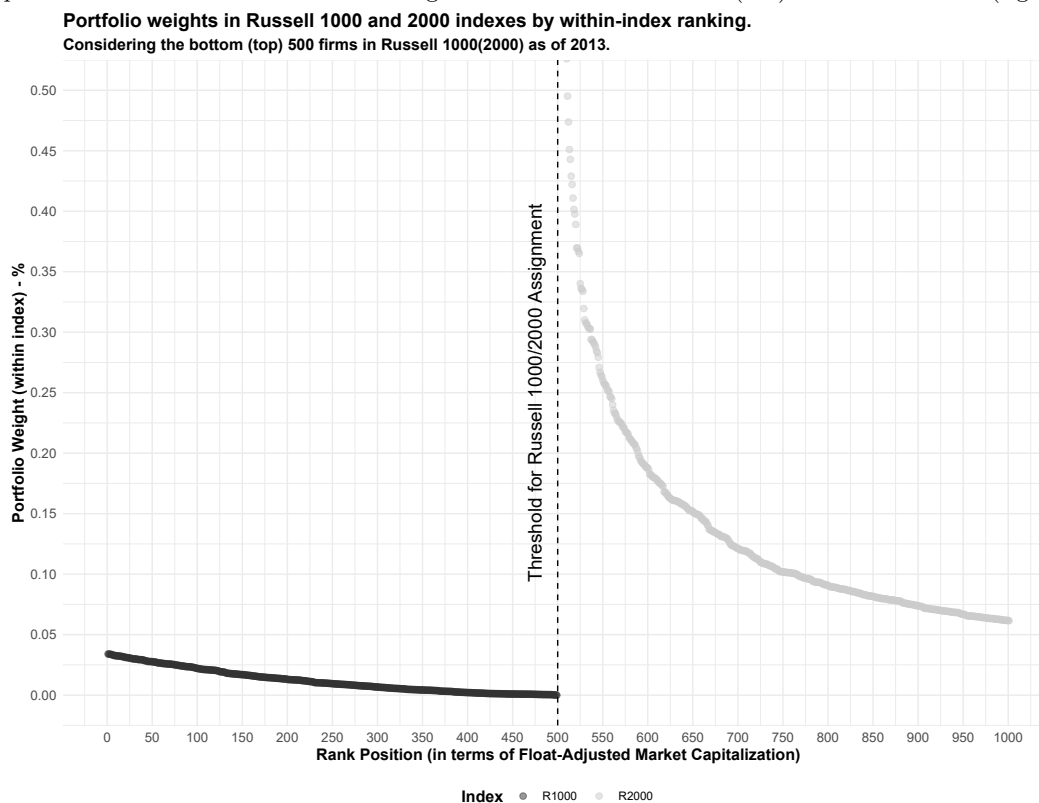


Figure 14 – Portfolio Weight Distribution as of 2013 reconstitution year.

estimates imply an increase of approximately 29% in the passive ownership, even after controlling for the factors that determine assignment to the *Russell 2000* index. As a result, stocks that were assigned to the *Russell 1000/2000* and that are near to the threshold should be comparable in the sense that unobserved characteristics are unlikely to drive changes on firms' future outcomes except for the change in passive ownership due to index assignment.

With this information in mind, Table 28 presents the results from the second-stage IV regression, where the dependent variable is the one-year-ahead debt concentration level, $HHI_{i,t+1}$. To clarify the interpretation of the results, I normalize Passive Ownership before obtaining the results from the first-stage regression.

The results from Table 28 provide evidence that increases in passive ownership due to the assignment to the *Russell 2000* index induces firms towards a *multi-tiered* debt structure: a one standard deviation increase in the (instrumentalized) level of passive ownership decreases HHI by approximately -0.2 . Given that the average level of debt concentration in our sample is 0.69, this implies a decrease of approximately 29%, which is both economically and statistically significant. Put another way, firms that faced increases

Table 27 – First-stage Results - Passive Ownership and Russell 1000/2000 Assignment

