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Accounting standards setting and regulatory capital arbitrage

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ACCOUNTING STANDARDS SETTING AND REGULATORY CAPITAL ARBITRAGE

by

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BIOGRAPHICAL NOTE

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In 2019 he took part in an institutional program of Central Bank of Brazil that provides scholarships to some employees to obtain a graduate degree while developing research of Central Bank of Brazil's interest. In this context, Cleber enrolled in the Master's in Accounting and Management Control at Faculdade de Economia da Universidade do Porto (FEP/UP) for the academic year of 2019/2020. Nevertheless, having higher ambitions, in the next year he applied and was accepted to the Doctoral program in Business and Management Studies, with specialization in Accounting and Management Control. Since then, he joined the class of 2020/2021 PhD students in this University.

As part of his academic journey, Cleber presented the first paper of this thesis in the European Accounting Association (EAA) Annual Conference that happened in Espoo/Finland, in May of 2023. Moreover, he discussed the paper in the Northernseam Seminar Day in Economics and Management organized by the Research Centre in Management and Economics (CEGE) in Porto, in February of the same year. Previously, Cleber shared his investigation with the students of the FEP/UP Master's in Finance in December of 2022, as a guest lecturer in a Seminar's class.

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ABSTRACT

This thesis delves into regulatory capital arbitrage (RCA) practice within the banking sector, focusing on how financial institutions exploit regulatory and accounting standards to circumvent minimum capital requirements. Banks can leverage accounting standards gaps using accounting-based inputs to meet regulatory capital requirements creatively. These RCA strategies enable banks to conceal risks, falsely suggesting they have sufficient capital buffers to withstand financial turmoil.

This research comprises three empirical studies on RCA methods. The first paper investigates the practice of RCA through shadow banking and the effects of a new consolidated accounting statements framework developed to prevent it. The second paper examines the use of loan loss provisions (LLP) discretion to influence the capital adequacy ratio (CAR) under different accounting standards. The last paper researches the use of fair-value estimates to manipulate the CAR and how recent changes in Basel III might have influenced the practice.

At a glance, findings from this thesis reveal that: (i) expanding financial conglomerates' consolidation scope effectively counters shadow banking and improves the capitalization levels without adversely affecting credit supply; (ii) banks facing capital shortage reduce discretionary LLP to avoid a regulatory violation, but enhanced governance, market oversight and ownership type can mitigate the practice; and (iii) banks nearing minimum capital ratios resort to greater discretion in fair-valued financial instrument estimates to perform RCA, but Basel III regulatory updates influenced to moderate the practice.

The study contributes to the academic literature on accounting standards setting and banking regulation by offering empirical evidence on the prevalence and patterns of RCA. It also provides practical implications for regulators, suggesting that a dynamic regulatory framework is essential to counteract arbitrage practices, fostering a more stable and resilient financial system.

RESUMO

Esta tese investiga a prática de arbitragem de capital regulatório (RCA) no setor bancário, focando em como as instituições financeiras exploram normas regulatórias e contabilísticas para contornar os requisitos mínimos de capital. Os bancos exploram lacunas nos normativos contabilísticos para atender de forma criativa aos requisitos de capital regulatório. Essas estratégias de RCA permitem que os bancos ocultem riscos, sugerindo falsamente que possuem reservas de capital suficientes para suportar turbulências financeiras.

Esta pesquisa contempla três estudos empíricos sobre métodos de RCA. O primeiro artigo investiga a prática de RCA por meio do shadow banking e os efeitos de um novo regulamento de demonstrações contabilísticas consolidadas desenvolvido para preveni-lo. O segundo artigo examina o uso da subjetividade nas Provisões para Perdas em Empréstimos (LLP) para influenciar o rácio de capital regulatório (CAR), sob diferentes padrões contabilísticos. O último artigo pesquisa o uso das estimativas de valor justo para manipular o CAR e como mudanças recentes no acordo de Basileia III podem ter influenciado a prática.

Em resumo, os achados desta tese revelam que: (i) expandir o escopo de consolidação dos conglomerados financeiros combate efetivamente o shadow banking e melhora os níveis de capitalização sem afetar negativamente a oferta de crédito; (ii) bancos com escassez de capital reduzem a LLP discricionária para evitar violações regulatórias, mas uma governança aprimorada, supervisão de mercado e o tipo de controle podem mitigar a prática; e (iii) bancos com rácios mais próximos aos mínimo recorrem a maior subjetividade nas estimativas de valor justo dos instrumentos financeiros para realizar RCA, mas as atualizações regulatórias de Basileia III moderaram a prática.

O estudo contribui para a literatura acadêmica sobre definição de padrões contábeis e regulação bancária, oferecendo evidências empíricas sobre a prevalência e os padrões de RCA. Também fornece implicações práticas para reguladores, sugerindo que um ambiente regulatório dinâmico é essencial para combater práticas de arbitragem, promovendo um sistema financeiro mais estável e resiliente.

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ABBREVIATIONS

2-SLS	2-Stage Least Squares
AFS	Available for Sale
ALL	Allowances for Loan Losses
AOCI	Accumulated Other Comprehensive Income
ASC	Accounting Standards Codification
BCB	Banco Central do Brasil
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BRGAAP	Brazilian Generally Accepted Accounting Principles
BRL	Brazilian Reais
CAR	Capital Adequacy Ratio
CMN	Conselho Monetário Nacional
EAA	European Accounting Association
EBA	European Banking Authority
EBT	Earnings Before Taxes
EBTP	Earnings Before Taxes and Provisions
EMBI	Emerging Markets Bond Index
EPU	Economic Policy Uncertainty
EU	European Union
EUI	Economic Uncertainty Index
EUROFIDAI	European Financial Data Institute
FAS	Financial Accounting Standards
FASB	Financial Accounting Standards Board
FE	Fixed Effects
FSB	Financial Stability Board
FVA	Fair-value Accounting
GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HFT	Held for Trading

HTM	Held to Maturity
IAS	International Accounting Standard
IASB	International Accounting Standard Board
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
IPCA	Índice de Preços ao Consumidor Amplo
IPEA	Instituto de Pesquisas Econômicas Aplicadas
LLP	Loan Loss Provision
LWO	Loans Write-offs
NPL	Non-performing Loans
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
OTC	Over-the-counter
RC	Regulatory Capital
RCA	Regulatory Capital Arbitrage
RCAP	Regulatory Consistency Assessment Programme
ROE	Return on Equity
RTS	Regulatory Technical Standards
RWA	Risk-weighted Assets
SD	Standard Deviation
SFAS	Statements of Financial Accounting Standards
US	United States
USD	United States Dollars

INTRODUCTION

Barth et al. (2013) wrote that motivating an investigation of bank regulation is easy because banks matter for human welfare, influencing economic growth, poverty, entrepreneurship, and the labor market. Moreover, the banking crisis of the twentieth century evidenced weaknesses in bank regulation and supervision (J. Barth et al., 2006). Therefore, investigating bank regulatory and supervisory policies is often a subject of interest for academia and society.

It is hard to escape from the accounting field when researching bank regulation because the supervisory process relies on accounting outputs to monitor banks' risks. Furthermore, prior research has related some procyclical accounting rules to the exacerbation of financial crises (Beatty & Liao, 2014). For these reasons, bank accounting has been the focus of significant academic studies, particularly after the 2008 financial crisis.

Despite the extensive literature, the market's dynamic results in an action-reaction game between banks and regulators, providing a prolific field for new research opportunities. For example, even when banks meet with regulators' determinations following new regulations, they can fail regulators' expectations, exploring regulatory gamesmanship known in the literature as Regulatory Arbitrage. Fleischer (2010, p. 227) defines it as "the practice to take advantage of a gap between the economics of a deal and its regulatory treatment, restructuring the deal to reduce or avoid regulatory costs without unduly altering the underlying economics of the deal." In the presence of regulatory arbitrage, banks can undermine the spirit of a regulatory initiative while complying with it, reducing its effectiveness and often leading to a second round of intervention to "close the loophole" (Fleischer, 2010, p. 229). Gerding (2016) calls this dynamic a "dialectical co-evolution", referring to the fact that every attempt to set new regulatory requirements historically resulted in new forms of arbitrage.

The accounting field is a resourceful arena for banks to engage in Regulatory Arbitrage due to the subjectivity of accounting codes, particularly in the principle-based accounting frameworks. Therefore, this research expects to enlighten how banks explore some accounting standards to do regulatory arbitrage and how accounting can help

regulators identify them. The focus will be a type of Regulatory Arbitrage known as Regulatory Capital Arbitrage (RCA). Jones (2000) defines RCA as a process through which banks substantially reduce their regulatory capital measures in risk, with little or no corresponding reduction in their overall economic risks. RCA is typically done by exploiting regulatory shortcomings that allow banks to artificially increase capital measures in the Capital Adequacy Ratio¹ (CAR) numerator or reduce the risk measures in the denominator.

This investigation will seek to uncover evidence of RCA by assessing the relationship between banks' regulatory indicators and their determinants, when influenced by accounting rules. The theoretical background on which our thesis builds is the Positive Accounting Theory, and more specifically, the Theory of Accounting Choices (Watts & Zimmerman, 1986). In sum, the Theory of Accounting Choices focuses on the factors influencing management's decisions regarding accounting standards and choices. These factors include tax planning, management compensation, bookkeeping costs, political costs and, particularly, regulation. Regarding the last, the theory predicts that managers adapt their choices to comply with legal requirements.

Concerning RCA, in particular, the accounting choices made by bank managers seek to comply with the minimum requirements regarding the regulatory capital, while keeping the lowest possible costs. This is because banks perceive capital requirements as a regulatory tax, because it forces the banks to maintain more capital than they would like to when solely subject to market discipline (Gerding, 2016; Jones, 2000). Moreover, government guarantees provide a strong incentive for financial institutions to prefer to fund their activities with debt instead of equity. Gerding (2016) explains that, by offering to bail out a bank's creditors, these guarantees make debt relatively cheap. Therefore, with the arbitrage, bank managers will look for the accounting choice that better helps the bank to meet the requirements with the minimum cost.

The thesis comprehends three empirical studies that investigate the accounting choices resulting in the most common RCA strategies according to Jones (2000): 1) the reduction of risk-weighted assets by taking off-balance-sheet exposures; and the

¹ The Capital Adequacy Ratio (CAR) is a measurement of a bank's available capital expressed as a percentage of a bank's exposures. It is used by bank supervisors to monitor a bank's loss absorption capacity and is calculated by dividing a bank's regulatory capital by its risk-weighted assets. (Hayes, 2020)

increment of regulatory capital by discretionary accounting choices regarding 2) loan loss provisioning and 3) fair-value estimates.

With our research, we primarily contribute to three currently open debates in the bank accounting literature. Initially, the first study will investigate the RCA practice in Brazil by operating through unconsolidated entities. It will benefit from a novel Brazilian standard for consolidated financial statements, introduced in the context of the Basel III convergence (BCB, 2013). Conventionally, banks have to elaborate a set of consolidated financial statements following specific regulatory rules different from the regular GAAP. The main difference is that the conglomerate derived from the regulatory rule usually encompasses only financial entities. In contrast, the general rule of IFRS requires the parent entity to consolidate all controlled entities. This difference happens because the regulators' interests in the accounting reports differ from those of other users, and including non-financial firms can confound the regulator's supervision.

However, operating through shadow banks² can undermine the regulator's efforts because those entities are neither regulated nor monitored, and the regulatory capital does not cover their risks. Therefore, the new framework extended the consolidation perimeter, requiring banks to include their controlled shadow entities under the same conglomerate, impacting the regulatory capital calculation. This reform expanded the consolidation scope and approximated the regulatory rule to the international standard while allegedly strengthening the system's soundness. This investigation will explore this event to identify if banks were engaging in RCA prior to the norm and the changes in banks' indicators under the new regime. There are two aspects of interest. Firstly, to verify if the system's soundness increased (capitalization level) after the new rule, meeting the regulator's expectation. Secondly, to check if that initiative impacted the credit supply, since imposing more restrictive capital adequacy rules can force banks to lower or hold their exposures to not violate the minimum capital ratios (Bernanke & Lown, 1991).

We do not know studies dealing with prudential consolidation to deal with the shadow banking issue. Prior research reports ad-hoc solutions for dealing with it by demanding banks to identify and ensure sufficient capital for shadow banks, but these are

² Formally, which firms are considered shadow banks will depend on the country's Central Bank jurisdiction. However, the Financial Stability Board (FSB) defines shadow banking as "credit intermediation involving entities and activities (fully or partially) outside the regular banking system" (FSB, 2017)

off-balance sheet initiatives (Usoskin, 2019). Our study will close this gap by investigating, for the first time, a new accounting rule that changes how banks produce and disclose full financial statements, intending to mitigate RCA through shadow banking. We aim to understand how the soundness of the financial system is affected when the shadow banking channel is blocked with the scope extension brought by the prudential consolidation rules, and if this affects the bank credit offering. To achieve this objective, the first paper will answer the following research question:

RQ1: Do the extension of the bank's consolidation perimeter to prevent shadow banking enhances the financial system soundness? Does it cause undesired social costs by reducing credit intermediation?

The second study is about the discretionary use of Loan Loss Provisions (LLP) for RCA and how the bank's characteristics influence the practice. Prior literature shows that bank managers can use discretionary LLP to influence the CAR (Ahmed et al., 1999; Moyer, 1990). However, changes in regulation across time and local characteristics can affect bank managers' incentives to use LLP for RCA purposes, requiring caution in extending previous conclusions in different contexts.

More recent studies revisited the subject and found mixed results. Leventis et al. (2011) and Pérez et al. (2008) did not find a significant relationship, while Bouvatier & Lepetit (2008), Kim & Kross (1998) and Kund & Neitzert (2020) found that banks with lower regulatory capital make less LLP. Notably, different methodological approaches were employed to analyze the relationship between LLP and regulatory capital, potentially explaining the divergent findings. For instance, while Kim & Kross (1998), Kund & Neitzert (2020), and Leventis et al. (2011) did not differentiate between discretionary and non-discretionary components of LLP in their research design, Bouvatier & Lepetit (2008) and Pérez et al. (2008) proposed models to segregate discretionary LLP, albeit with contradictory outcomes.

Thus, this study aims to fill the research gap by employing a two-step method to segregate the discretionary part of the total LLP and verify its relationship with the bank's CAR. Moreover, we incorporated bank-specific control variables in line with previous research emphasizing the significance of firm-specific attributes in accounting discretion

(Bratten et al., 2020; Irani & Oesch, 2013; Menon & Williams, 2004). Our objective was to explore whether the association between discretionary LLP and the CAR exhibits a linear pattern or if it is contingent upon specific characteristics. These characteristics include the quality of corporate governance, external oversight mechanisms, and the type of ownership. Additionally, we leveraged a unique aspect of Brazilian legislation, which mandates that a subset of banks publish full financial statements in local and international accounting standards. By doing so, we investigated whether the observed relationship between LLP and CAR persists when applying international standards instead of the local GAAP.

We aim to extend the literature by applying a different methodological approach to a new research design to help us solve previous divergences. Furthermore, we contribute to the discussions on accounting standards convergence by exploring the research problem under different accounting standards. To accomplish these contributions, the second paper will answer the following research question:

RQ2: Do banks use discretionary LLP for RCA? What characteristics of banks influences this use? Does the accounting standard influence this practice?

The last study will investigate the opportunistic use of fair value measurements in RCA and the role of external oversight in mitigating it. Previous studies associated the greater use of discretion of Level 3 fair value estimates with regulatory capital constraints, and enhanced corporate governance and market pressure can inhibit it (Glaser et al., 2013; Yao et al., 2018). It suggests that bank managers can use discretion in Level 3 estimates for RCA. However, the literature on emerging markets context is scarce and has only exploratory studies (Moura & Dantas, 2015; Oliveira et al., 2021). Studying these markets is important because of the rules concerning fair value estimates in IFRS 13. The standard relies strongly on an active and public market to reach the best fair value estimate of financial instruments (Peng & Bewley, 2010). Unlike developed countries, emerging economies can lack this premise, depending on their capital market's development level.

Moreover, no studies have been conducted on the subject since an important regulatory change happened in 2013. Prior to the Basel III amendments, there was a rule that excluded fair-value gains and losses of Available for Sale (AFS) assets registered

under the Accumulated Other Comprehensive Income (AOCI) account from the regulatory capital calculation (a.k.a. “AOCI prudential filter”). This feature shielded the bank’s capital from fair value oscillations, but it also encouraged managers to take on excessive risks, and it was removed after 2012. Since then, all gains and losses coming from AFS instruments have impacted the regulatory capital. This is relevant because it changes the incentives that banks have to do RCA by incorporating an instrument that previously had no impact on a bank’s capital into the regulatory ratios calculation. Therefore, to the best of our knowledge, this study is the first to investigate whether the findings of prior studies remain after the AOCI prudential filter removal and what effect it has had in the RCA practice. In sum, the contributions of the last paper will be granted by answering the research question below:

RQ3: Do banks use discretion in fair-value estimates for RCA? Does external oversight influence the practice? Do the changes in regulatory accounting rules after Basel III changes this behavior?

To develop our empirical work, we focus on the Brazilian financial system. Several reasons justify the choice. First, the Brazilian financial system is the largest banking industry in Latin America and one of the largest worldwide (The World Bank, 2021). It also has four top 100 biggest banks globally (S&P Global, 2020) and the first five in Latin America (S&P Global, 2021).

Moreover, Brazil is one of the few countries with a relevant market size that fits as an "early adopter" of the Basel recommendations, according to the last Regulatory Consistency Assessment Program (RCAP) (BCBS, 2013). Therefore, the Brazilian financial system can provide empirical data to evaluate public policies that interest policymakers. Furthermore, even though the BRGAAP is similar to the standards of other countries, some of the Brazilian regulatory initiatives in accounting are unique (e.g., the prudential consolidation rule and the loan loss provisioning model). Thus, this study can also contribute to the literature on alternative accounting standards and the debate on the convergence of accounting standards.

The rest of this document is as follows. Chapter 1 presents the first paper, "Preventing shadow banking and regulatory capital arbitrage through accounting

regulation, " regarding how implementing a new accounting consolidation rule strengthened the financial system by preventing the RCA through shadow banking. The second paper, "Loan Loss Provisions and Regulatory Capital Arbitrage under different accounting standards" is featured in Chapter 2 and focuses on the use of discretionary LLP to influence the bank's capital adequacy ratio, the bank's characteristics that influence the practice, and the differences between the national and the international standard. Chapter 3 depicts the third paper, "Uncovering regulatory capital arbitrage within IFRS 13 rules", which addresses the opportunistic use of fair value discretion in the valuation of financial instruments intended to do RCA, and how Basel III regulatory changes impact the practice. In the last section, we summarize each paper's findings and the thesis's general conclusion.

CHAPTER 1

Preventing shadow banking and regulatory capital arbitrage through accounting regulation

1.1. Introduction

Since the 1988 Basel Accord (BCBS, 1988), the banking industry has adopted a capital-based framework to regulate and monitor the risks that banking activity presents to society. In the last decades, the accord passed through several revisions and amendments, strengthening the rules, and making the capital requirements stricter, impacting the bank management decisions and, consequently, the business itself. As with other regulatory impositions, a consequence of demanding banks to comply with minimum capital standards is their search for solutions to avoid regulatory costs, a practice called Regulatory Capital Arbitrage (RCA) (Jones, 2000).

A common alternative found by the banks to arbitrage with the imposed minimum capital is to transfer part of their operations to controlled entities outside the financial system that does not fall into the central banks' jurisdiction and, therefore, have lower (to none) regulatory costs. This practice became known as *shadow banking*, as these institutions act similarly to banks without formally belonging to the banking system (FSB, 2017). However, the growth of shadow banking challenges the regulators as it conceals the risks of the regulated financial system by keeping operations out of their legal jurisdiction. Moreover, since the shadow banks do not follow strict capital rules, they have a lower capacity to resist adverse events and can threaten the main banking system through contagion. That has been one great concern of the international regulatory forums, and bank authorities have been taking measures to prevent it (FSB, 2013, 2017).

This study investigates the Brazilian initiative to mitigate the shadow banking practice by introducing a new regulatory accounting standard for consolidated statements. The new rule extended the consolidation perimeter requiring the banks to incorporate the risks of shadow entities under their control into the minimum regulatory capital calculation. The proposal aimed to strengthen the financial system's resilience to shocks

by setting stricter capital requirements but increasing the regulatory costs that may cause undesired side effects, the most threatening, a reduction in the credit supply (Bernanke & Lown, 1991; Chiuri et al., 2002; Mésonnier & Monks, 2014; Nguyen et al., 2020). In attempting to understand and evaluate the regulatory intervention, this study estimated the effect of the new standard on the bank's capitalization level, measured by the Capital Adequacy Ratio (CAR), as well as the changes in the credit supply, measured by the relative participation of Credit Assets in Total Assets in the bank's portfolio composition.

This paper adds novel empirical evidence to the literature on regulatory arbitrage, regulatory accounting standard setting, and shadow banking. The results showed that, on the one hand, after the issuance of the accounting norm, the affected banks had an impact on their CAR levels, presenting a relevant increment relative to their counterparts that were not engaging in shadow banking activities. This is consistent with the capital buffering and risk aversion theory which argues that banks, particularly the low capitalized, tend to increase their capital buffers following a regulatory intervention to avoid the regulator's interference and the risk of a violation (Pereira & Saito, 2015). On the other hand, the credit-to-assets ratio did not have a significative change. It suggests that the capital restriction did not impact the bank's credit supply, in line with Rime (2001) and Stolz (2007). They showed that banks adjust capital faster than the risk in the face of added regulatory pressure, the low-capitalized ones even more pronounced. The evidence supports the efficiency of the regulatory initiative in that it strengthened the banking system's capital levels without impacting the actual economy by restricting credit intermediation. Even though the results are particular to the sample used in the estimations, the Brazilian regulatory framework is highly adherent to the Basel standards, and the banks are very integrated with the international financial community. Therefore, it can provide important insights to regulators and policy makers of other jurisdictions.

The rest of the document is divided as follows. Section 1.2 provides a literature review of capital requirements, RCA, and shadow banking and how the Central Bank of Brazil dealt with the matter by issuing a new regulatory accounting standard. Moreover, it presents the theoretical framework for constructing the paper's hypotheses. Section 1.3 describes the data and sampling procedures used in the empirical analysis. Section 1.4 details the methodology. Section 1.5 presents and interprets the results of the regressions. Finally, section 1.6 concludes and suggests future research possibilities.

1.2. Literature review and hypotheses development

The literature review discusses the role of regulatory capital in banking regulation and how RCA emerges as a consequence of minimum capital requirements. Next, it analyzes how banks operate RCA through shadow banking and presents the new Consolidated Accounting Statements standard, the Brazilian regulatory initiative to prevent RCA. The last part discusses the impacts of the norm and constructs the hypotheses.

1.2.1. Banking regulation and the role of regulatory capital

An important underlying assumption when researching bank regulation is that banks *need* to be regulated and supervised. The literature presents several perspectives regarding why the existence of regulation is necessary, always directly or indirectly related to the information asymmetry between banks and depositors (Beatty & Liao, 2014). In short, the investors' inability or incapacity to assess banks' risks blocks the funding channel between society's savings and investments. Therefore, investors' risk aversion would undermine the foundations of the banking intermediation system. Banking regulation resolves this agency problem by restoring depositors' trust, constraining banks to operate within allegedly safe policies and standardized frameworks. Moreover, once accountancy is the "language of business," setting accounting standards and defining requirements for financial and non-financial reporting becomes one of the preferred regulators' means to such ends.

The regulatory proposals commonly deal with measures to increase the soundness of the financial system by legislating in matters such as provision cushioning or transparency enhancement. However, capital adequacy has been longstanding regarded as the key element for it (Burhouse et al., 2003) and the first line of defense for protecting banks' stakeholders (Calomiris & Mason, 2004). Berger et al. (1995) explain that regulatory capital requirements are motivated by two main concerns. First, to mitigate the potential market indiscipline induced by the safety net in which banks operate. Unlike other industries, several precautions surround the banking system to prevent failures, the most important being deposit insurance and access to the Central Bank discount window. As a result, it dislocates the optimal capital level to lower levels than it would be needed without these safeguards at the expense of safety net providers (mainly the taxpayers and

other banks that finance the deposit insurance fund). Second, regulators respond to the externalities associated with financial intermediation on behalf of society. Then, the main concern is the systemic risk of a massive financial crisis caused by successive bank failures and the high social costs it would inflict on the government. In this scenario, a well-capitalized system would be better prepared to bear the bankruptcy of a few banks and avoid a chain reaction that could bring the system to fall apart.

1.2.2. Consequences of regulatory capital requirements

Demanding banks for more capital or, from another perspective, limiting their exposures to a given capital level, does not come without consequences. Beatty & Liao (2014) underline the existence of an extensive stream of research that investigates the effects of regulatory capital requirements on banks' economic behavior.

The theoretical landmark for understanding such impacts is Modigliani-Miller's (MM) portfolio theory (Modigliani & Miller, 1958). Bridges et al. (2014) explain that in the context of the banking sector, MM theory predicts that the introduction of minimum capital requirements should have no relevance to banks' portfolio allocation. The reason is that adjustments in banks' liabilities should not affect the overall funding cost in the MM model's frictionless world, not causing asset redistribution. However, in the real world, many possible frictions cause capital requirements to have real effects, both in the short and long-terms: i) the tax deductibility of debt interest payments, which implies an increase in bank's funding costs when regulators raise capital requirements; ii) information asymmetry; iii) debt overhang; and iv) the costs of each alternative to complying with the capital requirements (e.g., dividend retention versus equity raising) (Bridges et al., 2014).

All these factors may influence funding costs and, therefore, investment decisions. For example, Berger et al. (1995) explain that capital requirements can distort relative prices among banks and between banks and non-bank competitors, leading to allocative inefficiencies by diverting financial resources from their most effective uses (under the economic perspective). Thus, complying with minimum capital levels is far from being financially neutral in the bank's budget planning and resource allocation decisions and can produce negative externalities. In the 1990s, when the first Basel Accord was in force for a few years, Berger et al. (1995) warned about the long-run social tradeoff between

the benefits of reducing the risk of bank failures and the costs of lowering bank intermediation. Other authors still share this concern until recently, as shown by many research studies investigating the association between bank regulation and efficiency (J. Barth, Lin, et al., 2013; Bitar et al., 2018; Djalilov & Piesse, 2019; Saeed et al., 2020).

In the Basel Committee for Banking Supervision (BCBS) 10-year assessment of Basel I implementation, Jackson et al. (1999) summarized the two most relevant unintended potential side-effects concerning the committee that could derive from minimum capital requirements: first, that banks may have their lending activities constrained by the capital requirements, possibly causing a credit crunch and affecting economy output; and second, that the introduction of capital requirements for banks may have reduced their competitiveness compared to other forms of non-banking intermediation, creating the opportunity to the rise of shadow banking.

1.2.3. Regulatory capital arbitrage motivations

Demanding banks to hold equity cushions higher than they would otherwise choose impact management decisions. Raising equity is costlier than debt, owing to taxation, asymmetric information, agency costs, and the bank safety net. Thus, banks deem capital requirements as regulatory taxation (Jones, 2000). Jackson et al. (1999) argue that, like other forms of taxation, regulatory taxes encourage banks to find ways to avoid or minimize these costs. Therefore, RCA reflects banks' efforts to keep their funding costs, including equity, as low as possible.

The framework to explain this behavior is based on the Signaling Theory and Agency Theory/Moral Hazard (Pérez et al., 2008). First, introducing minimum capital requirements creates an agency conflict between managers and shareholders. Manager's compensation is usually linked to the bank's profits. Observing minimum capital requirements may represent a reduction in their remuneration because, for a given structure of assets and liabilities, it would be possible to achieve better results using debt instead of equity. Therefore, managers are incentivized to operate with capital levels close to the minimum to maximize their utility.

However, this behavior exposes the bank to a higher risk of a regulatory violation that can cause severe consequences to shareholders, such as prohibiting dividend payments or even a business shutdown. In this scenario, RCA can solve the agency

conflict. Managers can use RCA to maximize their utility because it allows them to comply with regulatory requirements without incurring regulatory costs. Moreover, RCA also enhances shareholder value by replacing equity with debt in banks' capital structure, releasing resources to be returned to the shareholders (via dividends or shares repurchases) or reinvested in the bank (Jones, 2000).