This table presents the estimates of the first-stage results, presented in Equation (4), and described in Section 3.5, following (Appel; Gormley; Keim, 2018), in such a way to capture all factors that determine index assignment in a given recalibration episode. The dependent variable, $Passive_{i,t}$, is the percentage of shares of firm i held by passive investors in period t . $R2000$ is an indicator variable that assigns 1 (one) if firm i has been assigned to the *Russell 2000* index in period t , and zero otherwise, and $Float_{i,t}$ denotes the Float-Adjusted market capitalization. $Band_{i,t}$ is an indicator variable that assigns one if firm i lies within the *banding* criteria for index assignment, and zero otherwise. Finally, this specification also includes 1^{st} , 2^{nd} , and 3^{rd} order polynomials for $MktCap_{i,t}$. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Dependent variable:		
		Passive %	
	(1)	(2)	(3)
<i>R2000</i>	4.122*** (0.670)	4.181*** (0.667)	4.293*** (0.719)
<i>Banding</i>	1.083*** (0.402)	1.049*** (0.401)	1.102*** (0.414)
<i>Previous R2000</i>	-0.064 (0.366)	-0.126 (0.369)	-0.110 (0.371)
<i>Banding × Previous R2000</i>	-0.822 (0.641)	-0.895 (0.633)	-1.015 (0.675)
Year fixed effects	✓	✓	✓
Firm fixed effects	✓	✓	✓
Float	✓	✓	✓
Pol. Order	1^{st}	2^{nd}	3^{rd}
S.E Clustering	Firm	Firm	Firm
Observations	2,938	2,938	2,938
R ²	0.817	0.817	0.817
Adjusted R ²	0.755	0.756	0.756
Residual Std. Error	3.303 (df = 2196)	3.301 (df = 2195)	3.301 (df = 2194)

Note:

*p<0.1; **p<0.05; ***p<0.01

in passive ownership coming through the *Russell 1000/2000* channel seem to spread its debt structure to include more types of debt relative to their debt structure prior to the *Russell 1000/2000 recalibration*.

What is also interesting to note about these results is how they relate to the findings presented in the prior literature, where it was shown that debt specialization (as measured by $HHI_{i,t+1}$) seems to have a positive relationship with *market-to-book*. All else equal, index recalibrations from the *Russell 1000* to the *Russell 2000* index would imply that the numerator component of the *market-to-book* is decreasing (or increasing less than others firms) since indexes are value-weighted, which is in line with the argument that firms with higher *market-to-book* ratios have more specialized debt.

Alternatively, one might be interested in understanding how such change reflects in the actual number of debt types that a firm can have. To shed light on how these effects can be translated in terms of the number of unique debt types (out of seven categories), Table 29 estimates Equation (5) using the number of different debt types that firm i has in period $t + 1$. As we results show, a one standard deviation in the (instrumentalized) level of passive ownership implies, on average, approximately 0.57 more debt type. From

Table 28 – Second-stage Results - Passive Ownership and Russell 1000/2000 Assignment

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018). The dependent variable, $HHI_{i,t+1}$, is the debt concentration index, as shown in equation (3), following (Colla; Ippolito; Li, 2013). $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>		
	HHI		
	(1)	(2)	(3)
$\widehat{Passive\%}$	-0.141* (0.084)	-0.144* (0.083)	-0.201** (0.093)
Year fixed effects	✓	✓	✓
Firm fixed effects	✓	✓	✓
Float	✓	✓	✓
Pol. Order	1 st	2 nd	3 rd
S.E Clustering	Firm	Firm	Firm
Observations	2,494	2,494	2,494
R ²	0.619	0.617	0.576
Adjusted R ²	0.468	0.465	0.408
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01		

these results, it seems that although there is a significant increase in the percentage of new debt structure types, firms are not completely changing their debt structure toward a more complex, multi-tiered debt structure. Rather, the change seems to be much more concentrated in a limited number of debt types, which is in line with the results presented in (Colla; Ippolito; Li, 2013) that most firms borrow predominantly from one type of debt, and thus have a tendency towards debt specialization.

3.6.1 Which types of debt are increasing?

The results from the previous tables highlight not only that the *Russell 1000/2000* index recalibration has the potential to exogenously increase passive ownership, but also that this variation induces firms to reduce their dependence on specific types of debt *ex-post* the influx of passive ownership. Now, I ask the question on whether such increase has to do with a specific type of debt, or it is widespread across all debt types present in my sample.

Table 31 presents the results of estimating Equation (5), where the dependent variable is the one plus the natural logarithm⁴ of the book value of $Debt_{i,s,t+1}$, where s is

⁴ To consider both intensive and extensive margins, I have considered the natural logarithm of one plus

Table 29 – Second-stage Results - Passive Ownership and number of debt types

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018). The dependent variable, $DebtTypes_{i,t+1}$, is the number of debt types presented in firm's i debt structure in period t . Debt structure types and categorization are defined following (Colla; Ippolito; Li, 2013). $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Dependent variable:		
	$DebtTypes_{i,t+1}$		
	(1)	(2)	(3)
$\widehat{Passive\%}$	0.423 (0.266)	0.443* (0.263)	0.568** (0.279)
Year fixed effects	✓	✓	✓
Float	✓	✓	✓
Pol. Order	1 st	2 nd	3 rd
S.E Clustering	Firm	Firm	Firm
Observations	2,916	2,916	2,916
R ²	0.788	0.787	0.776
Adjusted R ²	0.716	0.715	0.700
Residual Std. Error	0.728 (df = 2176)	0.730 (df = 2175)	0.748 (df = 2174)

Note:

* p<0.1; ** p<0.05; *** p<0.01

the specific type of debt in consideration, according to the definitions presented in (Colla; Ippolito; Li, 2013) and used throughout the analysis. Interestingly, not all types of debt are equally affected: while increases in passive ownership related to the index assignment do not seem to be related to increases in *Leases*, *Revolving Credit*, *Senior* and *Subordinate* bonds, passive ownership is positively related to increases in *Commercial Paper* and *Term Loans*.

More specifically, results show that firms are increasing *Commercial Paper* and *Term Loans* exposure after increases in passive ownership, which statistically significant effects that are also of economic relevance: a one-standard-deviation in the level of passive ownership translated in a 49% (112%) increase in the levels of *Commercial Paper* (*Term Loan*) after the recalibration period. While *Commercial Paper* is rarely adopted by firms (as presented in (Colla; Ippolito; Li, 2013)), *Term Loans* has gained share among the different debt types over time.

Interestingly, while *Commercial Paper* has shown to be predominantly adopted by high investment-grade firms, *Term Loans* is monotonically decreasing on credit ratings (Colla; Ippolito; Li, 2013). Together with the fact that most firms borrow predominantly from a specific type of debt, these results show that passive ownership has a significant effect on debt specialization for a wide spectrum of firms. In order to better understand this

the value of the debt.

Table 30 – Second-stage Results - Passive Ownership and Debt Structure Types

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018). The dependent variables, presented in columns 1-6, are the specific debt structure types present in firm's i debt structure in period t . Debt structure types and categorization are defined following (Colla; Ippolito; Li, 2013). $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>					
	log(<i>Commercial Paper</i>)	log(<i>Leases</i>)	log(<i>Revolving Credit</i>)	log(<i>Senior Bonds</i>)	log(<i>Sub. Bonds</i>)	log(<i>Term. Loans</i>)
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{Passive\%}$	0.434** (0.204)	-0.096 (0.390)	0.892 (0.544)	0.742 (0.553)	-0.085 (0.154)	1.125* (0.585)
Year fixed effects	✓	✓	✓	✓	✓	✓
Float	✓	✓	✓	✓	✓	✓
Pol. Order	3 rd	3 rd	3 rd	3 rd		
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Observations	2,938	2,938	2,938	2,938	2,916	2,938
R ²	0.600	0.757	0.661	0.728	0.647	0.662
Adjusted R ²	0.465	0.675	0.546	0.636	0.527	0.547
Residual Std. Error	0.625 (df = 2194)	1.194 (df = 2194)	1.666 (df = 2194)	1.694 (df = 2194)	0.476 (df = 2174)	1.791 (df = 2194)

Note: *p<0.1; **p<0.05; ***p<0.01

dynamic, Tables 32 and 33 re-estimate the equations presented in Table 31 for subsamples of firms with only one type and multiple types of debt *ex-ante* index recalibration, respectively. As results show, while there does not seem to have any relationship for firms that are borrowing from one type of debt, the results are entirely driven by the sub-sample of firms that adopted two or more types of debt *ex-ante* index recalibration. Not only the results for *Commercial Paper* and *Term Loans* are stronger in magnitude and statistically significance, these firms also show rely more on *Revolving Credit ex-post* increases in passive ownership.