Second, managers can arbitrage to signal efficiency to shareholders and the market. Managers who fulfill regulatory capital requisites without raising equity or reducing business activities seem more capable because the costs involved in RCA are usually lower. Thus, managers are incentivized to do RCA to signal a good use of the bank's resources.

Third, regulatory arbitrage can be perceived as unethical and may have dire reputational consequences for the manager and the bank. However, managers may believe they can do RCA without being noticed, disguising it as regular business choices. In that case, moral hazard can make them see it as an opportunity to reach their goals with less effort, compared to the need for deploying an equity raise, for instance.

RCA consequences can be positive. For example, Jones (2000) says RCA can be a market safeguard that allows banks to stay operating against non-bank competitors not subject to regulatory burden. RCA can also enable smaller banks to compete against bigger banks with cheaper funding and proportionally smaller regulatory costs. Furthermore, some authors defend that RCA decentralizes intermediation, creating funding alternatives and promoting technology innovations that reduce costs (Buchak et al., 2018; Calomiris & Mason, 2004; Irani et al., 2021; Jones, 2000).

However, RCA consequences can also be harmful. In practice, capital arbitrage gives room for significant divergences between the actual portfolio's risks and the risk represented by the CAR (Jackson et al., 1999). Therefore, RCA's primary outcome is that the reported CARs can hide deteriorations in banks' solvency, threatening the usefulness of formal capital requirements (Jones, 2000).

Furthermore, RCA can be regarded as a competitive advantage for some banks but not necessarily for all of them. Banks face a variety of costs to do RCA (legal, administrative, and structuring expenses), and the decision to engage in it needs a cost-benefit analysis (Jackson et al., 1999). Therefore, RCA may not be equally manageable to all banks for economies of scale and scope or differences in accounting frameworks,

supervisory, and legal regimes. In this case, RCA can have the opposite effect accentuating the disadvantages of the banks unable to do it.

1.2.4. Regulatory capital arbitrage methods

Banks doing RCA react through the same channels that regulators use to influence capital requirements. Formally, Jones (2000) defines RCA methods as actions that perform “cosmetic” adjustments in banks’ balance sheets to artificially: i) inflate the capital in the numerator of the CAR; or ii) deflate the risk-weighted-assets (RWA) in the denominator.

The arbitrage via RWA can be done through on and off-balance sheet adjustments. In the first case, Jackson et al. (1999) report that the oldest way is “cherry-picking.” In this form, within a particular risk-weight category, banks will shift the portfolio composition towards riskier assets to grant greater returns. As there is no differentiation among the assets in the same category, banks can increase their risk profile without changing the RWA calculation.

In the second case, banks reduce RWA by artificially transferring exposures out of the balance sheet reducing the actual risk they should account for. Historically, a usual method is securitization, in which banks sell assets to external companies while retaining partially or totally the risk of these assets (Jackson et al., 1999). However, regulators found and closed this backdoor, demanding the banks to keep securitization contracts with resource clauses in RWA calculation. Banks reacted by disguising such operations in sophisticated structures or operating through shadow entities with relevant step-in risk³. These mechanisms of RCA are associated in the literature with the growth of the shadow banking system and are the focus of this paper’s empirical work (Buchak et al., 2018; Usoskin, 2019).

Finally, the arbitraging of capital measures is commonly done by exploring accounting standards gaps or supervisory policies to make “cosmetic capital adjustments.” Jones (2000) describes fair value gains and discretionary loan loss provisions (LLP) as the most common ways to make such adjustments to boost capital measurements. These are beyond the scope of the current study.

³ According to the BCBS Guidelines, ‘step-in risk’ is the risk that a bank decides to provide financial support to an unconsolidated entity that is facing stress, in the absence of, or in excess of, any contractual obligations to provide such support (EBA, 2021)

1.2.5. Regulatory capital arbitrage via shadow banking

Shadow banking is recently growing as a form of financial intermediation through non-banking entities, such as FinTech and peer-to-peer lending. Buchak et al. (2018), de Roure et al. (2021), and Irani et al. (2021) regard it as a consequence of the regulatory burden increase, particularly after the 2008 financial crisis, which increased the costs of lending in traditional banking. For example, Buchak et al. (2018) report that this movement was so drastic in the US mortgage credit market that shadow banks represented 50% of the market share in 2015.

Firms with no relation to the traditional banking system can do shadow banking, but traditional banks can also adopt it. By operating through legally separated entities not consolidated for capital requirement purposes, banks hide a sponsoring (and often controlling) relationship. In this scheme, they avoid the regulatory cost of holding capital while sharing the benefits of reduced costs in lending. However, shadow banks are not subject to traditional banks' regulations, making it hard to assess whether their capital is enough to cover their risks. Moreover, shadow banks do not have access to the bank's safety net and have fewer funding options than traditional banks. Hence, in severe liquidity scarceness or a massive increase in credit delinquency, there is a greater risk of multiple shadow bank failures, posing a vulnerability that can be transmitted to mainstream banking.

Shadow banks connected to traditional banks can be more harmful because of the contagion risk. Bank authorities are aware of and have taken measures to inhibit it. The Financial Stability Board (FSB) issued in 2013 a policy framework for strengthening the oversight and regulation of shadow bank entities, with the primary objective "to mitigate the spill-over effect between the regular banking system and the shadow banking system" (FSB, 2013). Several local banking authorities responded to the FSB call and reformed their regulatory frameworks to pursue this goal. Usoskin (2019) reported that, in the US, the Financial Accounting Standards Board (FASB) ordered banks to indicate the assets of their supported shadow entities in their balance sheets in a separate line and cover them with higher equity rates. Likewise, the European Banking Authority (EBA) issued guidelines requiring banks to define and limit exposures to shadow banks, emphasizing the need to consider the step-in risk in banks' capital planning (EBA, 2015).

1.2.6. The Brazilian prudential conglomerate

In Brazil, the National Monetary Council (CMN) enacted Resolution N° 4.280 in 2013, creating new criteria for financial institutions to prepare their consolidated financial statements, introduced in the context of the Basel III convergence (BCB, 2013). Conventionally, banks must elaborate a set of consolidated financial statements following specific regulatory rules different from the regular GAAP. The main difference is that the conglomerate derived from the regulatory standard usually encompasses only financial entities. In contrast, the general rule of IFRS requires the parent entity to consolidate all controlled entities. It happens because the regulators' interests in the accounting reports differ from other users, and non-financial firms can confound the regulator's supervision.

However, operating through shadow banks⁴ can undermine the regulator's efforts because those entities are neither regulated nor monitored, and the regulatory capital does not cover their risks. Therefore, the new standard presented an innovation in the Brazilian regulatory framework because it changed the consolidation scope of the accounting statements, expanding the perimeter of previous financial consolidation ("Financial Conglomerate") to include a new range of entities and creating the concept of "Prudential Conglomerate." The regulator's objective was to define an embracing scope to include in the same conglomerate regular banks and their controlled⁵ non-regulated entities having bank-alike activities ("shadow banks"). This reform expanded the consolidation scope impacting the regulatory capital calculation and approximated the regulatory rule to the international standard while aiming to strengthen the system's soundness.

Furthermore, the norm granted the regulator the power and discretion to determine the consolidation of any entity posing a relevant vulnerability to the bank. With this apparatus, the regulator can legally demand banks for sufficient capital to cover their off-balance sheet risks and mitigate the shadow banking risks deriving from mainstream banking. Indeed, the objective of combating shadow banking was explicit in the norm proposal sent to the CMN appreciation before approval (BCB, 2013).

⁴ Formally, which firms are considered shadow banks will depend on the country's Central Bank jurisdiction. However, the Financial Stability Board (FSB) defines shadow banking as "credit intermediation involving entities and activities (fully or partially) outside the regular banking system" (FSB, 2017)

⁵ The concept of "control" as defined in the norm is broad and comprehensive. It comprises not only strict "share control", but also "operational control" derived, for instance, from shared management or the operation in the market under the same commercial brand.

1.2.7. Hypotheses development

The theoretical base supporting the hypotheses starts in Jones (2000). By his definitions (p.38), “RCA – like traditional tax arbitrage – represents a bank’s willingness to incur various ‘structuring costs’ to reduce the regulatory tax consequences of formal capital requirements.” Therefore, if a bank engages in RCA, the expected structuring costs should be lower than the gains from reducing funding costs and other benefits. Banks would decide to “outsource” assets to unconsolidated entities only if the costs involved are lower than the benefits of the freed-up capital.

The structuring costs can be internal or external and regard the expenses involved in creating the legal vehicle to operate the RCA, setting a management body, and providing initial capital funding. However, despite scarce evidence, the financial and technological innovations and increased competition in the financial services sector appear to set most bureaucratic structuring costs at a “low enough” level (Jones, 2000). Therefore, the decision substantially relies on verifying whether the assets allocated to the new entity require less equity to fund it than the amount necessary in the bank itself. It is also likely to happen because non-banking firms generally do not comply with minimum capital requirements, and shadow banks can operate with much lower equity amounts than banks.

In this scenario, the incentives for shadow banking are more appealing for the banks with a capital-intensive business model and lower regulatory capital surplus, which would have greater benefits by freeing-up some regulatory capital. On the other hand, if a bank operates regularly with a comfortable capital buffer, it would be less likely to incur the structuring costs of creating a shadow structure. Therefore, one expects the new Brazilian accounting standard will not reach all banks in the same way, and only a fraction of the system will be impacted.

The standard’s impact on the banks is complex, though. If the banks were suddenly obliged to consolidate the shadow entities’ balance sheets without time to react, the immediate impact should be a reduction in the bank’s capital adequacy ratio (CAR). This is because, after the consolidation, the RWA parcel would increase due to the added assets without a corresponding raise in the regulatory capital (since the non-banking entities are not obligated to observe minimum capital levels). However, this reduction

may not happen if the banks could adjust their balance sheets before adopting the new consolidation rule. For instance, banks could raise more capital beforehand to minimize the impact of the RWA increment, reduce or discontinue the activities of the shadow banks, and not be affected by the application date. In fact, the terms of Resolution N° 4.278/2013 granted the banks a one-year “grace period” to make such adjustments determining that the CAR calculation should consider the new Prudential Conglomerate only after 1/1/2015.

Hence, the impact of the standard introduction (treatment) is uncertain and will depend on two factors. First, suppose the banks in the treatment group don’t react, anticipating the treatment’s effects. In that case, it is expected that they will observe an immediate relative reduction in their CAR compared to the banks in the control group by the time the norm produces effects. On the contrary, and more likely, if banks foresee the treatment effects and have time to adjust, they will take measures and not just wait for the impact. The reaction will mainly depend on the size and profitability of its shadow business. On the one side, if the additional capital cost makes the shadow business worthless, and the costs of dismantling the structure are relatively small, they can interrupt their shadow banking activities and not be impacted. In this case, they would write off or transfer the operations to the bank’s books. On the other side, if the management assesses that the additional capital cost does not make the shadow business unprofitable and/or the cost of suddenly dismantling the shadow structure is too high, the bank will adjust to settle the new entities. There are some ways to do it: (i) raise capital to support the shadow operations; (ii) consume the bank’s capital buffer, if excessive; and (iii) free-up some regulatory capital to the new consolidated assets by reconfiguring the bank’s portfolio too less risky assets. The choice will depend on each particular situation considering the bank’s possibilities, but regardless of the option, it is expected to impact the bank’s CAR.

Given all the possibilities, the nature of an individual impact is hard to predict. However, the theory of capital buffering argues that banks maintain a capital buffer to reduce the interference of regulatory authorities and to avoid the costs of a minimum capital rule violation (Furfine, 2001; Milne & Whalley, 2002; Pereira & Saito, 2015). Therefore, banks approaching lower capital levels tend to increase their capital and/or reduce risk exposure to restore their ratios and avoid regulatory costs. Moreover, Milne & Whalley (2002) add that stricter regulation increases the bank’s risk aversion. Then, in

the face of a regulatory shift to more rigid capital requirements, banks tend to enlarge their capital surplus and choose less risky portfolios in reaction to higher levels of bank supervision, particularly the less capitalized ones. Evidence of this behavior is documented in Rime (2001), Stolz (2007), and, remarkably, Pereira & Saito (2015), who studied previous regulatory initiatives in the Brazilian banking system.

Implementing the new standard reduced the incentives for RCA, impacting the capital requirements indirectly but undoubtedly hardening the rules and strengthening the regulation. Also, as referred to earlier, the banks doing RCA (and thus affected by the standard) are more likely to have lower capital levels. Therefore, despite the alternatives cited above, it is expected that, on average, the standard may push the impacted banks to (i) raise their capital cushion and/or (ii) reconfigure their portfolio to a less risky profile.

These expectations allow for the construction of the study hypotheses. Since the norm has granted a transition period where banks could plan and adjust to the new rules, they are projected to anticipate the impact and react. Thus, according to the theory of capital buffering and the increase in bank risk aversion following regulatory strengthening, it is expected that the affected banks will meet the requirements not by just maintaining their capital levels as before the norm but, conservatively, by constituting some surplus as a precaution. This excess translates into a higher value of the bank's CAR, regardless of an increase in the regulatory capital or a reduction in the portfolio's risk (RWA). Therefore, the first hypothesis is:

H₁: The increased regulatory pressure brought by the extension of the consolidation perimeter causes a positive impact on the CAR

If the adjustment is made by a portfolio reconfiguring, a reduction in the share of riskier assets in total assets should be observed. The easiest way to do it is to reduce the participation of credit assets because the parcel of RWA because credit risk is the most significant contributor to a bank's total RWA⁶.

In fact, the decrease in banks' lending due to higher capital requirements is widely studied in the literature. Several studies in the 1990s and early 2000s investigated the

⁶ The average participation of the RWA-Credit parcel in Total RWA in the Brazilian banking system between 2010-2020 is 87,5% (BCB, 2022a)

implementation of minimum capital requirements in connection with the first Basel Accord signed in 1988, concerned with whether capital requirements are capable of causing a credit supply shortage. Bernanke & Lown (1991) were among the first to point to the redistributions in bank portfolios to adjust to Basel I as one of the reasons for the decrease of the bank loan supply in the United States at the time, causing a “credit crunch.” Other authors quickly followed them (Baer & McElravey, 1992; Hall, 1993; Moore, 1992), and Cathcart et al. (2013) report that the mainstream literature opinion blamed Basel I for causing the credit stoppage.

Nevertheless, these arguments were not undisputed. Berger & Udell (1994) published a paper arguing that the Basel I introduction of capital requirements fared the worst of all possible explanations of the bank credit reallocation of the 1990s. Peek & Rosengren (1995) also claimed that it was impossible to unambiguously attribute the cause of the US credit crunch to capital regulation. It is essential to say that they did not rule out regulatory capital requirements as a possible factor. Instead, they emphasized that other possible causes, such as demand-related components (macro/regional and secular decline, for instance), may have taken greater importance. Jackson et al. (1999) reported that, by the time of their revision, the literature acknowledged that capital restrictions could likely produce a generalized “credit crunch” during economic difficulties. However, it was uncertain in periods of normality because, although the capital restriction can impact a bank’s capacity to lend individually, market mechanisms can compensate for it by transferring the demand to other well-capitalized banks.

Since then, several studies have explored the issue with alternative approaches, samples, and timeframes, having mixed results. Chiuri et al. (2002) examined a dataset of emerging economies. They found that enforcing capital adequacy requirements reduced the supply of bank loans, particularly at less-capitalized banks. On the other hand, Cosimano et al. (2004) studied the effects of Basel I in Latin America and concluded that the accord did not seem to lead to an overall credit decline. Chami & Cosimano (2010) found that a monetary policy along the lines of the Basel Accord impacts a bank’s ability to offer loans, but only when there is low competitiveness

With the changes in international bank regulation after Basel I, studies began to explore the issue with alternative approaches. Cathcart et al. (2013, p. 4) used “Basel II as a point of impact” to analyze the subprime crisis. Mésonnier & Monks (2014)

examined the sudden anticipation of some Basel III requirements in the EBA 2011/2012 Capital Exercise. De Jonghe et al. (2020) investigated the impact of Pillar-II capital additions in Belgium. Finally, Juelsrud & Wold (2020) studied banks' reactions to Basel III implementation in Norway. In short, each of the mentioned studies, under their specific setups, established some negative relation between capital requirement increases and banks' lending.

The matter is not settled in the literature. Still, the latest developments seem to agree that there is an adverse effect on bank lending caused by stricter regulatory capital rules, at least under certain circumstances, such as for low-capitalized banks. Therefore, the second hypothesis argues that if the stricter new regulation led the banks to reconfigure their portfolio risk profile, it would reflect a reduction in the participation of credit assets in total assets (Credit/Assets ratio) in favor of less risky assets (e.g., treasury bonds). Thus:

H₂: The increased regulatory pressure brought by the extension of the consolidation perimeter causes a reduction in the Credit/Assets ratio.

1.3. Data and sampling procedures

The sample includes quarter-end data from 136 banks or bank conglomerates between 2011 and 2018, comprehending four years prior and post the norm. Additional observations from 2010 and 2019 were collected and used in robustness checks but not in the primary analysis⁷.

The selection comprehends active institutions in quarters before and after the new consolidation rule was put in force (12/2014 and 3/2015, the fourth quarter of 2014, and the first of 2015). The data before 2015 are from the Financial Conglomerates, and after, from the Prudential Conglomerates. All information was collected from the Brazilian Central Bank public repository IF.data (BCB, 2022a).

The observations were sorted by the CAR and revealed a high concentration around the 11-12% range with a long right-tale. This was expected due to the capital rules

⁷ According to Schiozer et al. (2021, p.7), it is not recommended to use too long periods in the Differences-in-Differences model, "because the analysis can be subject to the occurrence of other events (shocks) that also affect the variable of interest, and these events may confound the analysis".

that required the banks to keep a minimum total CAR of 11%. However, the skewness points to some banks with extremely high values on the right side of the distribution. These extreme values denote excessive regulatory capital relative to their risk-weighted assets, characterizing banks in particular situations (e.g., pre-operational state, discontinuing activities, etc.). On the other hand, on the left side of the distribution, very low ratios indicate banks in financial difficulties, close to bankruptcy, or in the resolution process. Therefore, these observations were considered outliers, and the sample was trimmed for each cross-section at the first and last deciles.

The variables Total Assets and Total Liabilities were used to identify the treatment and control groups in 3/2015, the first quarter reflecting the new consolidation rules. Even though the CAR began to be computed and reported only for the new Prudential Conglomerates, banks are still obligated to produce financial statements for the Financial Conglomerates. It allows us to identify whether the new rule caused changes (“treatment”) from the Financial to the Prudential Conglomerates by comparing the assets and liabilities between the balance sheets. If either the Total Assets or Total Liabilities of a Prudential Conglomerate are different (equal) from the respective Financial Conglomerate, it indicates that the bank was (was not) affected and belongs to the treatment (control) group. Following this criterion, from the initial 136 bank conglomerates, 61 are the treatment group, and 75 are the control group. However, after the outlier trimming, four conglomerates were eliminated from the control group resulting in a final unbalanced panel with 132 conglomerates throughout 3.287 bank-quarters observations (1.724 from the Control group and 1.563 from the Treatment Group).

1.4. Research design

The introduction of the new consolidation standard provides a quasi-experimental setting that allows using a Difference-in-Differences (DiD) design to test the hypotheses. The norm’s enactment is an exogenous shock that is expected to affect some banks (treatment group) but not others (control group). The treatment outcome is the model’s dependent variable, the CAR for H_1 , and the Credit/Assets ratio for H_2 .

1.4.1. Testing for the changes in the CAR

The econometric model to test H_1 is a standard DiD model, with alternative specifications to include some controls and fixed effects for firm and time:

$$CAR_{i,t} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \beta_3 (Post \times Treated)_{i,t} + u_{i,t} \quad (1.1)$$

where the subscripts i and t refer to bank and quarter, respectively. The dependent variable is the CAR , a measure of the capital adequacy ratio of a bank conglomerate, defined as the division of its regulatory capital (RC) by the risk-weighted assets (RWA). The variable $Post$ is a dummy assuming the value 1 in the post-norm announcement period (2014-2018) or after the in-force date (2015-2018), depending on the specification used, and 0 otherwise; the variable $Treated$ is a dummy that indicates whether the bank i is affected by the norm ($Treated = 1$) or not ($Treated = 0$). The main coefficient of interest is β_3 : it captures the difference between the observed average post-norm CAR and the average unobserved counterfactual CAR after the norm, i.e., the hypothetical value of CAR of affected banks absent the norm.

A DiD design relies on one fundamental assumption: the norm's enactment can be regarded as an exogenous shock producing an *as-if random* treatment to some banks. The following paragraphs develop the arguments to support this assertion.

The regulator did not explicitly design the rules to affect a group of banks based on characteristics previously known. However, the norm applies to all banks but affects only those with unconsolidated shadow entities. Therefore, part of the banks' population will be non-compliant before the norm and thus impacted by it, while the rest are pre-treatment compliers, remaining unaffected. This fact alone undermines the pure random assignment premise. Nevertheless, suppose the treatment and control groups are similar in all relevant variables other than the one impacted by the treatment. In that case, it can still be considered "as good as" random and produce consistent results (Atanasov & Black, 2016).

The capital requirement rules are equally applied to all banks, implying they may face the same incentives to engage in RCA. However, suppose the treatment – the consolidation of shadow bank entities – is systematically assigned to banks significantly different from the control group. In that case, the regression results may not be attributed

to the treatment but some other characteristics, not allowing a causal inference. In other words, a possible change in the CAR of affected banks (H_1) may not derive from the new rule of consolidation but from some other reason related to banks' characteristics.

There are two crucial aspects to consider regarding this assumption. The first is that the treatment can affect differently bigger or smaller banks thanks to the structuring costs referred to by Jones (2000). Indeed, the structuring costs can be a limiting factor in preventing some banks, presumably the smaller ones, from assembling a shadow banking structure. The second aspect regards the bank's capital situation *a priori*. Banks with capital levels closer to the minimum may have a greater incentive to do RCA to avoid violation costs. Therefore, it may suggest that poorly capitalized banks could be affected by the norm to a greater extent than the banks with higher CAR. In sum, if the treatment and control groups have significantly different sizes or pre-norm capitalization levels, an observed change in banks' CAR could not be caused by the regulatory shift but by other features related to the differences between the groups.

Given these issues, the identification condition to ensure the DiD regressions do not produce inconsistent results is that the treatment and control groups do not have a differential trending ("parallel trends assumption"), which will be assessed in the empirical work. Assuming that the model conditions are satisfied, the DiD design allows for addressing endogeneity concerns and inferring a causal relationship between the new consolidation rule and its impacts on the affected relative to the unaffected banks.

In addition to the standard DiD model, the regressions will include alternative specifications, incorporating controls to improve the regression fitness and estimate precision. They will encompass bank-level and macroeconomic variables previously referred to be associated with a bank's CAR in Klepczarek (2015) and firm and time-fixed effects.

The bank-level controls proxies are bank size, measured by the natural logarithm of total assets; risk profile, measured by the ratio between the RWA and total assets; and deposits share, measured by the ratio between deposits and non-equity liabilities. The values are set at pre-norm dates (2013) to avoid the 'bad-controls' problem, as the treatment may affect those variables themselves. Macroeconomic controls include the quarterly GDP average growth as a proxy for growth opportunities, and the average inflation of the period, as a proxy for macroeconomic uncertainty.

One last consideration about the modeling is, due to the possibility of treatment anticipation behavior, the treatment timing will be tested for both the announcement date and the norm enforcement date. Therefore, it will ensure that any impact on the CAR deriving as a response to the new consolidation rule will be appropriately tested.

1.4.2. Testing for the changes in the credit portfolio

The econometric model to test H_2 is similar to the DiD model referred to in 1.4.1:

$$\%CredAssets_{i,t} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \beta_3 (Post \times Treated)_{i,t} + u_{i,t} \quad (1.2)$$

where $\%CredAssets$ represents the ratio between banks' credit assets and total assets, and the other variables are as stated above.

As in the previous model, the treatment timing will also be tested for both the announcement date and the law enforcement date. Moreover, alternative specifications will include bank-level and macroeconomic controls, and firm and time-fixed effects. The covariates are based on Pham's (2015) work in determining the internal and external factors of a bank's propensity to lend. The bank-level proxies are bank size, measured by the natural logarithm of total assets; credit risk, measured by the ratio between loan loss provisions and total loans; and deposits share, measured by the ratio between deposits and non-equity liabilities. The macroeconomic variables are the sovereign interest rate, the average Selic⁸ rate of the period, indicative of the cost of opportunity between lending and investing in treasury bonds, and the quarterly GDP growth, proxying the credit demand.

1.5. Results

⁸ The Selic rate is the target interest rate set by the Monetary Policy Committee (Copom) of Central Bank of Brazil. It is computed as the daily average of the overnight lending rate of interbank loans backed by Brazilian federal securities, carried out in the Special System for Settlement and Custody (the Selic System) (BCB, 2022b).

1.5.1. Descriptive statistics

Table 1.1 presents the descriptive statistics for the variables at the bank level in four panels. They are divided into the treatment/control groups and by the periods before and after the norm publication or effective application. Concerning the capitalization level of each group, before the norm, the treatment group had a mean CAR lower than the Control group, regardless of the year considered as the treatment date (2014 or 2015). The difference between the average CAR of the two groups is statistically significant, implying that the Control group is more capitalized than the treatment group on average. This is consistent with the idea that less capitalized banks tend to engage more in RCA. However, the control group reduced their CAR from the pre-norm to the post-norm period, while the Treatment group increased it. This supports the discussed expectation that the treatment group could have grown its CAR in response to the regulatory initiative.

Regarding the credit/assets ratio, in the period before the norm publication, both groups present similar participation of credit assets in total assets, with the treatment group being slightly higher but not statistically significant. However, after the norm, both groups present a reduction in the ratio, but the decline in the control group is more pronounced, making the difference statistically significant. Indeed, the difference already turns significant when the first year after the norm enactment is included in the subsample. This suggests that the treatment anticipation measures could have prevented a higher decrease in the treated banks' ratio or that the assets consolidated from the new entities could have had this role.

Table 1.1 also shows that banks in the treatment group are significantly bigger than the Control group in all periods analyzed. This is consistent with the notion that bigger banks can bear the structuring costs to benefit from RCA more easily than smaller banks. The proxy for "risk profile" reveals that, before the norm, both groups had an average percentage of risk-weighted assets relative to total assets that were not statistically different, meaning both groups had a similar risk profile. Nevertheless, after the norm, the treatment group presented a steeper decline in the ratio, which made the average value for the proxy significantly lower than in the control group. Even though this group also had a decrease in the ratio, it suggests that the treatment may have reduced the "risk profile" of treated banks more than expected due to the treatment. It is consistent

with the idea previously discussed that regulatory capital constrictions may force banks to reconfigure their portfolios towards less risky assets to satisfy the new requirements.

Table 1.1. Descriptive statistics

	Control				Treatment				
Variables	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.	Wilcoxon rank-sum test
Panel A – Before the norm announcement (2011-2013)									
CAR	28,4%	25,5%	13,6%	629	19,3%	16,7%	8,2%	608	15.469***
Credit/Assets	45,3%	48,8%	29,8%	629	48,4%	49,0%	27,1%	608	-1.627
Assets	3,12	1,26	5,64	629	95,46	9,43	234,14	608	16.634***
Risk Profile	89,6%	85,0%	41,9%	629	87,2%	81,3%	36,5%	608	1.021
Deposits share	31,7%	30,0%	24,2%	629	32,0%	28,7%	22,1%	608	-0.486
Credit Risk	5,6%	3,7%	7,2%	554	5,1%	3,9%	6,8%	578	-0.284
Panel B – After the norm announcement (2014-2018)									
CAR	26,3%	22,1%	12,9%	1095	20,4%	16,9%	9,6%	955	15.161***
Credit/Assets	42,1%	41,2%	30,3%	1095	46,2%	45,6%	27,2%	955	-3.316***
Assets	4,82	1,94	7,80	1095	147,47	13,85	346,85	955	22.606***
Risk Profile	84,6%	77,3%	45,4%	1095	78,4%	74,0%	31,7%	955	1.829
Deposits share	29,5%	24,3%	25,5%	1095	25,8%	22,8%	21,2%	955	2.075**
Credit Risk	6,6%	4,1%	9,0%	934	5,7%	4,7%	8,6%	911	-1.427
Panel C – Before the norm effective application (2011-2014)									
CAR	27,8%	25,3%	12,9%	850	19,4%	16,7%	8,9%	816	18.026***
Credit/Assets	45,0%	48,1%	30,1%	850	48,5%	49,6%	27,5%	816	-2.125**
Assets	3,34	1,36	5,93	850	100,86	9,78	250,87	816	19.104***
Risk Profile	90,2%	85,1%	46,8%	850	86,6%	81,2%	35,7%	816	1.096
Deposits share	31,6%	29,9%	24,3%	850	31,2%	28,2%	22,2%	816	-0.129
Credit Risk	5,8%	3,6%	8,3%	744	5,3%	3,9%	7,4%	771	-1.048
Panel D – After the norm effective application (2015-2018)									
CAR	26,3%	21,7%	13,5%	874	20,5%	17,1%	9,3%	747	12.068***
Credit/Assets	41,5%	40,2%	30,2%	874	45,5%	44,4%	26,9%	747	-2.972***
Assets	5,04	2,21	8,05	874	156,05	15,15	359,80	747	20.722***
Risk Profile	82,7%	75,5%	41,3%	874	76,6%	71,9%	31,0%	747	2.161**
Deposits share	29,1%	23,4%	25,7%	874	24,9%	22,2%	20,8%	747	2.068**
Credit Risk	6,6%	4,3%	8,5%	744	5,6%	5,0%	8,5%	718	-0.755

Notes: The sample period ranges from 2011-2018. The Resolution N° 4.280/2013 was enacted on 31/10/2013, but Resolution N° 4.278/2013 determined its application in regulatory capital calculation after 1/1/2015. Banks in the Treatment (Control) group had different values for Assets or Liabilities between their Prudential and Financial Conglomerates in 3/2015. CAR refers to the Capital Adequacy Ratio, the ratio between a bank's Risk Weighted Assets (RWA) and its regulatory capital; Credit/Assets refers to the ratio between a bank's credit assets and its total assets; Assets refers to the total assets (in billions of Brazilian Reais); Risk Profile refers to the ratio between a bank's Risk Weighted Assets (RWA) and its total assets; Deposits share refers to the ratio between a bank's total deposits and its non-equity liabilities; Credit Risk refers to the ratio between a bank's loan loss provisions and its total loans. The Wilcoxon rank-sum test null hypothesis is that the variable means for each group (Treatment/Control) are equal. * Rejects the null hypothesis at the 10% level, ** at the 5% level, and *** at the 1% level.

The variable measuring the share of deposits in total non-equity liabilities also had no significant difference between the groups before the norm for either publication or application events. However, after the norm, the treatment group presented a greater reduction in the variable, and the difference with the control group became statistically significant. One possible explanation is that the consolidation of new entities' liabilities might have reduced the participation of the deposits in the ratio of the treated banks because the non-banking institutions cannot fund their activities with deposits. Another possibility is that the CAR increase in the treatment group reported above was supported by non-equity capital instruments (e.g., subordinated debt), which would also reduce the participation of the deposits in non-equity liabilities.

Finally, the last variable that proxies for the credit risk (percentage of LLP in total loans) did not present significant differences between the treatment and control groups before and after the norm, suggesting that the groups are not different regarding this aspect.

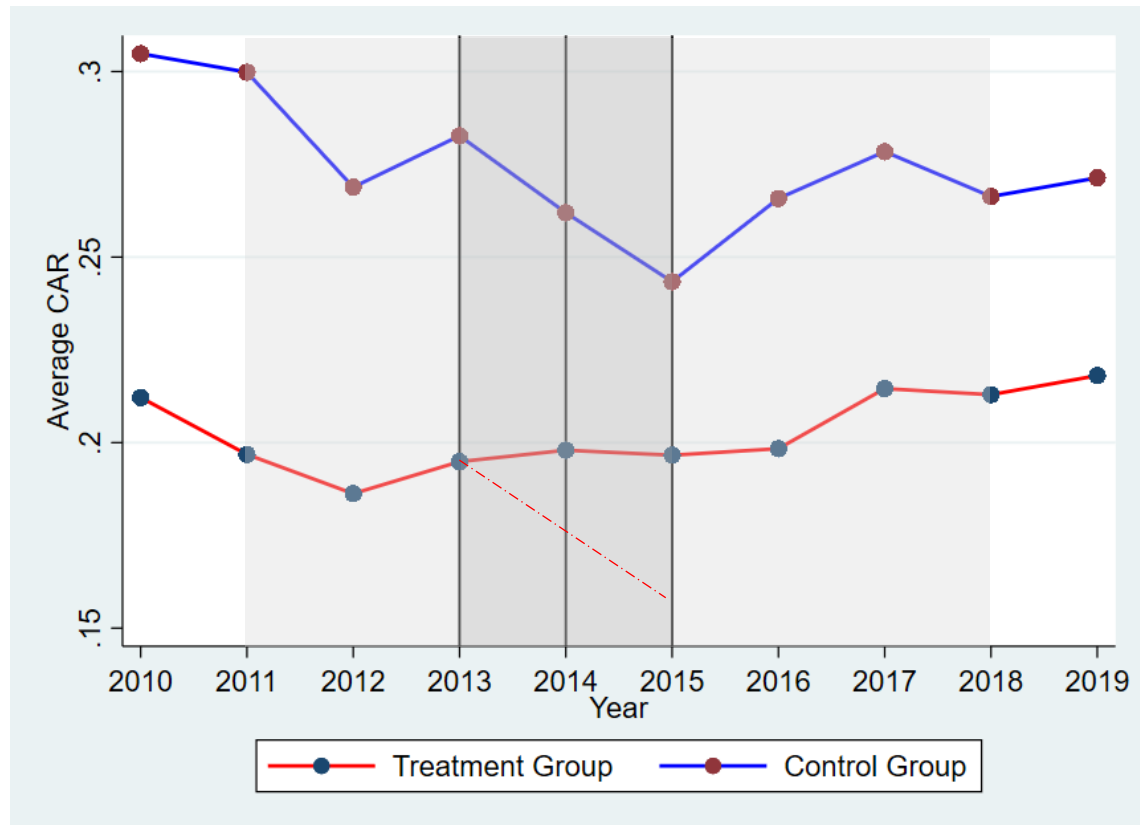
1.5.2. Parallel trends

As shown in the section above, the Treatment and Control groups present significant differences, which may undermine the DiD assumptions. Therefore, they must not have a differential trend regarding the response variables before the treatment. Figure 1 shows the evolution of the CAR for both groups in the period of analysis. In addition, one year of observations on each end of the sample was included in the plotting to make the analysis more robust.

The difference between the CAR levels between the Treatment and Control groups can be verified throughout the whole period, in which the Control group stays consistently at higher levels than the Treatment group. Both groups visually present a fairly parallel

trend in the first four years (2010-2013). After 2014, this tendency was interrupted until 2016, when a relatively parallel pattern could be verified again.

Figure 1.1. CAR evolution per group

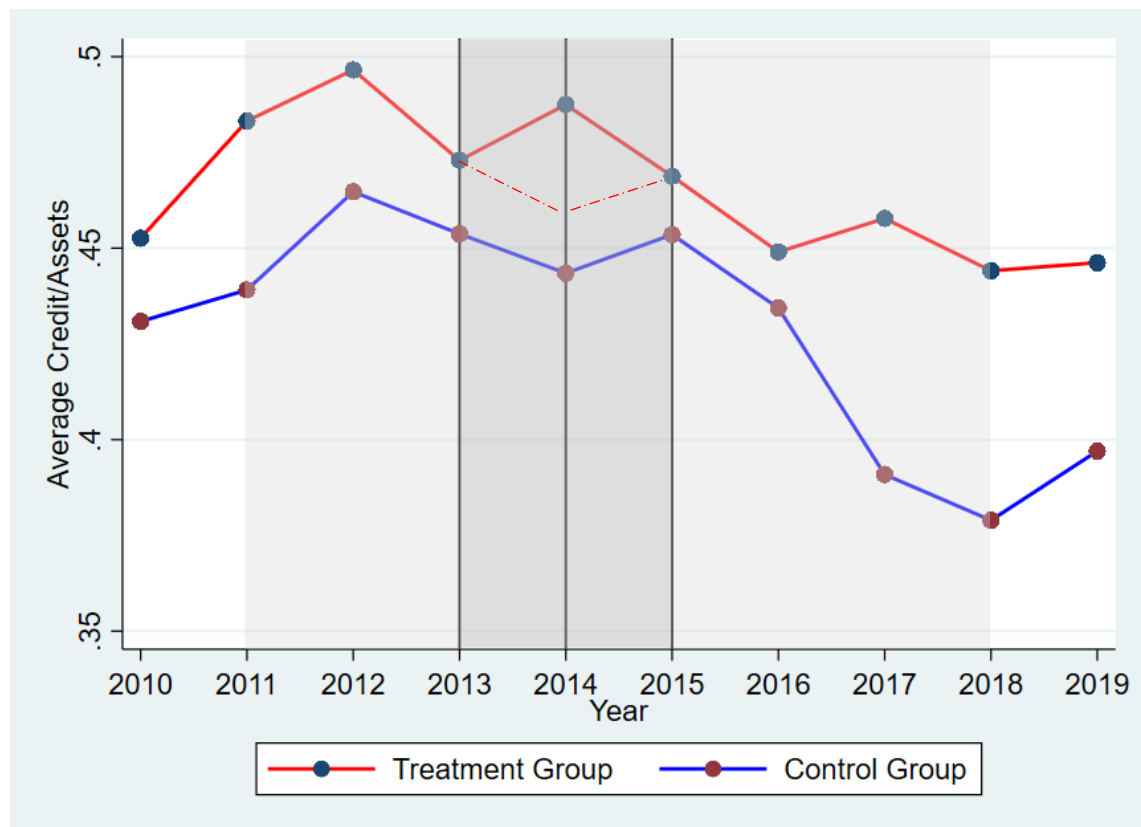


Notes: Values of Average CAR represent the mean of the four quarters for each year. The red dashed line illustrates the hypothetical counterfactual trend that the Treatment Group would present absent treatment. The light gray area is the period of analysis (2011-2018), and the dark gray area is the immediate period after the norm announcement until its effective application.

The change in trends coincides with the period of the regulatory initiative. The norm was announced in the last quarter of 2013, producing effects in the CAR calculation after 2015. The graph shows that the Treatment group did not follow the decreasing tendency verified in the Control group in 2014 and 2015, keeping a CAR stable around the 20% average. This suggests that the publication of the new rule provoked a treatment anticipation effect in 2014, with the banks preparing themselves by increasing their CAR levels. Indeed, in 2015, when the norm started producing effects, the Treatment group did not observe a relevant reduction in the CAR that would be expected after the incorporation of new entities' assets.

Regarding the second hypothesis, it can be seen in Figure 2 the Credit/Assets ratio of the Treatment group is slightly higher than the Control group and also present a reasonably parallel trend from 2010 to 2013. Like the CAR trend, this form was interrupted in 2014, with a sharp increase in the Treatment group while the Control group decreased. In 2015, the movement reversed, though. After 2016, the line trends of the groups break the parallelism until the end of the sample period.

Figure 1.2 – Credit/Assets Ratio evolution per group



Notes: Values of Average Credit/Assets represent the mean of the four quarters for each year. The red dashed line illustrates the hypothetical counterfactual trend that the Treatment Group would present absent treatment. The light gray area is the period of analysis (2011-2018), and the dark gray area is the immediate period after the norm announcement until its effective application.

Further robustness checks will be presented in the next section. Still, for this time being, the visual analysis will suffice to say that the trajectories in both charts are roughly parallel in the pre-treatment periods and that the identification condition for the DiD model is satisfied to proceed with the regressions.

1.5.3. Testing for the effect of the treatment in the CAR (H_1)

This section presents the results of the tests on H_1 according to the DiD model referred to in section 4. The dependent variable is the CAR, and both 2014 and 2015 were tested as the treatment date due to the concerns regarding a possible anticipation behavior explained earlier. Tables 1.2 and 1.3 present equation (1.1) estimation with several variations.

The first column is the traditional DiD equation, as specified in equation 1.1. The estimated coefficient for *Post* indicates a negative reduction in the average CAR of the Control group from the pre-norm to post-norm periods. However, the difference is not statistically significant, meaning that the CAR of the Control group in the pre-norm and post-norm periods are not significantly different. This result stays qualitatively the same regardless of the chosen treatment year (2014 or 2015). The *Treated* coefficient indicates that the treatment group's average pre-norm CAR is significantly smaller (at the 1% level) than the Control group. This result is also consistent in both setups. Finally, the main coefficient of interest of *Post x Treated* indicates that the mean CAR of the Treatment group increases more than its untreated counterpart. The average differential increment is 3,17 p.p. when the first treatment year is 2014 (significant at the 5% level) and 2,61 p.p. if 2015 is considered (but significant only at the 10% level, in this case). This finding is central to the analysis. It supports the hypothesis that the norm publication, announcing the elimination of the incentives for doing RCA through shadow banking, affected the banks that were taking advantage of this regulatory gap. Even though the norm was not yet applied, those banks detached from the unaffected group by increasing their CAR levels to prepare for the forthcoming regulatory tightening. This is consistent with the results of Pereira & Saito (2015), who found that when a regulatory tightening in capital requirements takes place, large banks act conservatively by raising their capital levels.

The following specifications included other features into the basic DiD regression. In column 2, the bank-level controls *Size*, *Risk Profile*, and *Deposits Share* were added to the regression. To avoid the bad controls problem, the pre-norm values were fixed. There are two reasons for adding controls. One is to improve the regression's precision and fitness. The other is to test whether alternative stories can falsify the main assumptions. A possibility would be that larger banks have easier access to external funding sources due to their stronger market position. For example, 2014 was a year of presidential

elections in Brazil, a common factor of market volatility and the increase of capital flow deriving from risk aversion. Then, large banks could have had good funding opportunities and raised their CAR, taking advantage of their position relative to the smaller banks. Since bank size is correlated with the *Treated* variable, this would cause an omitted variable problem. Thus, the results of column 1 could wrongly attribute the increase in CAR of the treatment group to the norm announcement and not to their size.

Table 1.2. Differences-in-Differences: CAR regressions (Treatment = 2014)

Variables	CAR				
	(1)	(2)	(3)	(4)	(5)
Post_2014	-0.0206	-0.0223*	-0.0113	-0.0266**	
	(0.0128)	(0.0127)	(0.0129)	(0.0127)	
Treated	-0.0910***	-0.0489***	-0.0488***		
	(0.0160)	(0.0160)	(0.0160)		
Post_2014 x Treated	0.0317**	0.0358**	0.0358**	0.0392***	0.0393***
	(0.0146)	(0.0143)	(0.0143)	(0.0146)	(0.0146)
Size_ PreTreat		-0.0178***	-0.0179***		
		(0.00430)	(0.00429)		
Risk Profile_ PreTreat		0.0336	0.0333		
		(0.0264)	(0.0261)		
Deposits Share_ PreTreat		-0.0416	-0.0416		
		(0.0314)	(0.0314)		
GDP growth			0.00301**		
			(0.00118)		
Inflation			-0.00393*		
			(0.00224)		
Observations	3287	3239	3239	3287	3287
R-squared	0.092	0.231	0.236	0.654	0.659
Bank FE	no	no	no	yes	yes
Time FE	no	no	no	no	yes
# of clusters (banks)	132	128	128	132	132

Notes: The dependent variable in all models is the CAR. Post_2014 is equal to 1 in all quarters after 3/2014; Treated is equal to 1 for the banks with different values for Assets or Liabilities between their Prudential and Financial Conglomerates in 3/2015; Size is the natural logarithm of a bank's total assets (in thousands of Brazilian Reais). Risk Profile refers to the ratio between a bank's Risk Weighted Assets (RWA) and its total assets; Deposits Share refers to the ratio between a bank's total deposits and non-equity liabilities. The “_PreTreat” suffix means that the variable value is fixed in the latest year available before 2014; GDP growth is the quarterly variation of Brazilian GDP; Inflation is the quarterly variation of the Brazilian official price index (IPCA – Índice de Preços ao Consumidor Amplo). The differences between the number of observations and clusters among the setups are due to the unavailability of data. Robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

This applies too to the *Risk Profile* variable. A lower risk profile in the pre-2014 period can indicate a higher managerial conservatism. This could lead more conservative banks to be more careful in the face of greater market volatility and increase their capital buffers. Finally, greater participation of deposits in the bank's funding instruments usually reflects a lower cost of capital because deposits are commonly cheaper than borrowing. The lower cost increases the bank's profitability, which tends to be associated with higher capital levels. This is consistent with the pecking-order theory, which suggests that retained earnings are a better funding source than debt, and debt is better than equity (Myers, 1984). Furthermore, in the event of market volatility, the *flight-to-quality* phenomenon can occur, with deposits shifting from riskier to safer banks. Thus, the increase in the CAR of the Treatment group could reflect the perceived safeness of the banks in the Treatment group and not a consequence of the new regulation.

The results in column 2 show that *Size* is negatively correlated with the CAR and its coefficient is statistically significant at the highest levels. This was expected and is consistent with previous findings in the literature, which report that asset size is negatively correlated with capital adequacy (Klepczarek, 2015). The variables *Risk Profile* and *Deposits Share* did not materially affect the CAR, as their coefficients are not statistically significant. Most importantly, the coefficients for *Post*, *Treated*, and *Post x Treated* did not change qualitatively compared to the estimates reported in column 1. Moreover, the magnitude of the main coefficient of interest of *Post x Treated* increased while remaining significant at the 5% level. This indicates that the previous inferences stand up to the inclusion of these covariates.

In column 3, the macroeconomic controls were added for further refinement. The *GDP Growth* is a common proxy for economic growth opportunities, which reflects in a bank's profitability and, consequently, its capitalization levels (Klepczarek, 2015). Conversely, *inflation* is a variable associated with market uncertainty about the future (Caglayan & Xu, 2016). A higher uncertainty reflects greater conservatism, which can positively impact the CAR. Therefore, these covariates can capture the changes in the CAR bank-invariant and not due to the variables included in the previous models. This would refine the estimates of previous coefficients or even falsify them if the magnitude of its influence is high enough to make the others materially insignificant. The results of this new setting indicate that the coefficient of *GDP Growth* is positive and statistically

significant (at the 1% level), suggesting that the growth of the GDP helps in the bank's capitalization levels, as expected. On the other hand, the *Inflation* variable is not statistically significant to explain the CAR variation (or, if any, only at the 10% level in the 2014 setup). Importantly, all the other main inferences of *Post*, *Treated*, and *Post x Treated* remain rather stable compared to the previous simulations.

Table 1.3. Differences-in-Differences: CAR regressions (Treatment = 2015)

Variables	CAR				
	(1)	(2)	(3)	(4)	(5)
Post_2015	-0.0147	-0.0179	-0.00642	-0.0239*	
	(0.0129)	(0.0127)	(0.0129)	(0.0126)	
Treated	-0.0840***	-0.0430***	-0.0428***		
	(0.0153)	(0.0155)	(0.0155)		
Post_2015 x Treated	0.0261*	0.0338**	0.0338**	0.0399***	0.0401***
	(0.0153)	(0.0146)	(0.0145)	(0.0147)	(0.0147)
Size_PreTreat		-0.0179***	-0.0180***		
		(0.00430)	(0.00429)		
Risk Profile_ PreTreat		0.0338	0.0334		
		(0.0264)	(0.0261)		
Deposits Share_ PreTreat		-0.0414	-0.0415		
		(0.0315)	(0.0314)		
GDP growth			0.00346***		
			(0.00118)		
Inflation			-0.00332		
			(0.00207)		
Observations	3287	3239	3239	3287	3287
R-squared	0.091	0.230	0.236	0.654	0.660
Bank FE	no	no	no	yes	yes
Time FE	no	no	no	no	yes
# of clusters (banks)	132	128	128	132	132

Notes: The dependent variable in all models is the CAR. Post_2015 is equal to 1 in all quarters after 3/2015; Treated is equal to 1 for the banks with different values for Assets or Liabilities between their Prudential and Financial Conglomerates in 3/2015; Size is the natural logarithm of a bank's total assets (in thousands of Brazilian Reais). Risk Profile refers to the ratio between a bank's Risk Weighted Assets (RWA) and its total assets; Deposits Share refers to the ratio between a bank's total deposits and non-equity liabilities. The "_PreTreat" suffix means that the variable value is fixed in the latest year available before 2014; GDP growth is the quarterly variation of Brazilian GDP; Inflation is the quarterly variation of the Brazilian official price index (IPCA – Índice de Preços ao Consumidor Amplo). The differences between the number of observations and clusters among the setups are due to the unavailability of data. Robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Lastly, columns 4 and 5 modify the basic DiD model to include bank and time-fixed effects. The fixed effects are time-invariant or bank-invariant, replacing the bank-level and macroeconomic variables. Moreover, as the bank-fixed effects are correlated by construction with the *Treated* dummy, and time-fixed effects are correlated with the *Post* dummy, these variables are no longer identified in each case. For columns 4 and 5, the main coefficient of interest of *Post x Treated* presented an increase in magnitude and statistical significance, consistent with the results of the previous specifications, regardless of the saturation of the model with fixed effects. Furthermore, these changes occurred along with a remarkable increase in the regression fitness, as denoted by the observed variation of the R-squared. This is a good indication of the robustness of the previous inferences.

Additionally, it is worth noting that the results are consistent and quite similar in both Tables 1.2 and 1.3. It strengthens the hypothesis of treatment anticipation following the norm publication and that this effect continued in the subsequent year. In other words, banks responded to the announcement of the end of RCA incentives by increasing their regulatory capital levels and sustained this raise after the norm's effective application.

1.5.4. Testing for the effect of the treatment on the Credit/Assets ratio (H₂)

Tables 1.4 and 1.5 present equation (1.2) estimation with several variations. The dependent variable is the Credit/Assets ratio, and the regressions were done for both 2014 and 2015 as the treatment date. The basic DiD model results are in the first column, and all coefficients turned out statistically not significant (except marginally at the 10% level for *Post* in Table 1.5). It implies that the average Credit/Assets ratio (i) of the Control group did not present a material difference before and after the norm; (ii) are not statistically different between the groups in the pre-norm period; and (iii) did not change significantly for the treated banks in the post-norm period in comparison to their untreated counterparts. These findings do not support the second hypothesis that more restrictive rules regarding the regulatory capital can cause a reduction in a bank's propensity to lend through a risk shift from credit assets to other less risky assets.

These three conclusions remain stable regardless of the simulation. The results in column 2 reflect the addition of bank-level controls, and the only statistically significant is the coefficient of the variable *CAR*. It indicates that an increment of 1 p.p. in a bank's

CAR is associated with an average reduction of 0,738 p.p. in its Credit/Assets ratio, consistent with the idea that lower participation of credit assets in a bank's portfolio reflects in a reduction of total RWA, increasing the CAR. Unexpectedly, the size of a bank and the share of deposits in its total non-equity liabilities do not seem to explain the variation of the Credit/Assets ratio significantly. In column 3, the set includes the macroeconomic covariates *GDP growth* and *Interest Rate*. The coefficient of *GDP growth* indicates that an increment of 1 p.p. in the quarterly GDP reduces the percentage of credit assets of a bank's total assets in 0,00314 p.p. for the 2014 simulation (0,00425 p.p. for the 2015 simulation). However, it is only statistically significant at the 10% level for the 2014 simulation (5% level for the 2015 simulation). This is an unexpected result because the GDP is often positively associated with credit growth (Pham, 2015). Nevertheless, the magnitude of the impact is very low and may not have a relevant economic meaning in this case. Furthermore, the variable *Interest Rate* also did not present a statistically significant coefficient, suggesting that the cost of opportunity does not play a role in explaining the variation of the Credits/Assets ratio in this specific configuration.

Table 1.4. Differences-in-Differences: Credit/Assets regressions (Treatment = 2014)

Variables	Credit/Assets				
	(1)	(2)	(3)	(4)	(5)
Post_2014	-0.0318	-0.00826	-0.0216	-0.00916	
	(0.0195)	(0.0153)	(0.0172)	(0.0115)	
Treated	0.0315	0.00186	0.00183		
	(0.0515)	(0.0631)	(0.0631)		
Post_2014 x Treated	0.00976	-0.0112	-0.0111	-0.0188	-0.0192
	(0.0271)	(0.0236)	(0.0236)	(0.0182)	(0.0184)
Size_PreTreat		-0.0129	-0.0128		
		(0.0129)	(0.0129)		
Credit Risk_ PreTreat		0.694	0.693		
		(0.445)	(0.446)		
Deposits Share_ PreTreat		0.103	0.103		
		(0.117)	(0.117)		
CAR_ PreTreat		-0.738***	-0.736***		
		(0.243)	(0.243)		
GDP growth			-0.00314*		
			(0.00176)		
Interest Rate			0.00505		
			(0.00690)		
Observations	3287	3239	3239	3287	3287
R-squared	0.007	0.114	0.115	0.928	0.931
Bank FE	no	no	no	yes	yes
Time FE	no	no	no	no	yes
# of clusters (banks)	132	128	128	132	132

Notes: The dependent variable in all models is the Credit/Assets ratio. Post_2014 is equal to 1 in all quarters after 3/2014; Treated is equal to 1 for the banks with different values for Assets or Liabilities between their

Prudential and Financial Conglomerates in 3/2015; Size is the natural logarithm of a bank's total assets (in thousands of Brazilian Reais). Credit Risk refers to the ratio between a bank's absolute value of its Loan Loss Provisions (LLP) and its total loan assets; Deposits Share refers to the ratio between a bank's total deposits and non-equity liabilities;. CAR refers to the bank's Capital Adequacy Ratio; The “_PreTreat” suffix means that the variable value is fixed in the latest year available before 2014; GDP growth is the quarterly variation of Brazilian GDP; Interest Rate is the quarterly cumulated interest rate of Brazilian official sovereign interest rate (Selic). The differences between the number of observations and clusters among the setups are due to the unavailability of data. Robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 1.5. Differences-in-Differences: Credit/Assets regressions (Treatment = 2015)

Variables	Credit/Assets				
	(1)	(2)	(3)	(4)	(5)
Post_2015	-0.0351*	-0.0117	-0.0265	-0.0153	
	(0.0202)	(0.0172)	(0.0201)	(0.0124)	
Treated	0.0347	0.00153	0.00144		
	(0.0517)	(0.0635)	(0.0635)		
Post_2015 x Treated	0.00516	-0.0146	-0.0146	-0.0266	-0.0267
	(0.0295)	(0.0267)	(0.0267)	(0.0204)	(0.0206)
Size_PreTreat		-0.0127	-0.0126		
		(0.0129)	(0.0129)		
Credit Risk _PreTreat		0.689	0.685		
		(0.446)	(0.447)		
Deposits Share _PreTreat		0.103	0.103		
		(0.117)	(0.118)		
CAR _PreTreat		-0.738***	-0.737***		
		(0.243)	(0.243)		
GDP growth			-0.00425**		
			(0.00201)		
Interest Rate			0.00174		
			(0.00673)		
Observations	3287	3239	3239	3287	3287
R-squared	0.008	0.114	0.115	0.930	0.931
Bank FE	no	no	no	yes	yes
Time FE	no	no	no	no	yes
# of clusters (banks)	132	128	128	132	132

Notes: The dependent variable in all models is the Credit/Assets ratio. Post_2015 is equal to 1 in all quarters after 3/2015; Treated is equal to 1 for the banks with different values for Assets or Liabilities between their Prudential and Financial Conglomerates in 3/2015; Size is the natural logarithm of a bank's total assets (in thousands of Brazilian Reais). Credit Risk refers to the ratio between a bank's absolute value of its Loan Loss Provisions (LLP) and its total loan assets; Deposits Share refers to the ratio between a bank's total deposits and non-equity liabilities;. CAR refers to the bank's Capital Adequacy Ratio; The “_PreTreat” suffix means that the variable value is fixed in the latest year available before 2014; GDP growth is the quarterly variation of Brazilian GDP; Interest Rate is the quarterly cumulated interest rate of Brazilian official sovereign interest rate (Selic). The differences between the number of observations and clusters among the setups are due to the unavailability of data. Robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The last two columns include fixed effects as a replacement for bank-level and macroeconomic controls. The results in columns 4 and 5 do not alter the conclusions about the treatment's outcome, regardless of the year considered. One remarkable aspect

is the increase in the R-squared from the previous models, particularly after including the bank fixed effects. It indicates that the bank-fixed effects explain a great part of the variation of the Credit/Assets ratio. Therefore, features such as the bank's management style and business model may be more important in explaining a bank's allocation decision in credit or other assets, to the point that the regulatory change became irrelevant.