3.6.2 Analyzing *ex-post* firm fundamentals

While the results from several debt types suggest that these changes are through debt structure composition, there is also the possibility such dynamics to be part of a broader channel that affects a wide range of firm fundamentals: if, for example, firms that are newly listed in the top positions of the *Russell 1000/2000* have more analyst coverage than others, which could be a potential explanation for firms being able to use multiple types of debt and do not require to provide enough incentives for a single monitor. On the other hand, if bad performance affected firms market capitalization, which in turn increased their probability of switching over to the *Russell 2000* index, then we would expect exogenous changes in passive ownership also to be related to firms' *ex-post* performance.

While I am not able to rule out the argument that analyst coverage is increasing along the threshold of my sample, (Appel; Gormley; Keim, 2018) shows that, if anything, this relationship is reverse: firms near the threshold that are not tracked anymore by the *Russell 1000* and are assigned to the *Russell 2000* show less analyst coverage relative to their counterparts. However, to the point that the documented changes are just part of a broader channel that is affecting several firms' fundamentals, I use the firms' identification codes to collect sample firms' fundamentals from *COMPUSTAT*. More specifically, I match my sample with *COMPUSTAT* figures based on firms' Ticker, SEDOL and CUSIP identifiers, collecting firm-year information regarding key target firm fundamentals, such as Cash-Flows, Assets, Profits, Short and Long-Term Debt, Dividends, and Leverage.

After applying all the filters regarding key financial indicators – *e.g.*, negative values for Assets, Debt ratios, Leverage, as well as negative/greater than one for PPE/Assets, Cash Holdings/Assets, etc – I winsorized all firms' financial variables on an yearly basis at the 1th and 99th percentiles. Table 33 shows the results of estimating Equation (5) on a wide set of firms' *ex-post* fundamentals at $t + 1$. Across all fundamentals, there is no evidence that increases in passive ownership stemming from *Russell 2000* assignment are related to changes in firms' fundamentals. These results do not align with the hypothesis that the changes observed in firms' debt structure are part of a broader channel that has impact on several fundamentals. In special, these results reinforce the argument in this

Table 31 – Second-stage Results - Passive Ownership and Debt Structure Types, only firms with one type of debt

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018), for the sub-sample of firms with only one type of debt, according to the debt structure categorization proposed by (Colla; Ippolito; Li, 2013). The dependent variables, presented in columns 1-6, are the specific debt structure types present in firm's i debt structure in period t . $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	Dependent variable:					
	log(Commercial Paper) (1)	log(Leases) (2)	log(Revolving Credit) (3)	log(Senior Bonds) (4)	log(Sub. Bonds) (5)	log(Term Loans) (6)
$\widehat{Passive\%}$	0.086 (0.470)	0.467 (1.208)	2.973 (2.147)	2.424 (1.755)	-0.018 (0.153)	-1.507 (1.583)
Year fixed effects	✓	✓	✓	✓	✓	✓
Float	✓	✓	✓	✓	✓	✓
Pol. Order	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Observations	1,161	1,161	1,161	1,161	1,160	1,161
R ²	0.468	0.745	0.317	0.485	0.920	0.600
Adjusted R ²	0.201	0.616	-0.027	0.226	0.880	0.400
Residual Std. Error	0.433 (df = 772)	1.113 (df = 772)	1.978 (df = 772)	1.617 (df = 772)	0.141 (df = 771)	1.458 (df = 772)

Note: * p<0.1; ** p<0.05; *** p<0.01

Table 32 – Second-stage Results - Passive Ownership and Debt Structure Types, only firms with multiple types of debt

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018), for the sub-sample of firms with only multiples types of debt, according to the debt structure categorization proposed by (Colla; Ippolito; Li, 2013). The dependent variables, presented in columns 1-6, are the specific debt structure types present in firm's i debt structure in period t . $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>					
	log(<i>Commercial Paper</i>) (1)	log(<i>Leases</i>) (2)	log(<i>Revolving Credit</i>) (3)	log(<i>Senior Bonds</i>) (4)	log(<i>Sub. Bonds</i>) (5)	log(<i>Term Loans</i>) (6)
$\widehat{Passive\%}$	0.557** (0.266)	-0.378 (0.435)	1.321** (0.659)	-0.168 (0.655)	-0.285 (0.224)	1.575** (0.737)
Year fixed effects	✓	✓	✓	✓	✓	✓
Float	✓	✓	✓	✓	✓	✓
Pol. Order	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Observations	1,754	1,754	1,754	1,754	1,753	1,754
R ²	0.649	0.788	0.622	0.748	0.604	0.623
Adjusted R ²	0.495	0.696	0.457	0.638	0.431	0.457
Residual Std. Error (df = 1219)	0.730	1.195	1.811	1.800	0.615	2.025

Note: *p<0.1; ** p<0.05; ***p<0.01

study that passive ownership has a direct impact on firms' debt structure.