As a final remark, by contrasting this section's results with the previous one, it is possible to infer that the new consolidation rule did affect the banks with shadow entities, increasing their capitalization levels. Still, it did not come with a simultaneous migration of credit assets to other assets. It suggests that the banks were not insensitive to the regulatory strengthening, but they reacted by reinforcing their regulatory capital reserves instead of changing their business portfolio composition. A possible explanation is that they could offer this response because the treated banks are predominantly large banks, having easier and cheaper access to funding sources and greater profitability to capitalize using retained earnings. Therefore, the decision was to not risk the bank's profitability by lending less but rather increase the capital buffer and keep it "business as usual." This is also consistent with Pereira & Saito (2015, p. 76), who argue that less capitalized banks engage in major positive short-term adjustments for capital and lower adjustments for risk.

1.5.5. Robustness checks

1.5.5.1. Treatment effect over time

The first check aims to strengthen the assumption of parallel trends made before running the DiD regressions in previous sections. Moreover, it also helps to identify the treatment's effect over time, such as if it was permanent or temporary and if it happened at once or gradually. This test uses the non-parametric DiD version as presented in Schiozer et al. (2021), described in equation C below:

$$CAR_{i,t} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \sum_t \omega_t (Post_t \times Treated_i) + u_{i,t} \quad (1.3)$$

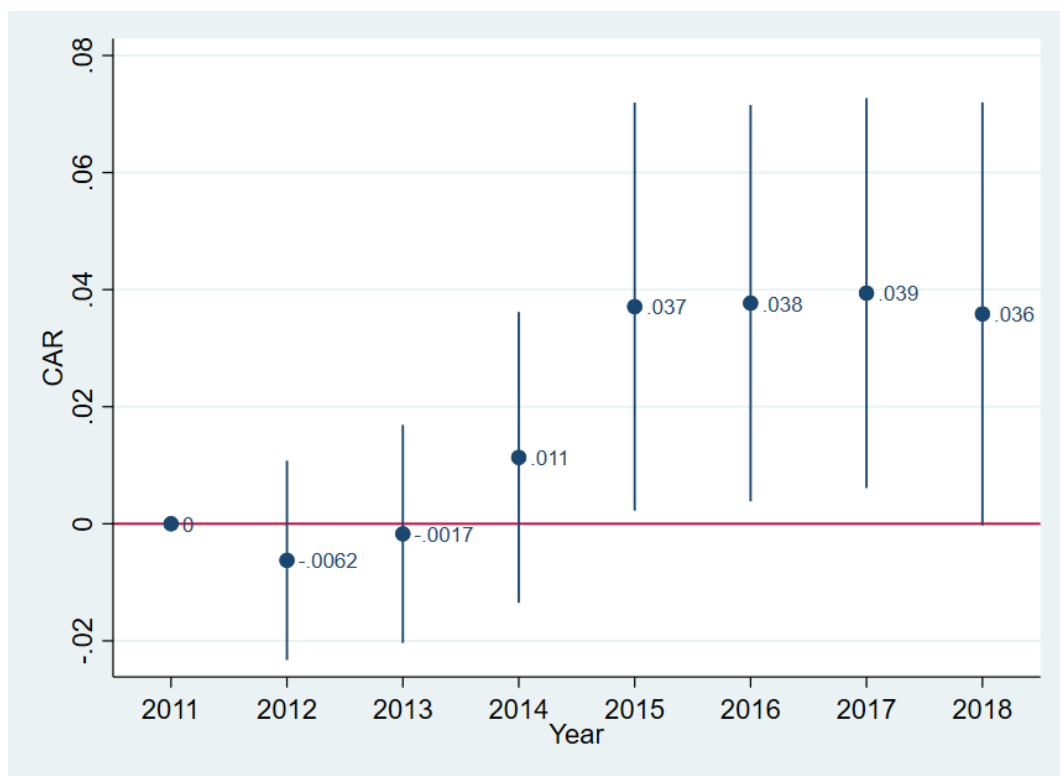
where $Post_t$ is equal to 1 if $time = t$, and 0 otherwise. The term in the summation symbol represents a series of interactions of the treatment dummy with each time of data (dropping one of them, usually the first). Therefore, the coefficients ω_t capture the

difference in *CAR* between treated and control banks on each date relative to the difference in the sample's first date.

For this check, the non-parametric DiD was estimated according to equation (1.3), plus the statistically significant controls found in the previous regressions in Tables 1.3 and 4 (*Size* and *GDP growth*). The vector of coefficients ω_t , along with their 95% confidence intervals, is depicted in Figure 1.3. The picture supports the assumption of

Figure 1.3 – Treatment effect over time (controlled for bank size and GDP growth).

Base = 2011



Notes: The CAR is the dependent variable of the regression. The dots represent the value of the coefficient ω_t in each year, and the vertical line delimits its confidence interval at the 95% level.

parallel trends before the treatment because the values of ω_{2012} and ω_{2013} are not statistically different from zero, as their vertical bars cross the horizontal axis. The magnitude of ω_{2014} cannot be statistically distinguished from zero, but it is higher than in previous years. It suggests that some effect might be starting, consistent with the hypothesis of treatment anticipation, even though not materially significant.

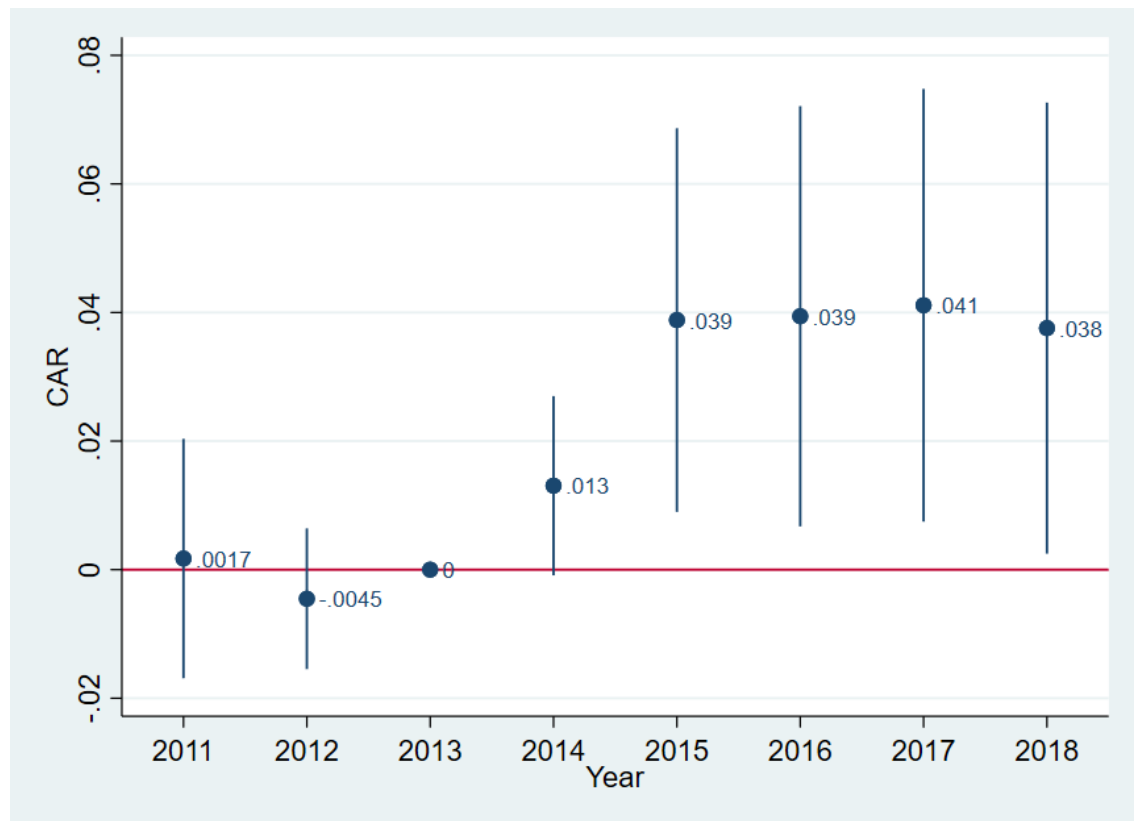
Nevertheless, the coefficients from ω_{2015} to ω_{2018} are all positive and statistically different from zero, supporting the hypothesis that the treatment happened in 2015 and

the treated banks raised their CARs in the post-norm period. Moreover, it shows that the treatment lasted at least until 2018, with almost all the impact in the first year (2015).

Schiozer et al. (2021) suggest, as an alternative test, setting the last year before the treatment as the reference date instead of the first year of the sample. The results for the re-estimation of ω_t using 2013 as the base date are plotted in Figure 1.4. Again, the

Figure 1.4 – Treatment effect over time (controlled for bank size and GDP growth).

Base = 2013



Notes: The CAR is the dependent variable of the regression. The dots represent the value of the coefficient ω_t in each year, and the vertical line delimits its confidence interval at the 95% level.

values of ω_{2011} and ω_{2012} are not statistically different from zero, as their vertical bars cross the horizontal axis. The coefficient ω_{2014} is higher and still not significant at the 95% level, but now for a very small margin, while all the other coefficients remain stable compared to the previous simulation.

1.5.5.2. Alternative specifications and placebo tests

As additional robustness checks, five alternative specifications for the DiD regression were done. First, the analysis period was extended by one year of each end of the sample,

ranging from 2010 to 2019. This is not a recommended procedure because too long periods can add more noise and unexpected events that may influence the results. However, if the estimates can be qualitatively sustained, it may be a good indication to support the original hypotheses. Second, a series of placebo tests were simulated using 2013, 2016, and 2017 as “sham” treatment years. If the placebo test does not present a statistically significant coefficient for the variable of interest *Post x Treated*, it can also reinforce the previous results.

The 2014 and 2015 extended period tests were re-estimated from the basic DiD model plus the bank-level and macroeconomic controls as in column 3 of Tables 1.2 and 1.3. For the placebo tests, the simulations were done using the basic DiD model and 3 pre-treatment and 3 post-treatment years in each case.

Table 1.6 presents the results of the tests. In column 1, the model sets 2014 as the treatment year, and the sample comprehends the 10 years from 2010-2019. The coefficient 0,0357 of *Post x Treated* is almost equal to the one reported in column 3 of Table 1.2 (0,0358) and is significant at the 5% level. The second column reports the results changing the first column treatment year to 2015. Again, the main coefficient of interest (0,0345) is similar to the 0,0338 previously estimated in column 3 of Table 1.3. This evidence that the results of previous estimations in Section 5.3 are robust even in a larger time frame analysis.

Columns 3 to 5 show the placebo tests using “sham” treatment years (2013, 2016, and 2017). The third column shows the results of a basic DiD placebo test in 2013 using the period from 2010 to 2015. The coefficient of *Post x Treated* is not statistically different from zero, meaning that the variation in CAR’s average of the treatment group from 2010-2012 to 2013-2015 did not differ significantly from the variation of the Control group between the same periods. It happens even with 2014 and 2015 being in the post-treatment period, where there is an actual treatment, strengthening the argument that there was no treatment in 2013. Column 4 displays the results for the placebo test using 2016 as the treatment date, the pre-treatment in the 2013-2015 interval, and 2016-2018 as the post-treatment period. Since the 2016-2018 range belongs to the actual treatment period, a

Table 1.6. Differences-in-Differences: CAR regressions (alternative time frames and placebo tests)

Variables	CAR				
	(1) 2010-2019 X =2014	(2) 2010-2019 X =2015	(3) 2010-2015 X =2013	(4) 2013-2018 X =2016	(5) 2014-2019 X =2017
Post_X	-0.00985 (0.0141)	-0.00570 (0.0137)	-0.0284** (0.0138)	0.00796 (0.0129)	0.0152 (0.0133)
Treated	-0.0480*** (0.0172)	-0.0433*** (0.0162)	-0.0926*** (0.0187)	-0.0658*** (0.0154)	-0.0592*** (0.0152)
Post_X x Treated	0.0357** (0.0163)	0.0345** (0.0160)	0.0268 (0.0164)	0.00398 (0.0162)	0.00229 (0.0169)
Size_PreTreat	-0.0179*** (0.00411)	-0.0180*** (0.00411)			
Risk Profile_ PreTreat	0.0368 (0.0273)	0.0369 (0.0273)			
Deposits Share_ PreTreat	-0.0500 (0.0307)	-0.0499 (0.0307)			
GDP growth	0.00370*** (0.00113)	0.00398*** (0.00117)			
Inflation	-0.00411* (0.00215)	-0.00354* (0.00205)			
Observations	3998	3998	2472	2470	2436
R-squared	0.224	0.224	0.108	0.075	0.061
Bank FE	no	no	no	no	no
Time FE	no	no	no	no	no
# of clusters (banks)	128	128	131	132	132

Notes: The dependent variable in all models is the CAR. Post_X is equal to 1 in all quarters after 3/X, where year X varies according to the specifications in the columns; Treated is equal to 1 for the banks with different values for Assets or Liabilities between their Prudential and Financial Conglomerates in 3/2015; Size is the natural logarithm of a bank's total assets (in thousands of Brazilian Reais). Risk Profile refers to the ratio between a bank's Risk Weighted Assets (RWA) and its total assets; Deposits Share refers to the ratio between a bank's total deposits and non-equity liabilities. The “_PreTreat” suffix means that the variable value is fixed in the latest year available before 2014; GDP growth is the quarterly variation of Brazilian GDP; Inflation is the quarterly variation of the Brazilian official price index (IPCA – Índice de Preços ao Consumidor Amplo). The differences between the number of observations and clusters among the setups are due to the unavailability of data. Robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

statistically significant coefficient for *Post x Treated* could indicate a continuous treatment that was still taking place. Nevertheless, the coefficient of 0,00398 is not only of very small magnitude but also statistically insignificant, supporting the idea that the shock was not gradual. The same happens with the last simulation, using the full treatment

period (2014-2016 and 2017-2019). The results in column 5 show that the coefficient of interest is not materially different from zero. So, the Treatment group's CAR average does not change more or less than its counterpart from the Control group between the 3 years before and after 2017. This supports that the treatment effect was all due in 2014 and 2015 since no effect was detected in 2017 (nor in 2016).

1.6. Conclusion

The capital-based regulation diffused worldwide after the Basel Accords, and its increasing importance, together with the need to deliver high profitability, pushed banks to look for solutions to arbitrage with the regulatory requirements. The rise of shadow banking is pointed out as one of the consequences of the minimum regulatory capital requirements and a great threat to banking system stability. This study investigated an accounting-based solution introduced in the Brazilian banking system to prevent shadow banking and RCA. To our knowledge, this is the first study to assess such kind of intervention to mitigate shadow banking issues.

The results indicate that extending the consolidation perimeter of the bank conglomerates can be an effective prudential supervision solution to enhance and strengthen the banking system. They show that the new standard promoted an elevation in the impacted banks' capitalization levels and did not impact their credit supply. The results are robust for several tests and alternative setups.

This paper contributes to the knowledge in three main ways. First, it strengthens the capital buffering theory in the stream of the literature that researches the effects of increased regulatory pressure on the banking system's capital levels. It extends the works of Furfine (2001), Milne & Whalley (2002), and Pereira & Saito (2015) by adding novel empirical evidence from an unresearched regulatory perspective. Consistent with the referred studies, this study found that increased regulatory pressure led the banks to raise their CAR levels conservatively.

Second, it adds to the stream of studies researching the effects of capital requirements on the bank's credit supply since the early 1990s with conflicting results. Contrary to the latest developments, this study did not find an impact on the bank's credit offering caused by increased capital requirements. Moreover, the results are consistent with the extended conclusions of the research on capital buffering theory, which found

that short-term adjustments made by less capitalized banks are made preferably in capital rather than in risk (Furfine, 2001; Milne & Whalley, 2002; Pereira & Saito, 2015).

Lastly, this paper contributes to the literature investigating the practical effects of new accounting standards in the banking industry, extending the stream resumed by Beatty & Liao (2014). It can be of value for both accounting standards researchers and policymakers.

Although we think the main conclusions may be generalized to banking contexts other than the Brazilian, caution is recommended in doing such a generalization due to the specific characteristics of the banking system and the legal and regulatory environment that may differ from each country. However, this constitutes an interesting research opportunity to be addressed in future studies using samples from different countries and alternative solutions to deal with regulatory capital arbitrage and shadow banking.

CHAPTER 2

Loan Loss Provisions and Regulatory Capital Arbitrage under different accounting standards

2.1. Introduction

The Basel framework for banking supervision established the regulatory capital as the minimum amount of equity banks must hold to ensure their solvency and stability (BCBS, 1988). However, regulatory capital requirements are not always aligned with the economic risks banks face, creating incentives for banks to engage in regulatory capital arbitrage (RCA). According to Jones (2000), RCA refers to exploiting the discrepancies between regulatory and economic capital⁹ by using transactions and structures that lower the effective regulatory capital charge without reducing the actual risk exposure. Consequently, RCA can undermine the effectiveness of prudential regulation and pose systemic risks to the financial system (Blum, 1999; Jones, 2000; Partnoy, 2001).

One of the main sources of RCA is accounting flexibility, which allows banks to influence their reported assets, liabilities, revenues and expenses to affect their regulatory capital ratios. Accounting flexibility can arise from ambiguities, inconsistencies, or gaps in accounting standards and is underlying managers' accounting estimates, judgments, or assumptions in applying accounting principles (Beatty & Liao, 2014; Kunkel, 2021). It can also be influenced by accounting frameworks, such as the International Financial Reporting Standards (IFRS) or the country's local GAAPs, which may differ in their definitions, recognition criteria, and measurement methods of financial instruments (BCBS, 2016a).

This paper investigates RCA through managerial discretion in recognizing loan loss provisions (LLP) to manipulate the capital adequacy ratio (CAR). The LLP expenses impact the regulatory capital through retained earnings, allowing it to be used as an instrument of RCA. Prior studies have investigated whether there is a relationship between LLP and regulatory capital, but the results are mixed. Leventis et al. (2011) and

⁹ The regulatory capital is calculated according to the regulator's rules, privileging high quality capital instruments, and need to observe a minimum amount to ensure the bank's going-concern according to its assets risk. The economic capital is the capital that shareholders would chose without regulation to optimize their utility function according to their goals (Elizalde & Repullo, 2007)

Pérez et al. (2008) did not find a significant relationship, while Bouvatier & Lepetit (2008), Kim & Kross (1998) and Kund & Neitzert (2020) found that banks with lower regulatory capital are less inclined to make LLP.

These studies mainly focused on European banks (except for Kim & Kross (1998), which studied US banks) in different periods ranging from as early as 1990 (Kim & Kross, 1998) until 2020 (Kund & Neitzert, 2020). They used different methods to relate the LLP and the regulatory capital, which can explain the differences in results. For instance, Kim & Kross (1998), Kund & Neitzert (2020) and Leventis et al. (2011) do not separate the discretionary from the non-discretionary part of the LLP in their research design. On the contrary, Bouvatier & Lepetit (2008) and Pérez et al. (2008) proposed models to segregate the discretionary LLP, but obtained contradictory results.

Our purpose is to contribute to solving this research gap with new empirical evidence from the Brazilian banking system. Unlike prior studies, we build on Beaver & Engel (1996) to develop a two-step panel regression with fixed-effects to estimate the discretionary LLP. Then, we isolate it from the total LLP and verify its relationship with the bank's CAR. Moreover, in line with prior studies that showed the importance of firm characteristics in accounting discretion (Bratten et al., 2020; Irani & Oesch, 2013; Menon & Williams, 2004), we controlled for bank-specific variables to investigate whether the relationship of the discretionary LLP and the CAR is linear, or if it is influenced by characteristics such as the quality of corporate governance, external oversight, and the type of ownership. Furthermore, taking advantage of a particular feature of Brazilian legislation that demands a group of banks to publish full financial statements under both the local and the international accounting standards, we examine if this relationship holds when the international standard is applied, instead of the local GAAP.

Our findings show that banks with lower (higher) values of CAR are associated with lower (higher) amounts of discretionary LLP, suggesting that managers reduce the amount of loan provisions to increase the CAR and avoid a regulatory violation, in line with Bouvatier & Lepetit (2008), Kim & Kross (1998), Kund & Neitzert (2020). Additionally, we found that this relationship between the CAR and the discretionary LLP is not significant for listed and state-owned banks, indicating that third-party monitoring and an enhanced governance structure, as well as the ownership type influence the

practice. Likewise, the effect is also reduced for foreign-controlled in comparison to national-controlled banks, possibly due to the same reasons, since multinational banks are bigger and have stocks listed in their home countries, but also conceivably for reasons related to a higher capital risk appetite. Lastly, we add that the local GAAP (BRGAAP) result does not meet the international standard. In this case, we could not find any significant relationship between the discretionary LLP and the CAR. This can be explained for two potential reasons: first, the absence of a strong incentive to manipulate the LLP under the international standard, since the CAR is computed under BRGAAP rules; second, the international standard has different rules regarding the LLP recognition, which may difficult or prevent the manipulative practice.

We contribute to the literature in three main ways. Firstly, we employed a different methodological design from prior studies to address the research question, allowing us to establish a more direct relationship between the discretionary LLP and the CAR. With this approach, we corroborate the results of the literature strand that argues in favor of the theory that banks do RCA using discretionary LLP. Moreover, we showed that the relationship is not linear and is influenced by the bank's characteristics, which affect the incentives for opportunistic behavior. Secondly, we extend the literature on alternative accounting standards and regulatory capital management (Pérez et al., 2008; Ribeiro et al., 2016; Stolowy & Ding, 2003) by adding novel evidence from an accounting standard (BRGAAP) outside the mainstream, demonstrating that banks can do RCA even under a local framework for LLP calculation stricter than the international standard. Thirdly, this is the first study to evaluate the practice of RCA management under different accounting standards, using the same sample and time frame. It allowed us to examine how a bank manager acts when pressured to do RCA in the official GAAP but also needs to report under a different accounting standard.

The rest of the document is organized as follows. Section 2.2 presents the literature review and develops the paper's hypotheses. Section 2.3 explains the research design and the econometric model we used to address the research problem. Section 2.4 describes the data collection process, sampling procedures, and presents the descriptive statistics. Section 2.5 reports and discusses the results, and Section 2.6 presents the conclusion and final remarks.

2.2. Literature review and hypotheses development

2.2.1. LLP and capital management

The information asymmetry between management and bank stakeholders, including owners, depositors, and regulators, leads to agency problems. These issues arise as managers prioritize their interests over those of the other parties involved (Fama & Jensen, 1983; Jensen & Meckling, 1976). Earnings management is one of the most common forms of managerial self-serving behavior and has been studied in the banking literature for a long time. Managers may engage in the upward manipulation of earnings to evade dismissal during periods of poor performance or, conversely, manipulate earnings downward when their bonuses have already reached the maximum threshold (Fan et al., 2019). Barth et al. (2017) add that bank managers, in particular, have the additional incentive to manipulate earnings to influence the regulatory capital.

Loan loss provisions (LLP) are accounting expenses calculated from estimations based on judgments of bank managers. They should reflect the expected losses of originating and held loans during the period (Tran et al., 2020). The LLP can be classified into two categories: non-discretionary and discretionary. Tran et al. (2020) explain that non-discretionary LLP are supposed to capture all adjustments reflecting the bank's performance fundamentals, while discretionary LLP are disconnected from performance fundamentals, representing a deviation from the adequate application of accounting rules, and are intended to manage earnings.

According to Bushman (2014), LLP is a critical accounting expense variable that impacts bank earnings significantly. Schipper (1989) adds that accounting accruals are crucial in earnings management practice, and LLP is the most significant accruals in the banking industry (Ahmed et al., 1999; Beaver & Engel, 1996). The regulatory capital is an adjusted version of the bank's equity that considers only higher-quality capital instruments capable of absorbing the bank's losses. Therefore, since the LLP expense impacts the bank's capital through retained earnings, the LLP discretion can be used as an instrument for capital management and RCA.

The way LLP impacts regulatory capital and capital adequacy has changed over time, reflecting the evolution of bank supervision regulation. Prior studies from the 1990s investigated the subject before the Basel I Accord and associated the use of LLP in capital management. For example, Moyer (1990) found that banks inflate LLP to raise capital levels when close to a violation, establishing a negative association between LLP and capital ratios, a result that was consistent with other studies (Beatty et al., 1995; Scholes et al., 1990; Wahlen, 1994). In these studies' context, the arbitrage was done by exploring a pre-Basel regulatory shortcoming that included LLP in the regulatory capital calculation. Even though LLP expenses impact the regulatory capital negatively by reducing the bank's equity through retained earnings, it was allowed to add the LLP back into the regulatory capital calculation. However, due to tax deduction rules, the final effect was not neutral, and for each monetary unit increase in the LLP, the bank could obtain a gain in the regulatory capital of one times the tax rate (Moyer, 1990). Consequently, banks with low regulatory capital had incentives to increase LLP.

With the Basel I and later amendments changes, the use of LLP in regulatory capital calculation became more restricted. It was eliminated from the computing of Tier 1 and Tier 2 capital, and was limited to a small fraction of the risk-weighted assets (RWA). The new setting changed the effect of LLP on the CAR, making it more difficult to predict its influence on capital management because increasing LLP has contrary impacts on Tier 1 and Tier 2 capital (Ahmed et al., 1999). While an increment (decrease) in the LLP will reduce (increase) Tier 1 capital through retained earnings, it could still raise (lower) a minor part of the Tier 2 capital. Therefore, how a manager would do RCA using LLP will depend on the bank's capital structure and the size of its risk-weighted assets portfolio.

Those mixed incentives reconfigured the relationship between LLP and capital management, and the empirical question has been revisited with inconclusive results. Ahmed et al. (1999) reexamined the subject by comparing pre-and post-Basel data from US banks and found support for the hypothesis that LLP is still used for capital management. However, the negative relationship was weaker when compared to the old regulatory context. Kim & Kross (1998) found that banks with lower capital ratios use LLP for capital management, but the relationship between the variables reversed in the new regime. Their results suggest that banks facing capital restrictions may reduce LLP instead of increasing it, contrary to most studies before the regulatory change. Bouvatier

& Lepetit (2008) also corroborated it for European banks, finding that poorly capitalized banks manage regulatory capital by decreasing (increasing) their LLP when their regulatory capital decreases (increases). This suggests that, on average, the negative impact on Tier 1 capital may supersede the benefits on Tier 2 capital.

On the other hand, Pérez et al. (2008) studied the Spanish banking system in the 1986-2002 period and did not find evidence of capital management through LLP. Curcio & Hasan (2015) studied European banks from 1996-2006. They found evidence of capital management by LLP only for banks outside the Eurozone, suggesting that local regulation and policies may influence managers' incentives for RCA. Leventis et al. (2011) explored a dataset of listed commercial banks in the EU for the 1999-2008 period to test whether the IFRS implementation influenced the use of LLP in capital management and could not find support for pre-and post-IFRS periods. Elnahass et al. (2018) investigated Islamic and conventional banks from countries in the Middle East from 2007-2013. They concluded that conventional banks use LLP to manage regulatory capital, but Islamic banks do not. Kund & Neitzert (2020) found that European banks opportunistically reduce discretionary LLP to raise the regulatory capital, improving the capital resilience in regulatory stress tests under IAS 39 – Financial instruments and IFRS 9 – Financial instruments. Finally, Galdi et al. (2021) show that regulatory capital does not relate to discretionary LLP accruals for their sample of Brazilian banks, neither under IAS 39 nor under the local GAAP (BRGAAP).

The distinct empirical evidence raised attention to the importance of considering local features influencing the incentives for RCA via LLP. There are three main reasons for this. First, not all countries fully adopted Basel prescriptions for regulatory capital calculation. For example, Pérez et al. (2008) report that, unlike other European countries, Spain's national government has tightened the Basel rules for LLP, and loan loss reserves were counted as neither Tier 1 nor Tier 2 capital.

Second, there may be crucial differences between national GAAP standards for LLP applied exclusively for bank accounting that can discourage or incentivize RCA. For example, as Pérez et al. (2008) mentioned, Spanish banks were managed under prescriptive and detailed rules on LLP that contrasted with the discretion that bank managers enjoyed in many other countries.

Lastly, in addition to the legal constraints, ethical, political, and professional conditions may influence the incentives for regulatory arbitrage (Fleischer, 2010). For example, Elnahass et al. (2018) show that Islamic banks tend not to engage in capital or income smoothing through LLP, while conventional banks in the same country do. The authors justify this difference in the constraints imposed by the business model and governance system derived from the Islamic banking ethos, which “emphasizes ethical behavior and moral accountability” (Elnahass et al., 2018, p. 21).

2.2.2. Accounting standards rules for LLP

The accounting standards are crucial in influencing how management can deploy RCA through LLP discretion. The BRGAAP details the LLP rules in the Resolução CMN 2.682/1999. The norm is a hybrid model based on incurred and expected losses. Financial institutions must categorize credit operations into nine increasing levels of risk (from AA to H) that should consider many aspects related to the probability of future defaults (expected losses) and review it periodically. Moreover, each one of the levels has a minimum fixed percentage of LLP to be recognized upon the loan register.

Nevertheless, the norm has a trigger that can overrule the bank’s classification if a loan payment is delayed. The bank must reclassify the loan into the correspondent level letter, according to the number of days past due, and recognize the corresponding LLP. This rule introduces a strong incurred-loss component into the Brazilian model by demanding a mandatory amount of provision mechanically connected to the days of delay, regardless of the actual loss expectation. Even so, Schechtman & Takeda (2018) highlight that despite the little discretionary space for estimating the minimum LLP, bank managers still have a degree of discretion to recognize LLP above the minimum because of their actual loss expectation. In addition, we emphasize that, in general, just a minor fraction of the loan portfolio will be delayed. Thus, the LLP will still be dependent on the bank’s credit risk assessment and, therefore, subject to managers’ discretion to a certain extent.

The international standards’ rules applied to LLP were prescribed by IAS 39 (until 2017) and IFRS 9 (since 2018). On the one hand, under IAS 39, the loan loss provisioning was primarily a backwards-looking process, focusing on incurred losses. Banks recognized impairments (provisions) only when there was objective evidence of a loss

event, such as a significant financial deterioration of the debtor. Nevertheless, it also stated that the manager should consider other aspects, such as the macroeconomic cycle, that could affect future cash flows due to the event of loan loss.

On the other hand, IFRS 9 introduces a significant shift by mandating the recording of LLP based on expected losses, intending to mitigate credit losses through early provisioning as soon as the financial asset is recognized on the financial statements. An important change from the former standard is that, under IFRS 9, even performing loans may need to be provisioned according to the bank's projected losses. Conversely, under the IAS 39, this would happen, in general, only for non-performing loans (impacted by an objective loss event).

While the Brazilian norm has similarities with both standards, it is the more restrictive of the three. It is because, under BRGAAP, banks must register LLP for the expected losses of performing loans upon recognition, such as in IFRS 9, and must recognize provisions after a loss event (days overdue), like in IAS 39, but even more restrictive due to the unconditional minimum ratios.

The rules for the regulatory capital calculation are independent of the accounting standards that define the LLP rules. Therefore, the ability to do RCA will depend on the accounting standard that rules the measurement of CAR inputs. In the Brazilian case, the CAR is estimated using the accounting data collected from the financial statements produced under the BRGAAP (also known as "Cosif"), the official standard for the Brazilian banking system. Consequently, the incentives for RCA to use the LLP are related to the BRGAAP rules, not international standards (IAS 39 or IFRS 9). Nevertheless, since the banks in our sample publish a full set of financial statements simultaneously in national and international standards, whether the RAC would be replicated in both publications remains an empirical issue discussed in the forthcoming sections.

2.2.3. Hypotheses development

The study's main hypothesis regards the relationship between the discretionary LLP and the bank's regulatory capital. Similar to the Spanish situation described in Pérez et al. (2008), Brazilian banks cannot include LLP in regulatory capital. In this case, banks can

only manage their regulatory capital using LLP to affect retained earnings – increasing the LLP lowers banks' earnings and reduces regulatory capital (Pérez et al., 2008). Hence, to do RCA, banks with lower capital adequacy ratios have an incentive to reduce discretionarily the amount of LLP, consistent with Bouvatier & Lepetit (2008) and Kim & Kross (1998). As mentioned before, the CAR is calculated using inputs deriving from the financial statements produced under BRGAAP rules. Thus, the first hypothesis is stated as follows:

H₁: Under BRGAAP, there is a positive relationship between the banks' CAR and their amount of discretionary LLP.

Next, we analyze the shape of the relationship described in H₁, whether it is linear in bank characteristics. The literature presents features that seem to increase or mitigate the accounting discretion, such as the quality of the independent auditor (Bratten et al., 2020; Glaser et al., 2013); the capital market oversight (e.g., a higher number of analyst coverage, rating agencies) (Irani & Oesch, 2013); and the strength of the corporate governance (Klein, 2002; Menon & Williams, 2004). Banks with stocks traded in a regulated stock exchange must observe stricter rules regarding audit quality, corporate governance and to attract greater market oversight. On the contrary, state-owned banks are known for suffering from political interference and having weaker governance (Hallerberg & Markgraf, 2018). An environment with tighter (looser) internal controls and external monitoring should make it harder (easier) for bank managers to use discretionary LLP aiming to influence the CAR. Therefore, the RCA is expected to be lower (higher) for listed (state-owned) banks relative to non-listed (private-owned) banks because such bank features are expected to act as moderators. Thus, we state hypotheses 2 and 3 as follow:

H₂: The relationship between the banks' CAR and their amount of discretionary LLP is lower for listed banks compared to non-listed.

H₃: The relationship between the banks' CAR and their amount of discretionary LLP is lower for private-owned banks compared to state-owned.

Additionally, even though the main incentive for RCA is the capital shortage, the bank's policy regarding capital risk appetite/aversion can influence the triggers for the

arbitrage. For example, a bank manager facing a higher CAR may have a higher incentive to manipulate the LLP than a manager facing a lower CAR if the former manages a bank in which capital planning requires a higher buffer (Milne & Whalley, 2002). Bank capital policies and buffer levels vary across countries depending on regulation and supervision (Fonseca & González, 2010). Consequently, it is plausible that managers of foreign-controlled banks may have different incentives for RCA than national-controlled banks. Since the total capital requirements in the European Union (EU) and the United States (US) (8%) are lower than in Brazil (11%), we speculate that foreign-controlled banks are more likely to have greater regulatory capital risk appetite and lower arbitrage less than Brazilian banks. Furthermore, multinational foreign-controlled banks are usually large and have stocks listed in their home countries, being influenced by the same incentives of listed banks described in the previous paragraph. Then, the fourth hypothesis of the study is stated as follows:

H₄: The relationship between banks' CAR and their amount of discretionary LLP is lower for foreign-controlled ones compared to national-controlled.

Lastly, we recall that in Brazil, banks simultaneously publish a full set of financial statements (balance sheets, income statements, etc.) under both national (BRGAAP) and international standards. However, since the CAR is only monitored by the bank supervisor for the BRGAAP, LLP discretion under the international standards will not cause an actual impact on the CAR monitored by the Brazilian supervisor. Consequently, it is unclear whether managers will explore the LLP discretion under international standards as they do under the national GAAP.

Nevertheless, although the accounting standards are different, the economic situation of the bank is unique, and the incentive for the arbitrage is the capital shortage. If managers adopt discretionary LLP under the BRGAAP for RCA, the financial statement under the international standards should reflect the same behavior to be consistent. Otherwise, they would not represent the same economic situation of the bank. Since both reports should be reconcilable, with discrepancies explained in the notes, and are independently audited and monitored by the regulators, an incompatibility between them could be noticed (BCB, 2020).

When uncovered, discretionary accounting practices negatively impact the firm's value, transactions, reputation, lead to loss of support from investors, increase the surveillance by auditors and regulators, and result in financial constraints (Fombrun; et al., 2000; Martínez-Ferrero et al., 2016; Roychowdhury, 2006). Even though the usage of discretion under the international standards statements does not impact the CAR, there is a potential cost of not replicating the opportunistic behavior in both standards, because it increases the risk of being uncovered. Therefore, assuming that the manager has the incentives and willingness to use the discretionary LLP for RCA, it is plausible that this should be reflected in both sets of financial statements, to avoid inconsistencies that can expose the discretion. The differences between them will stay only in the extent each standard allows for higher or lower LLP discretion. Then, as in H1, we state the last hypothesis for the international standard as follows:

H₅: Under International Standards, there is a positive relationship between the banks' CAR and their amount of discretionary LLP.

2.3. Research design

This section details the variables and the econometric model used to address the study's hypotheses. Two types of procedures are commonly adopted to investigate the determinants of the discretionary LLP in earnings/capital management studies. The first consists of a one-step model, that uses a single equation to estimate the association between a previously defined variable representing the discretionary provisions and the regressors of interest, which may explain the opportunistic behavior. This is the kind of approach adopted by Ahmed et al. (1999), Alali & Jaggi (2011), Kim & Kross (1998), Lobo & Yang (2001), Shrieves & Dahl (2003), among others.

The second type is a two-step model, consisting of a first step that segregates the discretionary and the non-discretionary parts of the LLP. The second step assesses its relationship with the variables that may explain opportunistic behavior. This is the kind of approach adopted by Beaver & Engel (1996), Bushman & Williams (2012), Cheng et al. (2011), Dantas et al. (2013), Kanagaretnam et al. (2003, 2004, 2009), Kanagaretnam, Krishnan, et al. (2010), Kanagaretnam, Lim, et al. (2010), among others. The advantage

of this model is that it relies on the observed LLP expenses to estimate the variable representing the unobserved discretionary LLP. This way, the dependent variable is modeled before the second step, enabling us to find the regressors leading to a better adjustment instead of relying on a proxy. This is the approach we adopt, which we will detail in the following sections.

2.3.1. First-step

The first step is based on Beaver & Engel (1996) model to split the total amount of LLP into discretionary and non-discretionary provisions. In short, it consists of regressing the total LLP expense against the variables that objectively influence it. With the estimation concluded, we assume that the predicted values of the LLP resulting from the model are the non-discretionary LLP (explained by objective inputs) and that the residuals (the difference between the actual observed LLP and the predicted ones) are the discretionary LLP (not explained by the model). Equation (1) below represents the regression's first-step model:

$$\begin{aligned}
 LLP_{i,t} = & \beta_0 + \beta_1 LWO_{i,t-1} + \beta_2 \Delta NPL_{i,t} + \beta_3 Reneg_{i,t} + \beta_4 LoA_{i,t} + \beta_5 \Delta Loans_{i,t} \\
 & + \beta_6 ALL_{i,t-1} + \beta_7 Interest_{i,t} + \beta_8 GDP_{i,t} + \beta_9 Unemployment_{i,t} \\
 & + \beta_{10} Selic_{i,t} + \beta_{11} EPU_{i,t} + \beta_{10} EUI_{i,t} + \varepsilon_{i,t}
 \end{aligned}
 \tag{2.1}$$

where:

$LLP_{i,t}$ is the amount of loan loss provision expenses scaled by the total loan portfolio at t for bank i ;

$LWO_{i,t-1}$ is the amount of loan write-offs, net of any credit recovery, scaled by the total loan portfolio at $t - 1$ for bank i ;

$\Delta NPL_{i,t}$ is the variation of non-performing loans from time $t - 1$ to t scaled by the total loan portfolio at $t - 1$ for bank i ;

$Reneg_{i,t}$ is the amount of renegotiated loans scaled by the total loan portfolio at time t for bank i ;

$LoA_{i,t}$ is the ratio of loans over total assets at time t for bank i ;

$\Delta Loans_{i,t}$ is the variation of the loan portfolio from time $t - 1$ to t scaled by the total assets at $t - 1$ for bank i ;

$ALL_{i,t-1}$ is the volume of allowances for loan losses (LLP stock) scaled by the total loan portfolio at time $t - 1$ for bank i ;

$Interest_{i,t}$ is the yearly average implicit loan interest rate (loans revenue over total loans) at time t for bank i ;

GDP_t is the yearly gross domestic product growth at time t ;

$Unemployment_t$ is the yearly average unemployment rate at time t ;

$Selic_t$ is the sovereign interest rate, deflated by the inflation of the period, at time t ;

$EPUbr_t$ is the Brazilian Economic Policy Uncertainty index, at time t ;

$EUIbr_t$ is the Brazilian Economic Uncertainty Indicator, at time t ;

$\varepsilon_{i,t}$ is the residual of the regression, representing the discretionary amount of LLP at time t for bank i .

We based on the extant literature previously referred to select firm-specific and macroeconomic variables that could directly or indirectly influence the LLP. First, the variables LWO , ΔNPL , and $Reneg$ are directly related to the risk of a loan portfolio and should be associated with the LLP, both because they indicate incurred losses or signal future defaults (Beaver & Engel, 1996; Bushman & Williams, 2012; M. S. Kim & Kross, 1998). The predicted signals of all coefficients are positive, as the greater their values, the riskier the loan portfolio, demanding higher provisioning.

We also include several variables to account for the banks' portfolio characteristics. First, the LoA measures the ratio of credit assets relative to a bank's total

assets. Banks with higher *LoA* are likely to have higher values of LLP, predicting a positive signal for this variable. Likewise, variable $\Delta Loans$ aim to capture the amount of the LLP originated by the growth of the credit portfolio. Since the LLP variable is scaled by total loans, in both cases, the premise behind the prediction is that an expansion of the credit portfolio (either relative, as in *LoA*, or absolute, as in $\Delta Loans$) is likely to be followed by an increase in the risk, influencing the LLP (Dantas et al., 2013; Kanagaretnam, Krishnan, et al., 2010). Finally, the variables *ALL* and *Interest* proxy for the portfolio's risk. While the *ALL* measures the cumulated amount of provisions stocked into the credit portfolio, the *Interest* computes the average interest rate of the loan portfolio. Both variables are directly associated with the portfolio's risk level and should have a positive signal (Dantas et al., 2013).

The macroeconomic variables try to capture the events that affect banks systemically. We expect a negative signal for the GDP because the better the economic growth, the lower the credit delinquency and, therefore, the necessity for LLP. Conversely, *Unemployment* should have a positive signal since a greater value indicates a higher number of unemployed people, increasing the risk of loan default (and the increase in LLP). The deflated *Selic* accounts for the economy's real interest rate and should be positively related to the LLP because higher interest rates are associated with higher default levels. Lastly, we use two indicators for economic uncertainty that can influence managers' discretionary behavior. The *EPUbr* (Brazilian Economic Policy Uncertainty) indicator measures policy-related economic uncertainty, while the *EUIbr* (Brazilian Economic Uncertainty Index) proxy market-related uncertainty. These variables should be positively associated with the LLP because the greater the uncertainty, the higher the risk, which influences financial decisions such as credit provisioning (Al-Thaqeb & Algharabali, 2019).

Equation (2.1) is estimated using a pooled OLS with cluster-robust standard errors in two specifications. First, with bank fixed-effects and the macroeconomic variables; second, for a robustness test, with both bank and year fixed-effects, but dropping the macroeconomic variables because of the perfect collinearity with the year dummies.

2.4.2. Second-step

The next step takes the residuals of the first step equation as the dependent variable ($dLLP$) in equation (2.2) below. As in Galdi et al. (2021), we used the absolute values of the residuals because our interest is in the opportunistic manipulation of the discretionary LLP, regardless of whether it is towards higher or lower provisioning since the arbitrage can occur in both directions.

$$\begin{aligned}
 dLLP_{i,t} = & \beta_0 + \beta_1 CAR_{i,t-1} + \beta_2 Listed_{i,t} \cdot CAR_{i,t-1} + \beta_3 State_{i,t} \cdot CAR_{i,t-1} \\
 & + \beta_4 Foreign_{i,t} \cdot CAR_{i,t-1} + \beta_5 EBTP_{i,t} + \beta_6 Listed_{i,t} \cdot EBTP_{i,t} \\
 & + \beta_7 State_{i,t} \cdot EBTP_{i,t} + \beta_8 Foreign_{i,t} \cdot EBTP_{i,t} + \beta_9 Listed_{i,t} \\
 & + \beta_{10} State_{i,t} + \beta_{11} Foreign_{i,t} + \beta_{12} Size_{i,t} + \varepsilon_{i,t}
 \end{aligned}
 \tag{2.2}$$

where:

$dLLP_{i,t}$ is the absolute value of the residuals of equation (1) representing the amount of discretionary loan loss provisions scaled by the total loan portfolio at t for a bank i ;

$CAR_{i,t-1}$ is the value of the capital adequacy ratio¹⁰ provided by the Central Bank of Brazil in period $t - 1$ for a bank i ;

$EBTP_{i,t}$ is the amount of earnings before taxes and provisions (scaled by total Assets) in period t for a bank i ;

$Listed_{i,t}$ is a dummy variable that assumes the value 1 if the bank i has shares traded on B3 (Brazilian Stock Exchange) in period t , and 0 otherwise;

$State_{i,t}$ is a dummy variable that assumes the value 1 if the bank i is controlled by a public stockholder in period t , and 0 otherwise;

¹⁰ The CAR is the quotient of the division of the bank's regulatory capital by its Risk Weighted Assets (RWA)

$Foreign_{i,t}$ is a dummy variable that assumes the value 1 if the bank i is controlled by a foreign stockholder in period t , and 0 otherwise;

$Size_{i,t}$ is the natural logarithm of the bank i total assets in period t .

The model is based on Galdi et al. (2021) but has some important modifications. First, we included the dummy variable *Foreign* in addition to *Listed*, *Public*, and *Size*. *Listed* evaluates whether the market oversight and the enhanced governance of listed banks can mitigate the managerial discretion; *State* captures the difference between the managerial decisions of state and private-owned banks; and *Size* collects the differences between large and small banks that may be associated with LLP discretion. Including *Foreign* aims to verify if foreign-controlled banks have a different LLP discretion behavior relative to national banks.

Second, we added the interaction variables with the dummies and the other variables of interest to address H₂, H₃ and H₄. Lastly, we used the lagged CAR as our main regressor of interest. If the manager decides to opportunistically manipulate LLP in the context of RCA, it will happen due to a regulatory capital need. Therefore, the CAR value at the time t (the year-closing value) would already reflect the manipulation in LLP throughout t . Since we are interested in verifying whether the CAR influences the LLP discretion, we used the CAR value at the beginning of the period t (the year-closing value of $t-1$) and β_1 is our main coefficient of interest.

The variable *EBTP* is included to control for the impact of earnings on discretionary LLP. Even though we are looking at the use of *dLLP* to manage earnings that will indirectly result in capital management, the use of discretionary LLP can be motivated purely by the need to manipulate the earnings themselves, for instance, to smooth income (Greenawalt & Sinkey, 1988; Jin et al., 2018; Kanagaretnam et al., 2004; Ozili, 2015; Ozili & Outa, 2017; among others). Even though this is not part of our research question and is out of the study scope, it was important to include it to control the changes in *dLLP* that are not driven by capital management purposes. Therefore, if the coefficient is significant, it suggests that the *EBTP* is a determinant of *dLLP*, and the bank may be using discretionary LLP motivated by pure earnings management purposes.

As in the previous section, equation (2.2) is estimated using a pooled OLS with clustered-robust standard errors. Since the residuals of equation (2.1) were estimated in the first step using fixed effects (with two specifications), the estimation for equation (2.2) was not used to avoid redundancy.

2.3.3. Endogeneity issues

One possible shortcoming of our model is related to the possibility of multiple sources of endogeneity in the two-step approach. The first is endogeneity caused by omitted variables. We address this issue by doing a comprehensive review of the literature regarding the determinants of our dependent variables and including as many variables as possible whilst avoiding the inclusion of “bad controls” as well. Additionally, we use alternative variables in the robustness tests.

The second possible problem is the possibility of endogeneity caused by simultaneity or reverse causality. We highlight particularly the cases of the ALL (allowances for loan losses) and the LWO (loans write-offs) variables, which are likely endogenous in our first step, and the CAR in the second step. When LLP expenses are recognized or reversed, it directly impacts the balance of the ALL account. Conversely, when the ALL account is increasing, it can signal risk deterioration, impacting future LLP. Likewise, an increment in the LLP expenses can signal an irreversible loan loss that will be written off in the future, impacting the LWO variable. But, at the same time, an increase in the LWO may denote a generalized deterioration of the portfolio, leading to future LLP expenses. Finally, the CAR is impacted by the LLP expenses/reversion through cumulated income, but it also can influence the amount of discretionary LLP when there is an RCA in place. Therefore, the three variables are sources of endogeneity, and to mitigate this issue, we use their one-year lagged values. Additionally, as a robustness test, we replace the CAR_{t-1} variable by its contemporaneous value CAR_t and estimate a 2-Step System Generalized Method of Moments (GMM) model instrumenting it with its lagged value (CAR_{t-1}) and the EBTP. More details and results are discussed in Section 2.5.3.

The third possible source of endogeneity is the measurement error in our independent variables. This is more unlikely to happen, given our regressors are

composed mainly of directly observable variables and not of proxies that might misrepresent their values. Nevertheless, this can happen with our macroeconomic variables, which are, by nature, always proxies for the economic conditions that can affect the regression outcomes. Given that this issue is hardly solved, we rely on doing time-fixed effects robustness tests to mitigate such a possibility.

2.4. Data and sampling procedures

2.4.1. Sample and sources of data

The sample contains all Brazilian banks (individual institutions or conglomerates, when applied) publishing financial statements in national (BRGAAP) and international standards. The time frame is 13 years between 2010, the first year the banks started publishing both documents simultaneously, and 2022, the last year available. Nevertheless, because the equations demand some time-lagged variables, the usable sample discards the first year and considers the period between 2011 and 2022. From 2011 to 2017, the data reflects the IAS 39 standards, while the statements produced in the next five years are based on the IFRS 9. In parallel, the BRGAAP data is available for the whole period.

The data for the international standards were hand-collected from the banks' online financial statements. For the BRGAAP, we extracted the data from the Brazilian Central Bank's public repository that congregates a structured database of the bank's financial statements and regulatory capital reports. Due to the heterogeneity of financial statements among institutions and throughout the years, some information was unavailable for some banks and years. Moreover, not all banks had data for all years for several reasons (discontinued activities, mergers/acquisitions, ineligibility to publish, or just unavailable online). Considering all restrictions, our sample comprises an unbalanced panel of 41 clusters (entities) and 434 observations for the whole period. Nonetheless, the number of usable observations may vary depending on the setting of each regression due to the panel imbalances.

Additionally, we collected data from two complementary sources for the macroeconomic variables. First, the website Economy Policy Uncertainty (www.policyuncertainty.com) provides indicators of economic policy uncertainty for

several countries, including Brazil. Second, the IPEA Data website (www.ipeadata.gov.br) for the Brazilian GDP, Unemployment, Interest Rate, Inflation, Exchange Rate and Country-Risk EMBI+ (Emerging markets bond index plus).

2.4.2. Descriptive statistics

The descriptive statistics for the main variables are in Table 2.1. From 2011 to 2022, the LLP expenses averaged 2.89% of the total loans under the BRGAAP standard, higher than the 2.49% observed for the international standard. The t-test for mean comparison rejects the hypothesis that the means are equal at the 95% significance level ($t = 2.0226$). The higher level of LLP expenses under the BRGAAP may reflect the mandatory minimum provisioning rule of the Brazilian standard that does not exist on the international one.

The amount of written-off loans is lower for the BRGAAP compared to the international standard, which is 1.67% and 2.10%, respectively. The discrepancy can be attributed to a rule in the BRGAAP that requires the banks to keep 100% provisioned loans on the books for 180 days before writing-off, which can occasionally maintain irreversibly deteriorated loans for a longer period than it would be under the international standard rules. Regarding the change in the non-performing loans during the period, the banks had a higher variation under the Brazilian norm than under the national model (0.17% and 0.10%, respectively). Additionally, the volume of renegotiated credits was similar in both standards, with the means under the Brazilian norm slightly higher (5.6% for the BRGAAP and 5.1% for the international standard).

Despite the differences in the LLP expense under each of the standards, the average allowance for loan losses (ALL) – the accumulated LLP – is similar for both GAAPs (4.5% for the BRGAAP and 4.4% for the international standard). The t-test for mean comparison can't reject the fact that the ALL for both standards are equal ($t = 0.0503$). It suggests that although the standards can have different impacts on the banks' income statements in the short term, in accumulated terms, taking into account the usage of such provisions, the coverage of the loans in the balance sheet is statistically equal under both standards.

Table 2.1. Descriptive statistics

2011-2022						
	BRGAAP			International		
	Mean	SD	Median	Mean	SD	Median
<i>LLP</i>	0.0289	0.0279	0.0232	0.0249	0.0262	0.0218
<i>LWO</i>	0.0167	0.0986	0.0104	0.0210	0.0297	0.0159
<i>DNPL</i>	0.0017	0.0241	0.0000	0.0010	0.0196	0.0000
<i>Reneg</i>	0.0564	0.1271	0.0253	0.0512	0.1255	0.0210
<i>LoA</i>	0.3567	0.2275	0.3539	0.4242	0.2466	0.4401
<i>ALL</i>	0.0455	0.0306	0.0456	0.0441	0.0582	0.0377
<i>Interest</i>	0.1818	0.0993	0.1659	0.1397	0.0804	0.1317
<i>EBTP</i>	0.0232	0.0195	0.0217	0.0243	0.0200	0.0225

2011-2022			
Other variables	Mean	SD	Median
<i>Public</i>	0.1336	0.3407	0
<i>Foreign</i>	0.4032	0.4911	0
<i>Listed</i>	0.4355	0.4964	0
<i>CAR</i>	0.1758	0.0635	0.1612
<i>Assets (BRGAAP)</i>	187.0	407.0	25.2
<i>Assets (International)</i>	190.0	424.0	23.3
<i>GDP</i>	0.0090	0.0275	0.0130
<i>Selic</i>	0.0282	0.0337	0.0254
<i>Unemployment</i>	0.1020	0.0269	0.1170
<i>EPUbr</i>	201.90	71.03	165.10
<i>EUIbr</i>	112.70	16.17	113.00

Notes: SD stands for “standard deviation”. *LLP* is the amount of loan loss provision expenses scaled by the total loan portfolio at the beginning of the year; *LWO* is the amount of loan write-offs, net of any credit recovery scaled by the total loan portfolio at the beginning of the year; *DNPL* is the variation of non-performing loans scaled by the total loan portfolio; *Reneg* is the amount of renegotiated loans scaled by the total loan portfolio; *LoA* is the ratio of loans over total assets; *ALL* is the volume of allowances for loan losses scaled by the total loan portfolio at the previous year; *Interest* is the yearly average implicit loan interest rate (loans revenue over total loans); *EBTP* is the amount of earnings before taxes and provisions scaled by total assets; *Public* is a dummy variable that assumes the value 1 if the bank is controlled by a public stockholder and 0 otherwise; *Foreign* is a dummy variable that assumes the value 1 if the bank is controlled by a foreign stockholder and 0 otherwise; *Listed* is a dummy variable that assumes the value 1 if the bank has shares traded on B3 (Brazilian Stock Exchange) and 0 otherwise; *CAR* is the value of the capital adequacy ratio; *Assets (BRGAAP)* is the total assets of the bank in billions of BRL under the BRGAAP; *Assets (International)* is the total assets of the bank in billions of BRL under the international standard; *GDP* is the yearly gross domestic product change; *Unemployment* is the annual average unemployment rate; *Selic* is the sovereign interest rate, deflated by the inflation of the period; *EPUbr* is the Brazilian Economic Policy Uncertainty indicator provided by <http://www.policyuncertainty.com> (Baker et al., 2016); *EUIbr* is the Brazilian Economic Uncertainty Index provided by FGV (Ferreira et al., 2019).

Table 2.2 displays the Pearson correlation matrix for the variables used in the regressions, for both standards. Regarding the results for the BRGAAP, the correlations among the variable *LLP* and the explanatory variables are statistically significant for most

of them. We highlight particularly: i) the positive correlation with the variables related to credit risk (*LWO*, *ΔNPL*, *Reneg*, *Interest*, *ALL*), as predicted since higher credit risk demands larger provisioning; and ii) the negative correlation of total *LLP* with *CAR*. Regarding the latter, banks with higher CAR tend to be well-capitalized, usually with less risky portfolios that demand lower LLP (Aktas et al., 2015).

The remaining variables show several pairwise significant correlations. Nevertheless, most correlations are small, below 0.62, meaning that the multicollinearity issue should not be of concern in the regressions. The results concerning the international standard presented similar conclusions. Even though, we emphasize that there were fewer statistically significant correlations.