3.6.3 Which firms reduce debt specialization?

As a final piece of evidence on the effects of passive ownership on debt structure, I ask whether decreases in debt specialization vary across different sizes of firms. For example, bigger firms may benefit from a wider set of debt structure options that smaller firms are not allowed to (or do so only at prohibitively high costs). Furthermore, smaller firms may need to concentrate their debt structure on types so as to ensure enough incentives for debtors to monitor its performance.

To analyze these points, Table 34 provides estimates similar to Table 28 for different sizes of firms based on the terciles of the year distribution of Total Assets. Interestingly, all of the reduction in debt concentration comes from firms in the lower tercile of the distribution of assets – *i.e.*, smaller firms⁵.

This result provides a more clear picture of how debt structure dynamics take place after increases in passive ownership: not only the fact that only smaller firms are reducing debt specialization, these firms are increasing their exposure to *Commercial Papers*, *Term Loans*, and *Revolving Credit*. Relatedly, evidence presented in (Colla; Ippolito; Li, 2013) shows that, in terms of credit quality, debt specialization varies in a nonmonotonic fashion (excluding firms with ratings lower than CCC+), with firms with highest/lowest grades (A and BBB) showing higher debt specialization, and firms in the middle of the rating spectrum (A and BBB) leaning towards a multi-tiered debt structure. Taken together, smaller firms, which tend to have lower credit ratings, are exactly the ones to reduce its debt structure concentration after exogenous increases in passive ownership, which can indicate that a higher degree of passive ownership can unlock different debt structure types that wouldn't otherwise be feasible.

3.7 Potential mechanisms and relationship with the previous literature

Prior literature on debt specialization has discussed potential explanations for the stylized facts that i) within-firm debt structure is persistent over time; and ii) debt structure is substantially heterogeneous across firms. Although the results presented in Section 3.6 are merely exploratory of the potential mechanisms that could be driving debt structure changes through the passive ownership channel, in this final section, I discuss how these results relate to the hypotheses highlighted in the debt structure literature.

⁵ The changes in the sample size reflect the fact that it was not possible to match all observations with *COMPUSTAT*, which provides the information on Total Assets to create the terciles classifications.

Table 33 – Second-stage Results - Passive Ownership and Firms’ Fundamentals

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018), according to the debt structure categorization proposed by (Colla; Ippolito; Li, 2013). The dependent variables, presented in columns 1-6, are the different firms’ fundamentals at period $t + 1$. *Assets* is defined as the firms’ book value of total assets, and it is estimated in the natural logarithm format. *Cash Holdings* is defined as the ratio of cash, cash equivalents and short-term financial instruments to Total Assets. *Leverage* is defined as Total Debt divided by Total Equity. *Cash Flow* is defined as the ratio of firms’ Cash Flow to Total Assets. *LT Debt (%)* is the ratio of Long-Term Debt relative to Total Assets, and *ST Debt (%)* is defined as the ratio of Dividends Paid to Total Assets. the *Passive%* is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1^{st} , 2^{nd} , and 3^{rd} order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, ***, denote statistical significance at 10, 5, and 1 percent, respectively.

	Dependent variable:							
	log(Assets) (1)	Cash Holdings (%) (2)	PPE (%) (3)	Leverage (4)	Cash Flow (%) (5)	LT Debt (%) (6)	ST Debt (%) (7)	Div (%) (8)
Passive %	-0.180 (0.124)	-0.015 (0.016)	0.026 (0.027)	-0.827 (0.755)	0.005 (0.020)	0.004 (0.050)	-0.004 (0.050)	-0.089 (0.067)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Float	✓	✓	✓	✓	✓	✓	✓	✓
Pol. Order	3^{rd}	3^{rd}	3^{rd}	3^{rd}	3^{rd}	3^{rd}	3^{rd}	3^{rd}
S.E Clustering	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,744
R ²	0.968	0.927	0.978	0.486	0.361	0.631	0.631	0.601
Adjusted R ²	0.958	0.903	0.971	0.318	0.152	0.510	0.510	0.471
Residual Std. Error	0.203 (df = 1320)	0.046 (df = 1320)	0.038 (df = 1320)	2.026 (df = 1320)	0.061 (df = 1320)	0.140 (df = 1320)	0.140 (df = 1320)	0.154 (df = 1313)