Table 2.2. Pearson correlation matrix (numbers below the main diagonal refer to BRGAAP; above, the international standard)

	<i>LLP</i>	<i>CAR</i>	<i>EBTP</i>	<i>LWO</i>	<i>ΔNPL</i>	<i>Reneg</i>	<i>LoA</i>	<i>ΔLoans</i>	<i>ALL</i>	<i>Interest</i>	<i>Size</i>
<i>LLP</i>	1.00	-0.06	0.21***	0.20***	0.06	0.03	0.08	-0.01	-0.28***	0.11**	0.00
		0.19	0.00	0.00	0.18	0.58	0.10	0.78	0.00	0.02	0.94
<i>CAR</i>	-0.17***	1.00	0.01	-0.11**	-0.02	-0.12**	-0.22***	0.20***	0.02	-0.18**	-0.17***
		0.00	0.83	0.02	0.59	0.01	0.00	0.00	0.68	0.00	0.00
<i>EBTP</i>	0.39***	0.05	1.00	0.38***	0.03	-0.04	0.37***	0.06	0.13***	0.41***	0.08*
		0.00	0.23	0.00	0.49	0.34	0.00	0.19	0.00	0.00	0.07
<i>LWO</i>	0.57***	-0.10**	0.32***	1.00	-0.17***	0.06	0.21***	-0.03	0.28***	0.56***	0.00
		0.00	0.03	0.00	0.00	0.18	0.00	0.49	0.00	0.00	0.95
<i>ΔNPL</i>	0.14***	-0.01	0.00	-0.14	1.00	-0.08*	0.03	-0.00	-0.04	-0.08*	0.03
		0.00	0.83	0.96	0.00	0.09	0.46	0.95	0.37	0.10	0.52
<i>Reneg</i>	0.23***	-0.16***	0.08*	0.04	0.03	1.00	0.03	-0.02	0.04	0.21***	-0.07
		0.00	0.00	0.07	0.23	0.54	0.55	0.68	0.34	0.00	0.11
<i>LoA</i>	0.30***	-0.14***	0.35***	0.19***	0.04	0.22***	1.00	-0.06	-0.01	0.31***	0.06
		0.00	0.00	0.00	0.42	0.00		0.21	0.79	0.00	0.17
<i>ΔLoans</i>	-0.05	0.17***	0.00	-0.15***	0.12**	-0.05	-0.05	1.00	-0.03	-0.08*	-0.05
		0.25	0.00	0.98	0.00	0.01	0.24		0.52	0.09	0.24
<i>ALL</i>	0.44***	-0.19***	0.15***	0.51***	-0.03	0.24***	0.17***	-0.13***	1.00	0.18***	-0.02
		0.00	0.00	0.00	0.55	0.00	0.00	0.01		0.00	0.64
<i>Interest</i>	0.61***	-0.17***	0.52***	0.50***	0.00	0.24***	0.43***	-0.19***	0.50***	1.00	-0.05
		0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.00		0.34
<i>Size</i>	0.12**	-0.15***	0.11***	0.03	0.05	0.02	-0.02	0.02	0.14***	0.02	1.00
		0.01	0.00	0.02	0.47	0.32	0.65	0.66	0.61	0.58	

Notes:-Size is the logarithm of bank's total assets. Other variables' definition as per Table 2.1.

2.5. Results

2.5.1. First-step regression: estimating the discretionary LLP

This section presents the results of the first step of the regression (Table 2.3), which is the equation (1) model to segregate discretionary from non-discretionary LLP expenses. Columns 1 and 2 display the results for the data deriving from the Brazilian standard (BRGAAP) while columns 3 and 4 are from the international standard. Meanwhile, columns 1 and 3 show the regressions using macroeconomic controls; in contrast, columns 2 and 4 have time-fixed effects instead.

Seven variables account for the firm-specific factors influencing the LLP. First, the change in the non-performing loans is significantly positive under both standards. This result shows the importance of the ΔNPL as an indicator of risk and a mechanical determinant of the LLP under the national standard, due to the “days past-due” criteria, while under the international one is considered an

Table 2.3. Regression First-Step

Independent Variables	Dependent variable: LLP			
	BRGAAP		International	
	(1)	(2)	(3)	(4)
ΔNPL	0.196** (0.0805)	0.190** (0.0854)	0.178** (0.0765)	0.200** (0.0816)
LWO	0.131* (0.0754)	0.135 (0.0828)	0.410*** (0.0784)	0.409*** (0.0823)
$Reneg$	0.0305 (0.0187)	0.0306 (0.0187)	0.0021 (0.0098)	0.0023 (0.0099)
LoA	-0.0000 (0.0089)	-0.0038 (0.0089)	0.0490** (0.0208)	0.0498** (0.0206)
$\Delta Loans$	0.0030 (0.0033)	0.0028 (0.0031)	-0.0000* (0.0000)	-0.0000* (0.0000)
ALL	0.0556 (0.0734)	0.0568 (0.0710)	-0.0239 (0.0194)	-0.0239 (0.0173)
$Interest$	0.151*** (0.0259)	0.134*** (0.0299)	0.0045 (0.0278)	0.0002 (0.0300)
GDP	-0.0454 (0.0290)		-0.0394 (0.0464)	
$Unemployment$	-0.176*** (0.0426)		-0.148** (0.0620)	

<i>Selic</i>	-0.0536*** (0.0198)		-0.0323 (0.0336)	
<i>EPUbr</i>	0.0000** (0.0000)		0.0000 (0.0000)	
<i>EUIbr</i>	-0.0000 (0.0000)		0.0000 (0.0000)	
N	426	426	424	424
R-squared	0.749	0.758	0.681	0.687
Bank FE	yes	yes	yes	yes
Year FE	no	yes	no	yes
Clusters (banks)	41	41	41	41
<i>Cluster-robust standard errors in parentheses</i>				
<i>*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$</i>				

Notes: Variables definitions as per Table 2.1.

objective loss event that must be considered for LLP recording. Conversely, *LWO*, the amount of loan write-offs, is positive and highly significant under the international standard but only at the 10% level under the Brazilian standard. A possible explanation for this result is the write-off rule of the BRGAAP, which requires a bank to keep a loan 100% provisioned for 180 days before writing it off. The consequence is that it may have little correlation with the LLP expense by the moment of the asset write-off.

Reneg, the amount of renegotiated loans, shows positive signs but no statistical significance in any of the model specifications. This result is not unexpected given that, although both standards admit the existence of loans' renegotiation, banks may not recognize LLP for renegotiated loans. The variable representing the share of credit in total assets (*LoA*), which did not turn out significant at any conventional level for the BRGAAP, is positive and significant for the international standard, an unexpected result since the variable should influence the LLP similarly regardless of the standard.

The fifth variable is the loan growth (*ΔLoans*), which was expected to have a positive effect on the LLP because an accelerated expansion of the credit portfolio usually implies an increment in the risk and, therefore, in the LLP (Dantas et al., 2013; Kanagaretnam et al., 2004). The coefficients were positive but not significant for the BRGAAP. Conversely, the variable has a negative and significant value at a 1% level for the international standard but with a very small effect size on the LLP, indicating a

negligible real economic impact. This could be attributed to the fact that the accelerated loan's growth impacts the LLP with delay, and the increment on the LLP expenses would be more pronounced in future periods rather than in the current one.

The stock of allowances for loan losses (*ALL*) has no significant values under both standards, which is an unexpected result given the significant correlations that Table 2.2 displays for this variable.

Finally, the average implicit interest rate of the loan portfolio (*Interest*) is significant under BRGAAP (at 1% level), not under the international standard. The former result is expected, since a loan's interest rate is associated with the borrower's credit risk. The latter, obviously, is unexpected.

Regarding the macroeconomic variables, the *GDP* growth was not significant in any specification. Unexpectedly, the *Unemployment* rate has negative and significant coefficients in both settings, indicating that higher unemployment levels are associated with lower LLP. A possible explanation is that banks will act more conservatively when the job market is contracting, be more selective in lending, and prefer less riskier counterparts. The same happened to the variable *Selic*, which measures the economy's deflated interest rate. Contrary to the expected, under the BRGAAP, the coefficient is significantly negative and therefore, a higher sovereign interest rate is associated with lower LLP levels. Similarly, we can speculate that banks' lending conservatism drives this result. As we saw with the variable *Interest*, the idiosyncratic risk measured by the implicit interest rate of the portfolio is positively associated with the LLP under BRGAAP. Nevertheless, the systemic risk represented by the country's interest rate came out negative, suggesting that an economic cycle with higher interest rates will work as a contractionary monetary policy, leading banks to lend less and be more risk-selective, causing a reduction in the LLP levels.

The last two macro variables are the economic uncertainty indicators (*EPUbr* and *EUIbr*). As expected, the *EPUbr*, which accounts for risk derived from policy uncertainty, is significantly positive under the national GAAP. This indicates that banks will perceive the political environment instability as a risk factor and cautiously increase provisioning levels. Similarly, the *EUIbr* proxy for the general market perception of risk indicates

higher or lower optimism and should affect the LLP similarly to the EPU. Nevertheless, the coefficient is not significant under any of the standards.

A last remark worth noting is the model fitness measured by the regression's R-squared. All specifications have a relatively high R-squared (above 0.68). This result suggests that the setups are good in modeling the non-discretionary part of the LLP.

2.5.2. Second-step regression: testing the hypotheses of LLP discretion and RCA

The second step regresses the first step's residuals against the variables that might affect the discretionary LLP: the CAR (due to regulatory capital arbitrage) and the EBTP (due to earnings management).

To assess H_1 , we examined the coefficient of the variable CAR. If the hypothesis stands, the coefficient is expected to be significantly positive. Table 2.4 displays the outcomes of second-step regression for the data deriving from the BRGAAP. We present the regression results in nine incremental versions, each adding a control from our base model and a tenth one including time-fixed effects.

The results came out as predicted. The CAR coefficients are positive and significant, suggesting that higher (lower) levels of CAR are associated with higher (lower) levels of LLP discretion. We highlight that this result is significant in all ten different regression configurations. This result supports the hypothesis that as a bank's CAR reduces (getting closer to the minimum level, a fixed percentage), the bank manager will reduce the amount of discretionary LLP to avoid a violation. Regarding the effect size, a 95% confidence interval let us predict that a CAR reduction of 1 p.p. would reduce the discretionary LLP from 0.022% up to 0.045% of the bank's loan portfolio on average¹¹. Given that the average total LLP under the Brazilian GAAP was 2.89% of the loan portfolio during the studied period, this represents a maximum reduction of 1.57% of the total LLP.

¹¹ These results are untabulated

Table 2.4. Regression Second-Step (BRGAAP)

Independent Variables	Dependent variable: <i>dLLP</i>									
	BRGAAP. Period: 2011 to 2022									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>CAR</i>	0.0142* (0.00774)	0.0142* (0.00783)	0.0186* (0.00954)	0.0191* (0.00970)	0.0377*** (0.00788)	0.0353*** (0.00641)	0.0345*** (0.00633)	0.0344*** (0.00636)	0.0342*** (0.00673)	0.0336*** (0.00589)
<i>Size</i>		- 0.0000112 (0.000192)	- 0.0000778 (0.000181)	-0.0000068 0 (0.000171)	0.0000658 (0.000156)	0.0000546 (0.000146)	0.0000557 (0.000149)	0.0000962 (0.000144)	0.0000952 (0.000146)	0.0000657 (0.000150)
<i>Listed</i>			0.00385* (0.00220)	0.00391* (0.00216)	0.00605** (0.00252)	0.00501* (0.00252)	0.00557* (0.00279)	0.00578** (0.00275)	0.00578** (0.00275)	0.00631** (0.00228)
<i>Listed x CAR</i>			-0.0147 (0.0129)	-0.0135 (0.0126)	-0.0284** (0.0140)	-0.0241* (0.0138)	-0.0243* (0.0137)	-0.0244* (0.0136)	-0.0242* (0.0140)	-0.0270** (0.0110)
<i>State</i>				0.00520** (0.00239)	0.00624** (0.00239)	0.00560** (0.00190)	0.00576** (0.00201)	0.00152 (0.00296)	0.00152 (0.00297)	0.000628 (0.00235)
<i>State x CAR</i>				0.0411*** (0.0131)	0.0489*** (0.0121)	0.0445*** (0.0101)	0.0458*** (0.0104)	0.0344*** (0.0111)	0.0344*** (0.0111)	-0.0308** (0.0114)
<i>Foreign</i>					0.00346 (0.00248)	0.00310 (0.00222)	0.00291 (0.00218)	0.00281 (0.00219)	0.00286 (0.00224)	0.00278 (0.00205)
<i>Foreign x CAR</i>					-0.0247* (0.0129)	-0.0229* (0.0114)	-0.0220* (0.0112)	-0.0218* (0.0112)	-0.0216* (0.0117)	-0.0188* (0.00991)
<i>EBTP</i>						0.0280* (0.0161)	0.0358* (0.0205)	0.0359* (0.0206)	0.0376 (0.0298)	0.0429* (0.0245)
<i>Listed x EBTP</i>							-0.0200 (0.0299)	-0.0302 (0.0283)	-0.0318 (0.0342)	-0.0443 (0.0284)
<i>State x EBTP</i>								0.0877 (0.0588)	0.0875 (0.0591)	0.107* (0.0569)
<i>Foreign x EBTP</i>									-0.00344 (0.0380)	-0.0189 (0.0354)
N	401	401	401	401	401	401	401	401	401	401
R-sq	0.022	0.022	0.045	0.060	0.077	0.088	0.089	0.094	0.094	0.094
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	no	no	no	no	yes
Clusters (banks)	41	41	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses
 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: *dLLP* is the residual of the regression for each model (bank-fixed effects or bank and time-fixed effects), representing the discretionary amount of LLP; other variables as per Tables 2.1 and 2.2.

Next, we test for the influence of the bank's characteristics in mitigating or incentivizing the RCA practice. Results are also in Table 2.4. The coefficient on the interactive variable *Listed x CAR* is negative and significant, supporting H₂. This coefficient suggests that listed banks may be influenced by enhanced governance and third-party stakeholders' oversight (auditing, market, government, etc.) restraining LLP arbitrage. Moreover, the moderating effect of being listed is so big, that a joint F-test¹² of the sum of *CAR* and *Listed x CAR* coefficients ($F=0.91$, $p\text{-value} = 0.3448$) shows that the *CAR* effect is not significantly different from zero. This suggests that listed banks are not engaging in RCA.

The dummy *State* aimed to find whether the allegedly weak governance of state-owned banks relative to the private-owned banks could have the opposite effect and foster the RCA behavior. Surprisingly, the coefficient was significantly negative for the BRGAAP setting, indicating that under the national norm, state-owned seem to engage less in RCA than privately controlled banks, rejecting H₃. Likewise, a joint F-test for the sum of *CAR* and *State x CAR* coefficients ($F=0.05$, $p\text{-value} = 0.8176$) suggests that the moderating effect is high, and we cannot rule out the hypothesis that *CAR* has no effect in dLLP for state-owned banks.

The same happened with the variable *Foreign*, which aimed to look for any difference between the national and foreign-controlled banks. The coefficient of *Foreign x CAR* came out negative and significant (at the 10% level), suggesting that the amount of discretionary LLP due to the CAR level is lower for foreign-controlled banks than the national-controlled, supporting H₄. It is worth mentioning that foreign banks are usually bigger and listed in their home countries, meaning that they are more likely to suffer from the same moderating effect mentioned for listed banks. However, the joint F-test for the sum of *Foreign x CAR* and *CAR* coefficients ($F=3.08$, $p\text{-value} = 0.0870$) reject the hypothesis that the total *CAR* effect is zero (at 10% level), suggesting that foreign banks still do RCA to some extent.

Finally, we tested whether big and small banks (variable *Size*) were different concerning RCA, but the coefficients were not significant in any setting.

¹² The joint F-tests were done for the coefficients of the setup with all variables (column 10 of Table 2.4).

We also should mention the inclusion of the variable EBTP because of the possibility of income smoothing using discretionary LLP. Lower (higher) earnings would constrain (foster) managers' behavior in undertaking discretionary LLP, which is expected to have a positive relation between the variables. Even though this question is not in our scope, we highlight that the coefficients were mostly positive and statistically significant (at the 10% level). This result suggests that banks may use LLP discretion to smooth out income.

To test for H₅, we ran model 2, as we did for BRGAAP, using the international data set. Table 2.5 shows the results of the regressions for the whole period (2011-2022). As in Table 2.4, we also present the regression results incrementally regarding adding controls.

Differently from the results discussed above, the CAR coefficient is insignificant in any of the ten settings. This finding does not support H₅, which states that there is a positive relationship of the bank's CAR and the discretionary LLP for the financial statements produced under the international standard. As we argued earlier, this could be attributed to two reasons. First, the manager will not manipulate the LLP to influence the CAR under the international norm because there would be no direct benefit, provided the CAR is computed only with BRGAAP numbers. Second, the manager practicing RCA under the BRGAAP might want to replicate the arbitrage under international standards to avoid the risk of being uncovered but may not be able to succeed due to the specificity of the international rules regarding the LLP.

Table 2.5. Regression Second-Step (International standard)

Independent Variables	Dependent variable: <i>dLLP</i>									
	International Standard. Period: 2011 to 2022									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>CAR</i>	0.00334 (0.00907)	-0.000838 (0.00873)	0.00739 (0.00965)	0.00810 (0.00967)	-0.000605 (0.0147)	-0.000521 (0.0149)	0.000213 (0.0148)	0.000223 (0.0149)	-0.00271 (0.0150)	0.00381 (0.0139)
<i>Size</i>		-0.000763 *** (0.000221)	-0.000788 *** (0.000210)	-0.000701 *** (0.000210)	-0.000719 *** (0.000215)	-0.000709 *** (0.000215)	-0.000730 *** (0.000213)	-0.000720 *** (0.000226)	-0.000703 *** (0.000220)	-0.000812 *** (0.000222)
<i>Listed</i>			0.00593** (0.00282)	0.00592** (0.00280)	0.00460 (0.00338)	0.00493 (0.00343)	0.00386 (0.00375)	0.00387 (0.00376)	0.00408 (0.00385)	0.00601* (0.00323)

<i>Listed x CAR</i>	-0.0288 (0.0173)	-0.0271 (0.0170)	-0.0200 (0.0188)	-0.0210 (0.0191)	-0.0206 (0.0187)	-0.0206 (0.0188)	-0.0160 (0.0191)	-0.0254 (0.0171)
<i>State</i>		0.00605 (0.00407)	0.00530 (0.00421)	0.00569 (0.00441)	0.00520 (0.00424)	0.00452 (0.00303)	0.00491 (0.00298)	0.00273 (0.00252)
<i>State x CAR</i>		-0.0462* (0.0256)	-0.0422 (0.0268)	-0.0445 (0.0277)	-0.0413 (0.0271)	-0.0396* (0.0214)	-0.0412* (0.0212)	-0.0268* (0.0159)
<i>Foreign</i>			-0.00237 (0.00329)	-0.00232 (0.00334)	-0.00211 (0.00329)	-0.00212 (0.00329)	-0.000629 (0.00363)	-0.0000848 (0.00324)
<i>Foreign x CAR</i>			0.0117 (0.0173)	0.0120 (0.0175)	0.0112 (0.0171)	0.0113 (0.0171)	0.0146 (0.0174)	0.00922 (0.0159)
<i>EBTP</i>				-0.0165 (0.0241)	-0.0380 (0.0305)	-0.0381 (0.0306)	0.0139 (0.0384)	0.0104 (0.0359)
<i>Listed x EBTP</i>					0.0424 (0.0451)	0.0410 (0.0468)	-0.00435 (0.0525)	-0.00860 (0.0499)
<i>State x EBTP</i>						0.0145 (0.0672)	0.00646 (0.0687)	-0.00920 (0.0590)
<i>Foreign x EBTP</i>							-0.0897* (0.0522)	-0.0768 (0.0476)
N	398	398	398	398	398	398	398	398
R-sq	0.001	0.040	0.054	0.062	0.064	0.066	0.069	0.098
Bank FE (1 st step)	yes	yes	yes	yes	yes	yes	yes	yes
Year FE (1 st step)	no	no	no	no	no	no	no	yes
Clusters (banks)	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4.

In short, the results displayed in this sections show that banks employ discretionary behavior regarding the LLP only when there is a potential benefit regarding an improvement on the CAR, explaining why the coefficients are significant under the BRGAAP, but not under the international standard. Moreover, the relationship between the CAR and the discretionary LLP is not linear, depending on bank's characteristics. We demonstrated that listed and state-owned banks does not present the same behavior, while foreign banks had a smaller coefficient, indicating a moderating effect.

2.5.3. Robustness tests

2.5.3.1. Endogeneity tests

To test the endogeneity issue regarding our main variable (CAR_t), we ran a 2-Step GMM estimation model instrumenting the variable CAR_t by its lagged value CAR_{t-1} and the $EBTP_{t-1}$ (results in Table 2.6; columns 1 and 3 refers to the simulations without year fixed-effects; columns 2 and 4, with year fixed-effects). Instrumenting a variable by its lagged value is a common solution found in the literature (for a comprehensive revision on the topic, see Reed, 2015), because economic variables are, in general, correlated with past values, while cannot be determined by a future value of another variable due to time separation. Nevertheless, this solution does not always produce consistent results, and using the lagged values as exogenous instrumental variables can be a better alternative (Reed, 2015). Moreover, we argue that $EBTP_{t-1}$ is exogenous because it is estimated before provisions, unaffected by the contemporaneous LLP, while influencing the CAR_t through the retained earnings account. The GMM regressions were tested for multiple potential issues, and the instruments' validity was not rejected (except for the Hausman test for the international standard). We report that the results remain stable under the GMM model for hypotheses 1, 2, and 5, supporting the robustness of these findings. The exceptions are the coefficients of the *State* and *Foreign* variables, which resulted in a lack of significance under the GMM model, which is different from the results presented in Table 2.4. Thus, endogeneity does not seem to be a real issue in our research.

Table 2.6 – 2-Step GMM estimation

Independent Variables	Dependent variable: $dLLP$			
	BRGAAP		International	
	(1)	(2)	(3)	(4)
CAR_t	0.0318906*** (0.0076734)	0.0316737*** (0.007514)	0.0011652 (0.0216179)	0.0086972 (0.020842)
<i>Listed</i> x CAR_t	-0.024208* (0.0141824)	-0.0272479** (0.0139201)	-0.0247598 (0.0257444)	-0.0349242 (0.0247797)
<i>State</i> x CAR_t	-0.07188 (0.0517132)	-0.0701303 (0.0506287)	-0.0772655 (0.0717221)	-0.048705 (0.0688634)
<i>Foreign</i> x CAR_t	-0.014169 (0.0110988)	-0.011359 (0.0108687)	0.0120389 (0.0237674)	0.0060715 (0.0228982)
<i>Size</i>	0.0001085 (0.000155)	0.0000707 (0.0001518)	-0.0006686*** (0.000213)	-0.0007815*** (0.0002045)

<i>Listed</i>	0.0053672** (0.002439)	0.0056445** (0.0023887)	0.005333 (0.0042541)	0.0072122* (0.0040988)
<i>Foreign</i>	0.0016446 (0.002037)	0.0012478 (0.0019946)	-0.0024894 (0.0040253)	-0.0015661 (0.0038832)
<i>State</i>	0.0099741 (0.0084709)	0.009936 (0.0082927)	0.0110449 (0.0117367)	0.0061108 (0.0112692)
N	401	401	398	398
F-statistic	4.18	4.01	3.19	4.40
Bank FE (<i>1st step</i>)	yes	yes	yes	yes
Year FE (<i>1st step</i>)	no	yes	no	yes
Clusters (banks)	41	41	41	41
Underidentification test (H ₀ : Model is underidentified) Anderson canon. corr. LM stat)	143.751***	143.735***	142.648***	142.640***
Weak identification test (H ₀ : Model is underidentified) Cragg-Donald Wald F statistic	43.698	43.691	43.350	43.346
Overidentification test Sargan-Hansen statistic (H ₀ : Instruments are valid)	2.270 p = 0.1319	1.523 p = 0.2171	0.930 p = 0.3349	1.305 0.2532
Endogeneity test of endogenous regressors (H ₀ : Endogenous variables are exogenous)	14.496***	15.525***	9.566**	9.785**
Hausman Specification Test (H ₀ : GMM and OLS are both consistent)	14.03*	14.91*	9.36	9.60

Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Instrumented variables: *CARt*, *CARt * Listed*, *CARt * State*, *CARt * Foreign*

Instrumental Variables: *CARt-1*, *CARt-1 * Listed*, *CARt-1 * State*, *CARt-1 * Foreign EBTP*

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4.

2.5.3.2. Other robustness tests

We performed several other tests to evaluate whether the findings are robust to alternative specifications. As mentioned earlier, we ran our base-model regressions, replacing the macroeconomic variables with time-fixed effects. The results are reported along with the main results in Tables 2.4 and 2.5 in the last column. In summary, the test shows that the results of the bank-specific regressors stay mostly the same with time-fixed effects, both in the first and second-step regressions.

Secondly, we ran a set of alternative specifications for equations (2.1) and (2.2). Regarding the first step, in addition to the base model, we defined three modifications:

A) remove the variables LWO and ALL; B) replacing the variable DNPL for the NPL itself; and C) replacing the variables EPUbr and EUlbr for the country risk index (C-Risk) and the variation of the deflated USD-BRL exchange rate (FXrate).

Because the LWO and the ALL are likely endogenous, the first change aims to test how it would affect the results, removing them from the specification. The second change follows Kanagaretnam, Lim, et al. (2010), who used the percentage of non-performing loans at time t instead of the variation of this percentage from $t - 1$ to t . The DNPL is found more often in the literature, because its effect on the LLP is straighter: in the incurred-losses model, a change in the NPL is a clear sign of deterioration and should cause new LLP expenses – on the contrary, if the NPL stays constant, the amount of existing LLP would be appropriate and thus would not change. Nevertheless, the NPL level itself is a risk indicator that managers could consider when assessing expected losses, and it can also influence future LLP expenses. Lastly, the third change tests different variables to proxy for the economic uncertainty, the country risk index and the exchange rate variation.

Considering all the possible combinations with the three modifications mentioned above, we ran seven different equations in addition to the original base model, considering all possible combinations of changes (A), (B) and (C). The results of the tests (available in the Appendix 2.1) show the coefficients remain mostly stable with the same economic meaning and statistical significance, suggesting that the estimates for dLLP to be used in the second step are robust to alternative specifications.

Concerning the second step regression, we add two modifications: (D) replacing the lagged CAR for the lagged Tier-1 capital (T1-CAR); and (E) replacing the variable EBTP for the bank's return on equity (ROE). The first change is based on the premise that discretionary LLP manipulation affects the total regulatory capital (CAR) and the Tier-1 capital (T1-CAR). Therefore, given that banks also have T1-CAR minimum requirements to observe, we expect that the CAR results might be consistent with the simulations using the T1-CAR. The second change uses the bank's ROE as an alternative proxy to account for the effect of profitability in dLLP. The two modifications lead to three new combinations of tests.

We ran the base model of equation (2.2) for all three combinations and the combined results of the first-step robustness tests. The results (available in the Appendix 2.2) show that the previous conclusions are robust for both the changes (D) and (E) alone under any accounting standard. Nevertheless, the coefficients lose significance when the ROE and the T1-CAR replace both the EBTP and the CAR. One possible explanation is that the ROE and the T1-CAR are weaker determinants for discretionary LLP manipulation, and when put together, the regression loses explanatory power. First, the impact of the LLP on the EBTP is more direct than it is on the ROE, which is a comprehensive bank's profitability indicator and can be influenced by multiple factors. Second, the T1-CAR requirements are easier to comply with than the total CAR requirements if the bank has Tier 1 capital in excess. Therefore, discretionary LLP arbitrage would be more likely to be used for CAR arbitrage than for T1-CAR. Indeed, the R-square of the configurations with both changes is the lowest of the three.

In sum, the robustness tests do not change qualitatively our previous results.

2.6. Conclusion

This paper investigated the practice of Regulatory Capital Arbitrage in the Brazilian banking system, examining the association of managerial discretion in LLP recognition and the bank's capital adequacy ratio (CAR). Moreover, we sought to find whether the relationship is linear or depends on banks' characteristics that moderate the RCA practice. Furthermore, we simultaneously evaluate if there is any difference between the behavior under different accounting standards for LLP, the local standard (BRGAAP), in contrast to the international standard. We benefit from a unique set deriving from Brazilian legislation, which requires banks to publish financial statements in both local and international standards, allowing a comparison between the different frameworks.

Our findings show that, under the BRGAAP, less capitalized banks have lower amounts of discretionary LLP, suggesting that managers reduce loan provisioning to avoid a regulatory violation. Moreover, we found that this relationship is not linear, being moderated for listed, state-owned and foreign-controlled banks, indicating that external

oversight, corporate governance, and ownership type can mitigate the practice. Conversely, this behavior is not found in the data derived from publications under international standards. This could be attributed either to the lack of a direct benefit, provided the CAR is computed using only BRGAAP data, or to the specificity of the international standard definitions regarding the LLP constitution.

These results are of particular interest to bank regulators concerned with regulatory capital arbitrage. Likewise, accounting standard setters can learn from empirical evidence derived from an alternative GAAP other than the international standard. Therefore, we contribute to the literature on banking regulation by exploring the research question using a methodological approach to estimate the discretionary LLP different from previous studies (Bouvatier & Lepetit, 2008; M. S. Kim & Kross, 1998; Kund & Neitzert, 2020; Leventis et al., 2011; Pérez et al., 2008). Furthermore, we help clarify existing divergences in the RCA literature by adding new evidence regarding the bank's characteristics that can affect managers' opportunistic behavior. Lastly, we add to the literature on alternative accounting standards new empirical evidence regarding the practice of RCA by exploring the impact of different standards simultaneously, a novelty in this type of literature.

It is worth acknowledging that our study is not exempt from limitations. For example, our sample does not represent the total population of Brazilian banks because the legislation requiring the banks to publish financial statements under the international standard only applies to a part of the system. Nevertheless, the sample's banks correspond to a large fraction (> 95% of total assets) and represent the bank's population. As usual, one should always be cautious when generalizing the results.

As a final remark, we highlight that Brazilian legislation is progressing towards implementing the IFRS 9 rules for LLP calculation after 2025 (BCB, 2021). Therefore, future studies can revisit and extend our work assessing the impact of the changes regarding the convergence to the IFRS 9 on the LLP and CAR calculation, in comparison to the current BRGAAP standard, benefiting from a larger sample of the whole Brazilian financial system.

CHAPTER 3

Uncovering regulatory capital arbitrage within IFRS 13 rules

3.1. Introduction

The literature on management accounting choices and discretion has a longstanding established body of empirical research. Watts & Zimmerman (1986, ch.11) consolidated evidence on the motivations to choose from alternative accounting methods or adjust accruals. Such motivations include management compensation schemes, contractual arrangements, and political processes. Concerning bank accounting, Beaver & Engel (1996) add the regulatory dimension as one particular motivation for this industry, justifying that regulatory incentives arise because of the desire to provide reported numbers that cause a bank to appear less risky and more capital-adequated to regulators.

The capital requirements deriving from the Basel Accords increased the incentives for bank managers to explore accounting choices and discretion to undertake regulatory capital arbitrage (RCA). Regulatory arbitrage occurs when firms exploit breaches to comply with the rules whilst deviating from the regulator's intentions (Jones, 2000). RCA is the practice of regulatory arbitrage intending to manipulate regulatory capital or the Capital Adequacy Ratios (CAR). Prior and recent research have studied some forms of RCA, such as the manipulation of loan loss provisions (LLP) (Ahmed et al., 1999; Beatty et al., 1995; Clark & Ebrahim, 2022; Jones, 2000; Mayordomo et al., 2023; Moyer, 1990; Pérez et al., 2008). We focus on using Fair Value Accounting (FVA) discretion as a channel for the opportunistic accounting choices intended to deploy RCA.

The International Financial Reporting Standard (IFRS) 13 defines fair value, provides a framework for measuring fair value, and requires disclosures about fair value measurements. It applies to all assets and liabilities measured at fair value or requiring fair value disclosures under other IFRS standards. It also specifies how to determine the fair value using observable and unobservable inputs and classify the fair value measurements into a three-level hierarchy, from Level 1 (most objective) to Level 3 (most subjective), according to the valuation method. The IFRS 13 aims to improve the transparency and consistency of fair value accounting. However, the extensive margin of discretion offered allows bank managers to influence accounting numbers

opportunistically. Through the manipulation of assets valuation, managers can influence the inputs used in the capital adequacy calculation, with no corresponding change in the underlying economics (Krauß, 2019). This can potentially undermine the regulator's intentions by hiding the actual risks of the bank's portfolio while keeping sound indicators.

We investigate the relationship between using discretion in the assets valuation classified under the Level 2 and Level 3 categories and the bank's CAR. We look to find evidence of RCA by assessing whether the managers of poorly capitalized banks use more discretion in fair-valued assets intending to influence the bank's CAR and avoid a regulatory violation. A few studies have investigated the relationship between the bank's fair-value hierarchy composition and the regulatory capital, finding a negative relation between the portfolio's fraction of higher subjectivity instruments (Level 3) and the bank's CAR (Glaser et al., 2013; Yao et al., 2018). These results suggest the use of fair-value accounting discretion to deploy RCA.

Our paper is motivated by four reasons. First, this investigation responds to the call of Laux (2016), who asked for studies regarding fair-value accounting choices after the Basel III reform. The Basel Accord removed the Accumulated Other Comprehensive Income (AOCI) filter among many novelties. This feature shields the regulatory capital calculation from unrealized gains and losses on available-for-sale (AFS) instruments. Without the filter, the fair-value gains and losses of AFS assets will impact the bank's CAR, creating new incentives for banks to manipulate their valuation by boosting gains or mitigating losses. As far as we know, previous studies' did not investigate whether the regulatory shift changed the bank's behavior.

Second, prior studies have methodological limitations regarding how the relationship between the CAR and the Levels 2 and 3 instruments is measured. In these investigations, the authors directly relate the fraction of these assets to the bank's CAR, which limits the conclusions regarding the use of discretion and the RCA practice. This is because the subjectivity of Levels 2 and 3 categories does not imply automatic discretion, and we seek to address this issue by using a new method to segregate the non-discretionary from the discretionary part of assets' value in these categories before assessing its relationship with the CAR.

Third, the convergence to fair value accounting following the IFRS prescriptions demands an important pre-requisite regarding the country's capital market state of development. If the firm's adherence to open-market trading is low, the reliability of fair value estimates is questionable (Peng & Bewley, 2010). The few prior studies investigating the relationship between fair-value accounting and regulatory arbitrage focused on European countries and the U.S., places with highly developed capital markets. Thus, the body of empirical research lacks evidence from emerging economies, where the capital markets might not be fully evolved, and the relationship between fair value accounting and the RCA remains an empirical question that needs to be investigated. We seek to find new evidence researching the Brazilian banking system.

Fourth, regulatory arbitrage, in general, and RCA are topics of great interest for bank regulators and policymakers that demand constant updates. Gerding (2016) reports that every attempt to regulate bank capital historically leads to new forms of RCA. Moreover, the repercussions of the Basel III enactment made the Bank for International Settlements (BIS) issue a statement to warn that "banks should not engage in transactions that have the aim of offsetting regulatory adjustments" as "they can have the effect of overestimating eligible capital or reducing capital requirements, without commensurately reducing the risk in the financial system" (BCBS, 2016b). New studies are necessary as the conditions to incentivize and prevent arbitrage change frequently – across time and between jurisdictions. Nevertheless, even if the particularity of the legal and economic context can be the sole motivation for new case-studies as ours, it is also of interest to different regulators. The ease of mobility can drive capital abroad, and RCA can be deployed by global conglomerates, which can be facilitated or diffculted by each context. Nowadays, banks operate globally, and a bank can save capital by arbitraging through jurisdictions with different regulatory strictness, spreading the risk worldwide and increasing the regulators' concern of contagion risk.

Using a 12-year-long sample of Brazilian banks, we hand-collected data from 41 bank-conglomerates IFRS statements. We adapted the Beaver & Engel (1996) two-step regression method to segregate the discretionary fraction of Level 2 and Level 3 assets from the non-discretionary. In the second step, we assess the relationship between the discretionary fraction of Level 2 and Level 3 assets and the bank's CAR. Additionally,

we include firm-level variables to scrutinize bank characteristics that may moderate the behavior.

Our findings support the negative association between the discretionary part of Level 2 and Level 3 categories' share in fair value assets and the bank's CAR. This is consistent with the theory that capital-constrained banks use more discretion in fair-value accounting measurements to avoid a regulatory violation. Moreover, after the AOCI filter removal, this relationship was attenuated, if not completely eliminated. We also highlight the importance of external oversight in preventing the behavior since our results show that this relationship is significantly mitigated for listed banks.

This investigation makes three important contributes. First, it is the first to demonstrate that the regulatory change brought by Basel III removing the AOCI filter reduced (if not eliminated) the bank's behavior concerning RCA through fair value accounting discretion. It suggests that banks found alternative ways to manage the impact of the inclusion of AFS assets into the CAR calculation, instead of using discretion in Levels 2 and 3 assets valuation. Two, we made methodological progress relative to previous works, which applied a single equation regression to relate the dependent variable to the CAR. Using Level 2 and Level 3 assets does not imply automatic discretion. Other features unrelated to opportunistic manipulation can justify a non-discretionary need for more assets in these categories, such as the bank's business line and market liquidity. Therefore, our design adapts a model commonly used in the literature of Loan Loss Provisions (LLP) discretion to our sample to segregate fair value assets classified into the higher categories (Level 2 and Level 3) due to non-discretionary reasons from the fraction existent in response to manipulative behavior. Third, our study is the first to investigate RCA through fair value accounting in an emerging economy. In the Brazilian financial system, and likely in other similar economies, the underdevelopment of the capital markets can be a reason for banks to choose Level 2 and Level 3 over Level 1 category, facilitating the arbitrage through fair value accounting discretion. Moreover, capital mobility across countries can create arbitrage opportunities for banks operating simultaneously in economies with different capital market development levels. Therefore, our results are of interest to the joint effort on global bank regulation to prevent the exploitation of this possibility.

The rest of the document is divided into five parts. Section 3.2 presents a literature review and develops the paper's hypotheses. Section 3.3 details the research design and the econometric model. Section 3.4 describes the sample and data collection, and presents the descriptive statistics. Section 3.5 presents and discusses the results, and Section 3.6 concludes.

3.2. Literature review and hypotheses development

Valencia (2011) reports the discretion over the gains/losses of financial instruments as the other preferred method for RCA, in addition to the loan loss provisions (LLP). Indeed, several authors investigating the relationship between LLP and capital management also studied the relationship between securities gains/losses and capital management (Beatty et al., 1995; Collins et al., 1995; Moyer, 1990; Scholes et al., 1990). Like in the case of LLP, the incentives to opportunistically influence the regulatory capital by manipulating gains and losses in financial instruments are strongly related to (i) the accounting framework for financial instruments and (ii) the regulatory treatment regarding its impact on capital ratio. We divide this section into two parts. The first reports the timeline of events regarding the accounting and regulatory landmarks related to FVA and its effect on regulatory capital. The second part formulates and states the study's hypotheses.

3.2.1. Historic development of fair-value and regulatory capital regulation

The first important landmark is the introduction of SFAS 115 (currently ASC 320) in 1993, modifying the accounting treatment for securities in the U.S. Before it, securities values were measured at amortized cost, and their gains and losses were recognized in earnings only when realized. Therefore, although fair values of securities were disclosed in financial statements, they did not impact banks' capital before the realization of gains or losses.

This does not mean that banks had no incentive to engage in capital management using the gains and losses of securities. Indeed, Beatty et al. (1996, p. 54) report that "prior to SFAS 115, bank managers could boost capital through the selective realization of gains and losses on security sales", and the literature that examined the question before SFAS 115 evidenced it. Moyer (1990) observed that banks with low CAR use realized

securities gains to increase regulatory capital. Scholes et al. (1990) showed that tax considerations and regulatory capital needs led to the realization of appreciated securities, partially supported by Collins et al. (1995).

One common feature among these studies is that the arbitrage mechanism is the intentional and selective delay of financial instrument loss recognition and the strategic timing of asset sales to influence the capital ratio purposefully. Using an analogous term to the one used in the earnings management literature, we refer to this form of transaction-based capital management as "Real Capital Management".

However, the changes brought by SFAS 115 pledged to affect these incentives. The norm created three categories for classifying securities and specified their accounting treatment. In short, securities should be classified upon acquisition as (i) held-for-trading (HFT) if the bank intends to trade it; (ii) held-to-maturity (HTM) if the bank intends and can hold it until maturity; and (iii) available-for-sale (AFS), in all other cases. HFT securities are accounted at fair value with unrealized gains and losses recognized in earnings. At the same time, HTM securities are recorded at amortized cost, and unrealized gains and losses do not affect earnings. Nonetheless, the most impactful innovation was that AFS securities are recognized at fair value with unrealized gains and losses registered in accumulated other comprehensive income (AOCI), an owners' equity sub-account. Because of that, under SFAS 115, selling appreciated AFS securities would not impact regulatory capital so long those gains were already accounted for in previous fair-value revaluations (Beatty et al., 1996).

The introduction of SFAS 115 should represent removing the incentive for Real Capital Management. However, in 1995, only one year after SFAS 115 effective date, the U.S. bank regulators modified the treatment of the AOCI in the regulatory capital calculation. The new framework instituted a "prudential filter" (also called "AOCI Filter"), determining that unrealized fair-value gains and losses on AFS securities registered as AOCI should be excluded from the regulatory capital calculation. The main justification follows the historical debate¹³ about the pros and cons of Fair Value Accounting (FVA). Critics argue that FVA is inherently procyclical and that an accounting-based regulatory system combined with pure FVA leads to contagious effects

¹³ For a comprehensive analysis, see Laux & Leuz (2009, 2010).

(Allen & Carletti, 2008). Therefore, the intent was to reduce the excessive volatility that could be produced by a (presumably) temporary variation in the value of AFS securities that would be irrelevant for regulatory purposes in the long term (Laux, 2012).

Right or not, research about the effects of FVA on banks' regulatory capital during the financial crisis showed that the prudential rules effectively protected banks' capital from a relevant deterioration (Badertscher et al., 2012; Laux & Leuz, 2010). On the other hand, incentives for capital management in the U.S.¹⁴ became quite similar to what they were before SFAS 115. Indeed, more recent research showed that banks still realize securities gains and losses to manage regulatory capital opportunistically. For example, Barth et al. (2017, p. 1762) demonstrated that banks keep exploiting "the discretion afforded to them by accounting standards and regulatory requirements that exclude unrealized securities gains and losses from earnings and regulatory capital."

The second important landmark is the 2006 issuance of SFAS 157 (currently ASC 820), disciplining FVA measurements in the U.S. Valencia (2011, p.1) reports that "the key issue associated with a continued expansion of the use of fair value accounting lies in whether fair value can be measured reliably for financial instruments which are not traded in competitive and liquid markets." Hence, SFAS 157 provided guidance on the issue. The norm requires the classification and disclosure of fair values within a 3-levels hierarchy: i) Level 1, for the values which reflect quoted prices in active markets for *identical* assets or liabilities; ii) Level 2, for the values which reflect quoted prices in active markets for *similar* assets or liabilities; and, when neither of the two previous options is available, iii) Level 3, for the valuations based on internally generated company estimates (Valencia, 2011).

However, what should have been deemed an important initiative for transparency enhancement and market discipline came with a critical side effect — the creation of Level 3 formally authorized banks to incorporate a great degree of discretion in fair-value measurements. Glaser et al. (2013, p.5) warn that "when banks are given the possibility

¹⁴ Even though the events stated refer to the US, a similar movement happened in EU, with some years of delay. With the introduction of IAS/IFRS into EU accounting regulation, banks began to adopt IAS 39 for securities valuation, a framework that reproduces the SFAS 115 very closely. Then, for the same reasons, the Committee of European Banking Supervisors (CEBS), currently European Banking Authority (EBA), issued the CEBS/04/91 "Guidelines on prudential filters for regulatory capital", proposing the same AOCI filter mechanism stated earlier. Later, the Directive 2006/48/EC instituted the filter formally (BCBS, 2015).

of (...) model an asset's value using unobservable and bank-supplied inputs, this discretion might also be abused". Laux & Leuz (2009) and Penman (2007) also expressed concerns regarding the opportunistic use of Level 3 valuations. Furthermore, market indicators reveal that investors price Level 3 assets significantly less, discounting it on average by 20% to 30% relative to Level 1 and 2, because they expect manipulations in banks' estimates (Goh et al., 2015; Kolev, 2019; Song et al., 2010). Interestingly, this discount is reduced when the regulatory capital is higher (Goh et al., 2015). This suggests that investors believe poorly capitalized banks have more significant incentives to use Level 3 discretion in RCA.

The literature evidence that the concern is grounded. In the context of the financial crisis, Fiechter & Meyer (2010) showed that the banks in the worst financial situation overstated Level 3 losses during the more brutal quarters of 2008 and presented positive results in the subsequent quarters, consistent with the practice of *Big Bath Accounting*. Milbradt (2012) demonstrated that banks keep the Level 3 assets portfolio artificially high when facing balance sheet constraints. Concerning RCA, in particular, Glaser et al. (2013) and Yao et al. (2018) found a negative relation between the regulatory capital and the share of Level 3 assets. Krauß (2019) demonstrates that banks influence their regulatory capital ratios with fair value manipulation but do not determine a relationship with the CAR levels. Xu (2019) established an indirect relationship between Levels 2 and 3 usages and capital management, verifying that banks with higher levels of Level 2 and 3 fair value assets and liabilities are more likely to use discretionary LLP to manage capital ratios. On the other hand, Valencia (2011) could not find evidence supporting the idea of Level 3 manipulation using capital thresholds as an incentive.

Finally, the third regulatory landmark was the Basel III framework in 2011, which recommended the adherents to the accord remove the prudential filter and include AOCI in the Tier 1 calculation (BCBS, 2011). Although the same arguments to institute the filter were still in place, the BCBS's recommendation proponents argued that shielding regulatory capital from unrealized AFS losses incentivizes banks to take excessive risks (Chircop & Novotny-Farkas, 2016) and to hold severely deteriorated securities instead of taking early action (Badertscher et al., 2012; Laux, 2012).

The proposal raised a great controversy (see Chircop & Novotny-Farkas, 2016 and Laux, 2016, for a detailed discussion) but was eventually implemented by the members in 2014¹⁵. In the current regulatory treatment, banks are not incentivized to hold (sell) depreciated (appreciated) AFS securities to manage capital because the effect of fair value gains and losses is already reflected in regulatory capital. Alternatively, now they could be more interested in manipulating the values of these AFS assets through the discretion of the valuation methods, representing an incentive to do RCA using Levels 2 and 3 instruments.

The literature after the AOCI filter removal is quite recent and relatively scarce. Hamilton (2019) and S. Kim et al. (2019) observed the migration of assets from AFS to the HTM category in U.S. banks affected by removing the AOCI filter but not in banks that opted out of the filter removal. Zhao & Deis (2020) found that bank holding companies affected by the filter removal reduced the sales of AFS securities, while those that remained in the old regime maintained the usual behavior regarding realizing gains and losses in AFS securities. Bischof et al. (2021) reported that when the filters were switched off, managers behaved differently concerning taking corrective actions in response to fair-value losses in AFS. They showed managers were more tolerant of holding depreciated AFS securities in the old regime, while they were more likely to take prompt corrective actions in the new regime. The lack of research in the period following the AOCI filter removal presents a good opportunity to investigate whether the findings of Glaser et al. (2013) and Yao et al. (2018) hold since their sample ended in 2012 and 2013, respectively.

Lastly, the literature regarding the background of emerging economies is even more scarce. The studies concerned with the relationship between fair value discretion and regulatory arbitrage are centered in the U.S. and European banks, and we could find only exploratory studies for the Brazilian market (Moura & Dantas, 2015; Oliveira et al., 2021). The only exception is Yao et al. (2018), who worked with a worldwide sample

¹⁵ In the US, the filter removal was mandatory only for banks adopting the internal ratings-based (IRB) approach to calculate the regulatory capital. The others had a one-time choice to opt-out the filter removal, and virtually all of them did it (S. Kim et al., 2019).

including Brazil and Malaysia but with a very restricted number of observations (27 and 31, respectively).

3.2.2. Theoretical background and hypothesis development

The theory of accounting choices and fair value accounting are closely interconnected in accounting. The theory of accounting choices examines how and why managers select particular accounting methods or estimates over others, often influenced by various factors, including regulatory requirements, economic incentives, and personal motivations (Watts & Zimmerman, 1986). Meanwhile, fair value accounting is a method in which assets and liabilities are measured and reported at their current market values (IASB, 2011).

The relationship between these two areas lies on how fair value accounting provides a context in which accounting choices are particularly significant and potentially impactful. Fair value accounting often requires considerable judgment and estimation, especially for assets and liabilities that are not actively traded in the market. Since these values are not directly observable, they must be estimated using various valuation techniques and assumptions, which introduces a degree of subjectivity (Dechow et al., 2010; Ryan, 2008).

This subjectivity inherent in fair value accounting gives opportunities for managerial discretion and bias in accounting choices. Managers may be motivated to make accounting choices that enhance financial reporting outcomes to meet regulatory requirements, influence market perception, manage earnings, or achieve other objectives. Such motivations align with the concepts described in positive accounting theory and agency theory (Watts & Zimmerman, 1986), which suggest that managers make accounting choices based on their interests and the economic consequences of those choices.

For example, limited by the boundaries of internal controls and external oversight, such as auditing, a manager might choose a valuation model for a Level 3 asset that inflates its value, thereby increasing reported income and potentially boosting the company's stock price. Conversely, a manager might undervalue an asset to decrease reported income in a period, perhaps to smooth earnings over time or to lower tax

liabilities. In our investigation, we explore the use of discretion to influence the bank's CAR.

Firstly, there are at least two reasons why banks choose to hold a higher, rather than a lower, CAR (Robinson et al., 2018). The first is that banks incur higher regulatory costs as the CAR decreases. Regulators may take various measures against banks that do not meet the minimum CAR requirements¹⁶, grading from closer monitoring to the requirement of a capital restoration plan, the prohibition of dividends distributions and share buybacks, the imposition of restrictions on business activities, the determination of changes on the board of directors or management team, up to, ultimately, the bank's resolution (Gup & Lutton, 2009). Therefore, banks with lower regulatory ratios face greater regulatory pressure than those with higher ones. Suppose the likelihood of violating a regulatory rule becomes too big. In that case, managers will be more prone to act to ease the regulatory pressure, providing a strong signal for both shareholders and managers who want to avoid keeping the CAR close to the regulatory minimum violation (Glaser et al., 2013; Mohrmann & Riepe, 2019; Yao et al., 2018). The second reason is that banks prefer to maintain a capital buffer to safeguard against the need to suddenly raise new equity at reasonable prices in periods of economic downturn or for prospective mergers and acquisitions (Berger et al., 2008).

Secondly, managers' choices regarding the fair value estimates can influence the CAR. The CAR is the division of the regulatory capital by the risk-weighted assets (RWA). The regulatory capital is an adjusted version of the bank's equity that considers only capital instruments of high quality and is impacted by the retained earnings account. Therefore, fair value gains boost a bank's income and increase the ratio's numerator. Those gains also impact the ratio's denominator by increasing the asset value. However, the denominator effect is generally much smaller for two reasons: i) the asset value is multiplied by a factor that is almost always smaller or equal to 1 (Robinson et al., 2018); and ii) the RWA value is composed by other significant parcels (e.g., the market risk, operational risk), proportionally diluting the impact of the increment. Consequently, an increase in the fair value of financial instruments can potentially increase the CAR. This

¹⁶ In our paper, we study only the minimum CAR (total capital adequacy ratio) requirement; however, there are other minimum capital requirements implemented by the Basel III accord, such as the Tier-1 (core capital), common-equity, capital conservation buffer, etc.

way, banks with CAR levels closer to the minimum are more prone to manipulate discretionarily fair-value assets valuation upwards aiming to increase the CAR and ease the pressure of a violation.

Thirdly, fair value instruments classified under the Level 1 category are not subject to discretionary manipulations as their prices are market-quoted and do not depend on managers' decisions. Thus, a manager must categorize the asset as Level 2 or Level 3 to manipulate fair value gains. Using Level 2, the manager can discretionarily choose an asset with better economic fundamentals than the original to serve as a pricing basis and obtain better results. If using Level 3, the manager has even greater freedom to create an internal model where the price of an asset meets a desired target.

In summary, banks with lower CAR are incentivized to use discretionary fair value gains to boost regulatory capital and avoid breaking the minimum legal. In comparison, banks with higher CAR do not, since they have larger capital buffers. Therefore, we expect that as the CAR reduces, getting closer to the regulatory minimum, the share of discretionarily valued Level 2 and Level 3 assets in the total fair-valued assets composition will increase. Following these arguments, we construct the following hypothesis:

H₁: There is a negative relationship between banks' CAR and the fraction of fair-valued assets discretionarily measured.

Until 2012, the balance of the AOCI account did not impact the CAR. As mentioned before, by this time, a regulatory feature excluded it from the regulatory capital calculation ("AOCI filter"), and fair value gains and losses registered under AOCI would not affect the CAR's numerator. For the reasons explained earlier, the AOCI filter was eliminated after Basel III, and the CAR began to suffer from fair value oscillations registered under AOCI. According to the IFRS 13 rules, the instruments classified as AFS will have their unrealized gains and losses registered under the AOCI account. Therefore, before the regulatory change, a bank manager could not influence the CAR using AFS instruments, but only HFT instruments that have gains registered directly on the net income account. However, after 2013, in addition to the HFT, AFS assets can be used as well.

To sum up, on the one hand, when the filter was active, AFS gains and losses did not affect the regulatory capital, so deliberately manipulating Levels 2 and 3 estimates to influence regulatory capital would be useful for HFT but pointless for AFS. On the other hand, removing the AOCI filter amplified the manager's possibility of arbitrage by including the AFS gains and losses in the CAR calculation. In other words, after the filter removal, more fair-valued instruments (HFT and AFS) are available to influence the CAR, making it easier to employ the discretion intending to do RCA. Therefore, we expect that, after the AOCI filter removal, the relationship described in H1 will be strengthened due to the ease of using discretion. Then, we state H₂ as follows:

H₂: The removal of the AOCI filter strengthened the negative relationship between banks' CAR and the fraction of fair-valued assets discretionarily measured

According to Glaser et al. (2013) and Yao et al. (2018), capital market pressure can weaken the incentives for the opportunistic use of fair value discretion in RCA. Listed banks suffer from greater scrutiny from stakeholders than non-listed banks. It makes them more vulnerable to litigation and impacts on share prices following a market's bad reaction derived from managers' accounting choices perceived as inappropriate. Then, managers will prefer to avoid questionable choices not to face capital market pressure. Moreover, listed banks must follow stricter rules from the securities authority regarding the quality of independent auditors. Better auditors have more serious reputational and litigation concerns. To mitigate such risks, they tend to be more rigorous, questioning less reasonable accounting choices, which reduces banks' incentives to employ fair value discretion. Therefore, we expect listed banks (under stricter capital market oversight) to use less discretion in Levels 2 and 3 valuations than non-listed banks.

H₃: Capital market oversight weakens the negative relationship between banks' CAR and the fraction of fair-valued assets discretionarily measured

3.3. Research design

To test our hypotheses, we adapt the Beaver & Engel (1996) two-step model to relate the share of fair-valued assets classified under Level 2 and Level 3 categories and the

variables of interest. The model segregates the discretionary fraction of the fair-valued assets from the non-discretionary part in the first step of the regression. Since the discretionary part of the fair-valued assets cannot be directly observed, it is estimated by regressing the total fair-valued assets value against the variables that explain non-discretionary variations of it in the first step. Then, the residual of this equation is assumed to be an estimate of the discretionary part of fair-valued assets value, as they represent the deviations from an equation purposefully modeled to explain only non-discretionary variations of the total fair-valued assets value.

3.3.1. First-step – estimating the discretionary part of fair-valued assets

The equation for the first step is described next:

$$pctLvN2N3_{i,t} = \alpha_0 + \alpha_1 \cdot \ln(Assets)_{i,t} + \alpha_2 \cdot pctFVAssets_{i,t} + \alpha_3 \cdot \Delta Ibov_t + \alpha_4 \cdot \Delta NPL_t + \alpha_5 \cdot Selic_t + \varepsilon \quad (1)$$

where:

$pctLvN2N3_{i,t}$ is the amount of Level 2 and Level 3 assets divided by the total fair value assets (Levels 1, 2, and 3) of a bank i at year t ;

$\ln(Assets)_{i,t}$ is the natural logarithm of the total assets of a bank i at year t ;

$pctFVAssets_{i,t}$ is the total fair value assets divided by the total assets of a bank i at year t ;

$\Delta Ibov_t$ is the variation of the Brazilian stock index between years t and $t - 1$;

ΔNPL_t is the variation of the non-performing loans rate between years t and $t - 1$;

$Selic_t$ is the annual average of the national interest rate as established by the Central Bank of Brazil at year t ;

The dependent variable $pctLvN2N3_{i,t}$ represents the fraction of fair-valued assets with prices not publicly available and greater values of $pctLvN2N3_{i,t}$ indicate that the bank's assets' values rely more on similar assets or in internal models based on non-publicly observable inputs. We chose to use the aggregate of Level 2 and 3 assets instead

of only Level 3 due to the large number of null observations for Level 3 assets (see descriptive statistics in Section 5). Nevertheless, we also ran a regression using only Level 3 assets as a robustness test.