Note: * p<0.1; ** p<0.05; *** p<0.01

Table 34 – Second-stage Results - Passive Ownership and Debt Structure Types - Varying on Asset Terciles

This table presents the estimates of the second-stage results, presented in Equation (5), and described in Section 3.5, following (Appel; Gormley; Keim, 2018), according to the terciles of the distribution of Total Assets, defined on an yearly basis. The dependent variable, $\widehat{HHI}_{i,t+1}$, is the debt concentration index, as shown in equation (3), following (Colla; Ippolito; Li, 2013). $\widehat{Passive\%}$ is the (instrumentalized) percentage of shares held by passive investors relative to the total. The specification includes year and firm fixed effects and Float-Adjusted Market Capitalization as controls, as well as 1st, 2nd, and 3rd order polynomials for $MktCap_{i,t}$. Standard errors (clustered at the firm-level) are in parenthesis. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

	<i>Dependent variable:</i>		
	1 st	$\widehat{HHI}_{i,t+1}$ 2 nd	3 rd
	(1)	(2)	(3)
$\widehat{Passive\%}$	-0.202** (0.092)	0.109 (0.187)	-0.131 (0.243)
Year fixed effects	✓	✓	✓
Float	✓	✓	✓
Pol. Order	3 rd	3 rd	3 rd
S.E Clustering	Firm	Firm	Firm
Observations	520	559	507
R ²	0.686	0.693	0.609
Adjusted R ²	0.489	0.528	0.445
Residual Std. Error	0.195 (df = 319)	0.190 (df = 363)	0.208 (df = 357)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01		

First and foremost, there is a growing literature that states that passive investors are, in reality, active shareholders of the firm. With the rise of proxy voting advisory firms, such as *ISS (Institutional Shareholder Services)* and *Glass-Lewis*, although passive institutional investors have the duty to accurately track the index components, they can rely on proxy advisory firms to proxy their voting shares to active shareholders of the firm. As the size of the passive ownership stake gets more significant (as a percentage of the firm's total shares), monitoring and coordination costs decrease for active shareholders, which can proxy passive investor's votes in their favor to shape corporate policies where otherwise the benefits of such intervention would not offset the agency costs. (Fisch; Hamdani; Solomon, 2018).

Active shareholders, on the other hand, have not only the "voice" but also the "exit" option – see (Edmans, 2014), where a credible threat of exit on the basis of private information can alleviate conflicts of interest between managers and shareholders – also referred to as the *Wall Street walk* (Admati; Pfleiderer, 2009). All in all, the exploratory results presented earlier are in line with the monitoring hypothesis, highlighted in the prior literature on debt specialization, that firms choose their debt structure so as to alleviate monitoring and information collection costs. As conjectured in (Colla; Ippolito; Li, 2013), more opaque firms, with high monitoring and information collection costs and facing

information asymmetry should have a more concentrated debt structure. As our results are entirely driven by smaller firms, which tend to be more opaque, the results presented herein can be supportive of passive ownership reducing information collection costs and, as a consequence, making debt diversification more likely.

Additionally, our results are aligned with the argument that firms have constrained access to some debt segments, and that debt structure reflects the optimal decision conditional on the debt structure types available. As sophisticated investors, institutional ownership can help overcome this issue by means of a lower coordination cost and an increase in the returns to monitoring – see, for example, (Shleifer; Vishny, 1986; Yang, 2021)).

Finally, regarding the hypothesis that debt structure is chosen as to balance bankruptcy costs and liquidation value, previous literature has conjectured that firms with higher expected bankruptcy costs should be more specialized in their borrowing so as to reduce the renegotiation costs associated with multiple lenders. As in (Colla; Ippolito; Li, 2013), which follows (Rajan; Zingales, 1995) and (Titman; Wessels, 1988) and considers Tangibility and Cash-Flow volatility as two measures of expected bankruptcy costs, I use these two measures and perform two ANOVA tests to verify whether there are significant differences across the quintiles of the $HHI_{i,t}$, and I find a positive and statistically significant relationship in both cases – *i.e.*, for my regression sample, debt specialization is also increasing in Tangibility and Cash-Flow volatility, which also provides evidence for the hypothesis.

Overall, although the analysis of the second-stage results should be considered exploratory, they do provide evidence in favor of the three hypothesis previously highlighted in the literature.

3.8 Conclusions and directions for future research

The fact that debt structure has presented substantial variability both in the cross-section and the time series provides a standpoint that shed criticism regarding the implications of any capital structure studies that treat debt as uniform. Interestingly, the study of debt structure - as opposed to the previous capital structure discussion - sheds light on the possible agency and informational problems faced by firms in their funding decisions (Rauh; Sufi, 2010), and gained attention in literature in the recent years. Although some hypothesis have been outlined in the literature so as to understand why within-firm debt structure is persistent, but largely heterogeneous across firms, there is still few empirical evidence to shed light on the potential determinants of debt structure decisions.

This study provides evidence that passive ownership can effectively affect financing

decisions – and, in special, debt decisions. In this sense, this study contributes to the growing literature on debt structure as it provides evidence that passive institutional investors can affect firms' debt structure decisions. Overall, the results show not only that debt specialization decreases 29% given a one standard deviation increase the passive ownership due to shifts in the the *Russell 1000/2000* assignment, but that this shift is heterogeneous across debt types, is entirely driven by smaller firms, and is not related to any other changes in firms' *ex-post* fundamentals. Although exploratory, the results show evidence in favor of the hypothesis previously highlighted in the literature on the determinants of debt structure.

All in all, capital structure (and ultimately debt structure) still remains a puzzle among corporate finance academics. By seeking to understand the changing nature of debt structure presented by U.S firms during the recent years, the insights presented in this paper can enhance our understanding of the mechanisms behind the firms' financing choices – in special, the choice between the different types of debt that a firm can have in place.

Conclusion

This thesis makes three distinct contributions to the field of Corporate Finance.

In the first chapter, we contribute by showing that M&As can work as leeway to relieve financing frictions in periods when credit supply frictions are more prevalent. Although much has been discussed in the prior literature about the adverse effects of credit supply shocks on firms' investments, less is known about how and why firms can actually withstand such shocks. To that matter, our results provide empirical evidence that M&A transactions can serve as leeway for financially constrained to smooth out negative credit supply shocks during (and after) banking crisis periods by means of increasing access to international financial markets that were not *ex-ante* explored.

With regards to the second chapter of this thesis, despite the relevance of the Brazilian healthcare industry, there is still no empirical assessment of the introduction of a capital requirements rules. To that matter, I fill this gap by showing that not only firms more exposed to the capital requirement rule grew their customer base less than their counterparts, but also that this effect is mainly concentrated in the subsample of non health cooperatives, and does not dissipate over a short period of time. Furthermore, when it comes to firm-level prospects, I show that this higher exposure also affects firms' future financial fundamentals, firms' likelihood of being delisted, and is negatively correlated with changes in the median price levels for customer healthcare plans. Finally, I also show that this differential exposure also passes through local markets, being capable of shifting aggregate industry fundamentals.

Finally, the third chapter shows evidence that passive ownership can effectively affect financing decisions – and, in special, debt decisions, contributing to the growing literature on debt structure as it provides evidence that passive institutional investors can affect firms' debt structure decisions. Overall, the results show not only that debt specialization decreases 29% given a one standard deviation increase the passive ownership due to shifts in the the *Russell 1000/2000* assignment, but that this shift is heterogeneous across debt types, is entirely driven by smaller firms, and is not related to any other changes in firms' *ex-post* fundamentals. Although exploratory, the results show evidence in favor of the hypothesis previously highlighted in the literature on the determinants of debt structure. All in all, capital structure (and ultimately debt structure) still remains a puzzle among corporate finance academics. By seeking to understand the changing nature of debt structure presented by U.S firms during the recent years, the insights presented in this third chapter can enhance our understanding of the mechanisms behind the firms' financing choices – in special, the choice between the different types of debt that a firm

can have in place.

All in all, the three chapters of this thesis shed light on different research questions seeking to enhance the understanding of market frictions and its relationship with corporate finance decisions.

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