On the right side of the equation, we include regressors to account for non-discretionary determinants of higher usage of Level 2 and Level 3 assets. The literature refers to the bank size and the business line as firm determinants for naturally higher values of $pctLvN2N3_{i,t}$ (Glaser et al., 2013; Robinson et al., 2018; Yao et al., 2018), because some bank characteristics can raise the share of Level 2 or 3 assets without necessarily implying discretion or manipulation. For the bank size, we include $\ln(Assets)$ to account for the influence it may have on a bank's fair value categories composition. A bigger bank is likelier to trade more tailored financial instruments that may not have an observed public price and must use valuation Levels 2 and 3. Moreover, bigger banks have greater resources to maintain the structure necessary to develop models and internal controls to observe the regulatory and auditing demands arising from a discretionary decision. These conditions can incentivize bigger banks to use more Level 2 or Level 3 assets, and we predict a positive signal for $\ln(Assets)$.

For the bank business line, we include the variable $pctFVAssets$, representing the fraction of a bank's total assets measured by fair value accounting methods. In banks, credit assets are usually measured by the amortized cost method, and represent the biggest part of its assets. A bank with relatively higher fair-value measured assets indicates that it trades more securities and derivatives, suggesting it is not a traditional credit-lending bank. For example, institutions in investment banking, venture capital, and treasury-trading businesses will have proportionally higher amounts of fair-valued assets than banks mainly involved in traditional lending. These business lines are more likely to trade assets that naturally fall into Level 2 or Level 3 categories, non-discretionarily. Thus, we expect that higher values of $pctFVAssets$ increase the probability of a bank being involved in the business that naturally demand Level 2 and 3 usage and should be positively associated with $pctLvN2N3_{i,t}$.

Additionally, we include bank fixed-effects to account for firm-specific invariant factors, such as the bank's culture and strategy, that can explain a larger amount of Level 2 and Level 3 assets.

Next, we acknowledge some features at the macroeconomic level that can incentivize the transactions requiring Level 2 or Level 3 assets, independent of bank characteristics or managerial choices. Yao et al. (2018) cite capital market liquidity as its main factor. According to the definitions of the IFRS 13, when an active market for an identical asset does not exist, managers should employ an alternative valuation technique to arrive at their best estimate of fair value. Banks are expected to increase the use of Level 2 or 3 instruments as capital market liquidity declines. For this purpose, we control for the variation of the Brazilian stock market index ($\Delta Ibov$). A significant decrease in the index indicates periods of lower liquidity, which diminishes active open-market trading and can incentivize bilateral trading. This can cause some assets previously traded to disappear and create customized over-the-counter (OTC) assets with no public pricing references. Managers will have to use alternative methods of valuation to estimate their fair values. This must increase the bank's usage of Levels 2 and 3 methods and, consequently, we predict a negative signal for $\Delta Ibov$.

The second reason for greater values of $pctLvN2N3_{i,t}$ is the growth of already existent Level 2 or 3 assets due to transferences between categories (reclassifications) or to revaluation. Concerning the first, the non-discretionary reason for the reclassification of an asset from a category of lower to one of higher subjectivity is the extinction of the pricing source previously used in valuation. If an asset was classified into Level 1, there was an active market for that asset, and the manager should change it only if this option is no longer available. In periods of higher liquidity, assets with low liquidity can experience a boost in trading activity, that goes away when the liquidity reduces (Naik & Reddy, 2021), causing the unavailability of a pricing reference. As mentioned in the previous paragraph, this situation can happen in periods of capital market lower liquidity, and we control for with $\Delta Ibov$. Regarding the latter, the reasons for a revaluation of currently existent assets, Level 2 and 3 instruments are likely to face non-discretionary changes in their fair values merely due to alterations in the economic conjuncture that affect the inputs of a bank's valuation model (Robinson et al., 2018). We include two

macroeconomic indicators for which variations are not subject to managerial discretion. First, the variation of the share of non-performing loans rate (ΔNPL), to proxy for the impact that a generalized increase in the default risk could have on an asset's price. We expect a negative sign for ΔNPL , provided that a greater default risk should reduce an asset's valuation. Second, the Brazilian sovereign interest rate (*Selic*). Most pricing models take the interest rate in consideration to build curves and discount cash flows when valuating an asset. However, the actual effect of the interest rate on an asset's price is uncertain, because it depends on the assets' conditions, and we do not predict a signal for *Selic*. Lastly, we also run simulations using time-fixed effects instead of the macroeconomic variables as robustness tests.

3.3.2. Second-step: regressing the determinants of the first step residuals

The second-step equation is as follows:

$$\begin{aligned} DpctLvN2N3_{i,t} = & \beta_0 + \beta_1.CAR_{i,t-1} + \beta_2.CAR_{i,t-1} \times Listed_t + \\ & \beta_3.CAR_{i,t-1} \times POST_t + \beta_4.EBT_{i,t-1} + \\ & \beta_5.EBT_{i,t-1} \times Listed_t + \beta_5.Listed_{i,t} + \beta_5.POST_t + \mu \quad (2) \end{aligned}$$

where:

$DpctLvN2N3_{i,t}$ is the estimated discretionary value amount of Level 2 and Level 3 assets divided by the total fair value assets value (Levels 1, 2, and 3) of a bank i at year t , represented by the absolute value of the first step residuals.

$CAR_{i,t-1}$ is the capital adequacy ratio (CAR) of a bank i at year $t - 1$, calculated by dividing the bank's regulatory capital by the risk-weighted assets.

$EBT_{i,t-1}$ is the value of the earnings before taxes divided by the total assets of a bank i at year $t - 1$.

$Listed_{i,t}$ is a dummy that assumes the value 1 if the bank i has stocks listed in the Brazilian exchange in the year t , and 0 otherwise.

$POST_t$ is a dummy that assumes the value 1 if the year t is 2013 or higher (after the AOCI removal) and 0 otherwise.

In the second step, the residual of the first step is used as the dependent variable and is regressed against explanatory variables that influence the discretionary fair-value accounting choices. Since manipulation can happen both upwards or downwards, we use the absolute values of the residuals (Galdi et al., 2021).

As explanatory variables, we include proxies for the two determinants of $DpctLvN2N3_{i,t}$ referred in prior studies: the capital adequacy management and bank performance (Glaser et al., 2013; Krauß, 2019; Milbradt, 2012; Mohrmann & Riepe, 2019; Robinson et al., 2018; Yao et al., 2018). Our primary interest is to investigate whether the banks use discretion in measuring fair-value assets with the intent to influence regulatory capital ratio, so our main independent variable of interest is the lagged CAR . As the CAR value approximates to the minimum, the risk of a regulatory violation increases, and the manager has greater incentives to react and report fair-valued assets opportunistically (Robinson et al., 2018; Yao et al., 2018). This can happen either as a deliberate business decision (by increasing the trading of customized assets in disfavor of standardized market-based ones) or as a revaluation/reclassification of current assets (e.g., being more optimistic in internally based estimates, choosing an asset with better performance but not accurately comparable to the other bank's Level 2 assets). Therefore, if our first hypothesis holds, we predict a significant negative sign for CAR .

Concerning the second driver, the literature on earning management in banks provides evidence that manipulating fair values has been a method often used by banks to reach earnings targets through profits and losses (P&L) management (Dechow et al., 2010; Fiechter & Meyer, 2010; Henry, 2009). Level 2 and 3 categories provide managers with greater easiness to manage earnings and, if a bank's $pctLvN2N3_{i,t}$ change cannot be justified by any non-discretionary factors, a significant relationship between $DpctLvN2N3_{i,t}$ and the bank's EBT suggests an opportunistic use of Level 2 and 3 instruments motivated by the bank's performance. We don't anticipate a signal for EBT because earnings management can occur towards lower or higher earnings depending on the management's intention to smooth income or boost profits. We also highlight that both

CAR and *EBT* variables are measured at the beginning of the year (end of the period $t - 1$). The values at the end of the year would already be impacted by manipulation, if any. Since we are interested in changes of $DpctLvN2N3_{i,t}$ driven by the explanatory variables, and not the other way around, using the values at the beginning of the period also mitigates endogeneity issues deriving from simultaneity¹⁷.

Next, we add two last variables of interest to the model. The dummy *POST* serves to test the second hypothesis concerning whether the removal of the AOCI filter affected the use of Levels 2 and 3 instruments. Because the AOCI filter suppresses the impact of AFS gains and losses on the *CAR* calculation, its removal increases the relevance of fair value valuations for the regulatory capital calculation. With the AOCI filter, managers could influence the *CAR* by manipulating the valuation only on HFT instruments. Still, after the removal, they can do it through AFS assets, making it easier to manipulate the *CAR*. Therefore, we expect that *POST* will have a positive signal while *CAR* $\times$ *POST* should have a negative signal. We do not include an interaction of *POST* with *EBT* because the AOCI filter is only applied to the regulatory capital calculation and has no effect on the bank's profits.

Lastly, to test our third hypothesis, we include the dummy *Listed* and its interactions with both *CAR* and *EBT*. If the hypothesis that listed banks are subject to higher monitoring and market oversight holds, they are less likely to use discretion to manipulate accounting indicators and do RCA and earnings management. Thus, a negative signal is expected for *Listed*, a positive for *CAR* $\times$ *Listed* (double-negative effect), and, since we do not anticipate a signal for *EBT*, we also do not predict a signal for *EBT* $\times$ *Listed*, only that it should have the opposite sign of *EBT*.

3.4. Data and sample selection

3.4.1. Data source and sampling

Our sample encompasses all Brazilian banks that have published financial statements according to international standards (IFRS) from 2011 until 2022. This is because the information regarding the fair-value hierarchy levels is an IFRS 13 determination, which

¹⁷ Further detailing regarding endogeneity are discussed in subsection “5.3 – Robustness tests”

was not fully incorporated into the Brazilian regulation until 2022. Therefore, the sample is restricted to banks obliged to produce complementary full IFRS reports due to Resolution 3.786/2009¹⁸.

We hand-collected the financial data from the banks' annual financial statements on the banks' websites. Nevertheless, as usual in non-structured databases, the reports lack standardization, and some information was not available for every cluster. Moreover, some banks did not have the data every year for several reasons, such as the discontinuation of activities, mergers/acquisitions, or the inapplicability of Resolution 3.786/2009. Considering it, the sample data constituted an unbalanced panel of 434 annual observations within 41 clusters (individual banks or bank conglomerates). However, given the panel's imbalances, we note that the number of observations considered in each regression varies according to the specification, depending on the available data.

Additional information regarding other control variables was collected from the Central Bank of Brazil repository (www.bcb.gov.br/IFDATA) and the Instituto de Pesquisas Econômicas Aplicadas (IPEA) website (www.ipeadata.gov.br).

3.4.2. Descriptive statistics

The descriptive statistics displayed in Table 3.1 show that Level 1 assets are prevalent in Brazilian banks. They represent, on average, 56.4% of the sample's total fair value measured assets, while Level 2 assets are 37.2% and Level 3 only 6.4%. This result indicates that using internal models for an asset valuation is not a regular practice in the Brazilian financial system, suggesting that when the manager cannot find a market price for an asset, they will likely opt for a similar asset with a market price (Level 2) instead of creating an internal model for it (Level 3).

¹⁸ The Resolution 3.786/2009 determines that, in addition to the Brazilian regulatory reports, all listed banks and/or banks required to constitute an audit committee must produce and publish annual consolidated financial statements in accordance with the standards issued by the International Accounting Standards Board (IASB).

Table 3.1. Descriptive statistics

	N	Mean	SD	Median	Min	Max
L1 Assets	422	.564	0.327	.654	0	1
L2 Assets	422	.372	0.322	.301	0	1
L3 Assets	422	.064	0.098	0	0	.912
L2+L3 Assets	422	.436	0.327	.346	0	1
Total Assets	434	190.00	424.64	23.31	.88	2,323.00
pctFVAssets	434	.274	0.217	.233	0	.996
CAR	434	.176	0.064	.161	-.104	.745
EBT	421	.013	0.020	.014	-.087	.133
Δ Ibov	434	.061	0.186	.047	-.181	.389
Δ NPL	434	.058	.277	.084	-.333	.608
Selic	434	.090	.034	.085	.027	.140
Listed	434	.435	0.496	0	0	1

Notes: *L1*, *L2*, and *L3 Assets* represent the ratio between a bank's Levels 1, 2, and 3 assets and the total of fair-value measured assets. *Total Assets* represents a bank's total assets in billions of the Brazilian currency (BRL); *pctFVAssets* represents the ratio between a bank's fair-value measured assets and its total assets; *CAR* represents a bank's capital adequacy ratio, measured by the division of its regulatory capital and the risk-weighted assets (RWA). *EBT* represents the ratio between a bank's earnings before taxes and its total assets. Δ Ibov represents the year-over-year variation of the Brazilian stock index B3 (formerly Ibovespa); Δ NPL is the variation of the annual non-performing loans national rate; *Selic* is the annual Brazilian sovereign interest rate; *Listed* is a dummy variable that assumes the value 1 if the bank has stocks listed in the Brazilian stock exchange B3 (formerly Ibovespa) and 0 otherwise. All variables were collected from 2011 to 2022.

There may be two possible explanations for this. First, the Brazilian legal and regulatory framework restricts over-the-counter (OTC) trading, pushing banks to trade financial instruments through exchanges (Upper & Valli, 2016). Even for unlisted products traded bilaterally on the OTC market (such as bank-issued financial instruments and tailored derivatives), there is an officially regulated clearinghouse for registering and publicizing these trades by market participants (IMF, 2018). This feature implies that most financial instruments have a publicly observed price, or at least a similar one, leaving little space for the necessity of Level 3 measurement. Second, developing a pricing model for estimating an asset's value may have high structure costs. It demands expertise and internal controls that may be cost-ineffective if there are too few Level 3 assets, leading the manager to prefer to classify it as Level 2, instead of Level 3.

The participation of fair valued assets to total assets is 27.4% on average, reflecting the prevalence of amortized cost accounting. This is expected since most assets correspond to the bank's loan portfolio, which is not measured at fair value. The total assets mean of the sample is BRL 190 billion with a very high dispersion and much lower median (BRL 23.3 billion), evidencing the great concentration of assets on bigger banks in the Brazilian banking system. The average CAR is 17.6%, along with an EBT over Assets of 1.3% per year. Finally, the average yearly variation of the Ibovespa (stock exchange) index is 6.1%, and 43.5% of the sample observations were banks with stocks listed in the exchange during the analyzed period.

Table 3.2. Pearson correlation matrix

	pctLvN2N3	CAR	EBT	pctFVAssets	ln(Assets)	ΔIbov	ΔNPL	Selic
pctLvN2N3	1.0000							
CAR	-0.0771 (0.1138)	1.0000						
EBT	0.0163 (0.7420)	0.3308*** (0.0000)	1.0000					
pctFVAssets	0.1972*** (0.0000)	0.0750 (0.1187)	0.0561 (0.2507)	1.0000				
ln(Assets)	0.0493 (0.3119)	-0.1691*** (0.0004)	0.0544 (0.2654)	-0.0251 (0.6017)	1.0000			
ΔIbov	-0.0517 (0.2894)	0.0083 (0.8633)	-0.0862 (0.0774)	-0.0697 (0.1469)	-0.0411 (0.3927)	1.0000		
ΔNPL	-0.0472 (0.3420)	-0.0127 (0.7949)	-0.0048 (0.9238)	0.0445 (0.3633)	-0.0039 (0.9358)	0.0642 (0.1898)	1.0000	
Selic	0.0161 (0.7416)	-0.0157 (0.7451)	-0.0494 (0.3119)	0.0081 (0.8672)	-0.0590 (0.2200)	0.0340 (0.4797)	0.0444 (0.3647)	1.0000

* p<0.10, ** p<0.05, *** p<0.01

Notes: *pctLvN2N3* represents the ratio between a bank's Levels 2 and 3 assets and the total of fair-value measured assets. *pctFVAssets* represents the ratio between a bank's fair-value measured assets and total assets. *ln(Assets)* represents the natural logarithm of a bank's total assets; other variables defined as per Table 3.1.

Table 3.2 presents the Pearson correlation matrix for all collected variables. Regarding the correlations among the dependent variable *pctLvN2N3* and the explanatory variables, we highlight that the highest correlation occurs with *pctFVAssets*. This suggests

that our proxy for the bank's business line significantly correlates with the share of Level 2 and Level 3 assets, supporting our assumption. The remaining variables did not present a statistically significant correlation, although their signals match our predictions made in the previous section.

The independent variables presented two significant correlations: i) *CAR* and *EBT* (+), suggesting that banks with higher results also have higher capital adequacy ratios; and ii) *CAR* and *ln(Assets)* (–), suggesting that bigger banks have lower capital adequacy ratios. Nevertheless, the highest correlation is 0.33, indicating that the multicollinearity issue should not concern the regression results.

3.5. Results

3.5.1. First-step regression

We estimated the equation (1) using *pctFvN2N3* (Levels 2 and 3 assets over total fair value assets) and *pctFvN3* (Level 3 assets over total fair value assets). As mentioned, the amount of Level 3 assets is minimal, with many null observations, potentially undermining the regression results. Therefore, we primarily used the sum of Levels 2 and 3 to proxy for the discretionary choice over the Level 1 assets (columns 1 and 2). Regardless, we also report the results for the estimation using only the Level 3 assets (columns 3 and 4) for robustness reasons. Furthermore, the macroeconomic variables are excluded when time-fixed effects are included. Results are in Table 3.3.

Table 3.3. First-step regression

Independent Variables	Dependent variables			
	pctFvN2N3 (1)	(2)	pctFvN3 (3)	(4)
lnAssets	0.0839** (0.0339)	0.0321 (0.0427)	0.0158 (0.0159)	-0.00774 (0.0132)
pctFVAssets	0.243** (0.100)	0.316*** (0.0982)	0.0773 (0.0834)	0.0646 (0.0774)
ΔIbov	-0.0898* (0.0529)		-0.0267 (0.0231)	
ΔNPL	0.0199 (0.3422)		0.0131 (0.0159)	

Selic	0.674** (0.314)		-0.0737 (0.126)	
N	408	422	408	422
Clusters	41	41	41	41
R-squared	0.659	0.656	0.282	0.302
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes
Robust standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Variables defined as per Tables 3.1.and 3.2.

Our results confirm that the bank size, represented by *lnAssets*, is positively and significantly associated with the share of Level 2 and Level 3 assets. This is expected because bigger banks are more likely to trade tailored assets that are not publicly traded often and demand a similar asset to compare it or a proprietary valuation method. The bank business line, proxied by *pctFVAssets*, is also positively and significantly associated with the share of Level 2 and Level 3 assets. This supports our predictions that banks with more assets evaluated by the fair-value method relative to the amortized-cost should also have relatively higher shares of Level 2 and Level 3. This is because banks with lower values of *pctFVAssets* are usually focused on credit and will trade exotic assets less frequently; conversely, banks with higher values of *pctFVAssets* are more engaged in business lines that trade customized assets often, and demand differentiated pricing methods (e.g., investment banking, venture capital, and treasury).

The coefficient of *Albov* resulted significantly negative, confirming our prediction. This suggests that in periods of lower capital market liquidity (stock index decline) (Naik & Reddy, 2021), the reduction of Level 1 assets availability can push the growth of Level 2 and Level 3 assets, increasing their relative share of wallet. The *ANPL* coefficient was not statistically significant at any conventional level, indicating that the default risk is not associated with the share of Level 2 and Level 3 assets. We highlight that Selic's coefficient resulted significantly positively, suggesting that higher interest rates are associated with higher amounts of Level 2 and Level 3 assets.

As explained earlier, our purpose was to obtain the residuals of the regression to use them as an estimative for the discretionary part of the Level 2 and Level 3 assets. To remark that only the ΔNPL coefficient was statistically insignificant at the conventional levels, suggesting that most of our explanatory variables are significantly associated with the share of Level 2 and Level 3 assets. By construction, we assume that these variables explain only the non-discretionary variations of our dependent variable. Furthermore, the regression had a good fit ($R^2=0.659$), and we expect that the residuals would be a fair representation of the variations explained by discretionary choices.

As a last remark, we underline that no variables were significant under the setups using only Level 3 assets (columns 3 and 4). This can be attributed to the sample limitation related to the high number of null observations but also can suggest that non-discretionary variables do not significantly explain Level 3 asset variations. This is plausible because the Level 3 assets are the most subjective category in the hierarchy and are more likely to be used for discretionary manipulations.

3.5.2. Second-step regression

We estimated equation (2) using $DpctFvN2N3$ and $DpctFvN3$ the absolute values of equation (1) residuals in each of the four regressions setups (columns 1-4 of Table 3.3), as our dependent variable. We first analyze the descriptive statistics of $DpctFvN2N3$ and $DpctFvN3$, as shown in Table 3.4 bellow.

Table 3.4. Residuals descriptive statistics

	Mean	SD	Median	Min	Max
$DpctFvN2N3$	0.1385	0.1309	0.1021	0.00002	0.8462
$DpctFvN2N3$ (with year FE)	0.1409	0.1298	0.1055	0.00039	0.9429
$DpctFvN3$	0.0337	0.0756	0.0119	0.00001	0.6699
$DpctFvN3$ (with year FE)	0.0353	0.0738	0.0157	0.00007	0.6814

Notes: $DpctLvN2N3$ represents the discretionary fraction of the ratio between a bank's sum of Levels 2 and 3 assets and its total fair-value measured assets, estimated by the absolute value of the residuals of the first-step regression. $DpctFvN3$ represents the discretionary fraction of the ratio between a bank's Level 3 assets

and its total fair-value measured assets, estimated by the absolute value of the residuals of the first-step regression.

The average values of *DpctN2N3* and *DpctN3* are 0.1385 and 0.0353, respectively. It evidences that the participation of *DpctN2N3* in the total of Levels 2 and 3 (Table 3.1) is smaller than the participation of *DpctN3* in total of Level 3 assets. This is expected because Level 3 assets allow for greater subjectivity and are more likely to have a bigger discretionary component. The residuals deriving from the regressions using year fixed-effects had similar results.

Table 3.5. Second-step regression

Independent Variables	Dependent variables			
	DpctFvN2N3		DpctFvN3	
	(1)	(2)	(3)	(4)
CAR	-0.785*** (0.288)	-0.671** (0.285)	-0.492*** (0.159)	-0.493*** (0.155)
CAR x Listed	1.180*** (0.238)	1.150*** (0.235)	-0.0647 (0.131)	-0.0721 (0.128)
CAR x POST	0.586** (0.286)	0.424 (0.283)	0.399** (0.157)	0.410*** (0.154)
EBT	0.813* (0.436)	0.461 (0.428)	0.376 (0.240)	0.402* (0.233)
EBT x Listed	-2.854*** (0.670)	-2.532*** (0.662)	-0.812** (0.369)	-0.827** (0.360)
Listed	-0.184*** (0.0405)	-0.189*** (0.0400)	0.0232 (0.0223)	0.0231 (0.0217)
POST	-0.158*** (0.0516)	-0.131** (0.0511)	-0.0788*** (0.0284)	-0.0811*** (0.0278)
<u>Joint F-test of coefficients'</u>				
<u>sum</u>				
CAR + CAR x Listed	0.395 (1.71)	0.479 (2.54)	-0.556*** (11.16)	-0.565*** (12.01)
CAR + CAR x POST	-0.199 (2.44)	-0.247** (3.96)	0.093 (1.76)	-0.08 (1.51)
CAR + CAR x Listed + + CAR x POST	0.981*** (22.18)	0.903*** (19.01)	-0.157 (1.88)	-0.155 1.90
EBT + EBT x Listed	-2.041*** (15.90)	-2.071*** (16.64)	-0.436 (2.38)	-0.425 (2.37)
N	397	411	397	411
Clusters	41	41	41	41

R-squared	0.114	0.110	0.052	0.052
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: *Listed* is a dummy variable that assumes the value one if the bank has stocks listed in the Brazilian stock exchange B3 (formerly Ibovespa) and 0 otherwise. *POST* is a dummy variable that assumes the value of 1 if the observation year is 2013 or higher (after the AOCI prudential filter removal) and 0 otherwise. Other variables defined as per Tables 3.1 and 3.4.

Next, we analyze the regressions' coefficients displayed in Table 3.5 to test our first hypothesis. Consistent with Yao et al. (2018) and Glaser et al. (2013), our results show that the coefficient of *CAR* is negatively significant in all scenarios, supporting H_1 . This indicates that as the bank's *CAR* reduces, the discretionary amount of Level 2 and Level 3 assets increases, suggesting that managers do RCA by boosting discretionary fair value gains. The effect size of a reduction of 1 p.p. in the *CAR* for unlisted banks before 2013 (*Listed* = 0; *POST* = 0) indicates that the percentage of Level 2 and Level 3 on fair value assets increases by 0.785 p.p. This represents a 5.67% growth on the average *DpctLvN2N3*.

Conversely, the results for *POST* and *CAR* $\times$ *POST* presented significantly negative and positive coefficients, respectively, contradicting our predictions in H_2 . This indicates that after the AOCI filter removal, on average, banks used relatively fewer discretion on Level 2 and Level 3 assets valuation than before 2013. It also suggests that the relationship between the *CAR* and the usage of Level 2 and Level 3 assets was attenuated after the AOCI filter removal. Moreover, the joint F-test for the sum of *CAR* and *CAR* $\times$ *POST* coefficients for the simulation without year fixed-effects cannot reject the hypothesis that it is different from zero; meanwhile, with year fixed-effects, the sum of the coefficients remained significantly negative at the 5% level. These results show that, after the AOCI filter removal, the effect of *CAR* in *DpctLvN2N3* reduced, but it is uncertain whether it was completely nullified or some residual effect was left.

The unexpected result can be attributed to two reasons. First, the results may be influenced by the sample imbalance between pre- and post-AOCI filter removal periods.

The sample began in 2011, and the removal was effective in 2013, leaving only two years of observations before the AOCI removal compared with the ten years after. This means that the periods may not be equally representative in estimating the banks' behavior, and the regression results can be distorted. Second, the amount of AFS assets that could be used to make discretionary manipulations may be irrelevant and/or reduced between the periods in response to the impact of the AOCI removal. This would be consistent with the findings of Hamilton (2019) and Kim et al. (2019) regarding the migration of the AFS assets to the HTM (held to maturity) category after the filter removal in the U.S. market. Moreover, after the AOCI filter removal, holding volatile AFS instruments can increase the risk of impacting the regulatory capital, and managers might prefer to take early actions and sell it (Bischof et al., 2021). Regarding the attenuation of the CAR coefficient, a possible reason is that some banks with unrealized AFS gains under the AOCI account could have benefited from the filter removal increasing the CAR by including those previously disregarded gains. If true, this would reduce the need for discretionary manipulations and mitigate arbitrage behavior. Unfortunately, our data did not allow us to verify the categories (HFT, AFS, and HTM) of fair-value assets for a significant part of the banks, constituting an interesting opportunity for a future study with access to a more complete database.

Regarding the third hypothesis, the coefficient of *Listed* is negative and significant, while the coefficient of $CAR \times Listed$ is positive and significant, as predicted. This supports H_3 , suggesting that listed banks are less likely than non-listed banks to use Levels 2 and 3 instruments and that the mitigating effect also happens for the banks with lower *CAR*. Indeed, the joint F-test for the sum of *CAR* and $CAR \times Listed$ coefficients shows that the effect size of the negative association verified in H_1 is completely nullified when the bank has stocks listed in the Brazilian exchange, and the *CAR* has no significative effect on $dPctLvN2N3$ for Listed banks, in both scenarios with and without time fixed-effects. This result is consistent with Yao et al. (2018) and Glaser et al. (2013).

Additionally, we report that the coefficients of *EBT* are positive and significant at the 10% levels, in the scenario without time fixed-effects, but not significant when including year fixed-effects. We recall that it was included as a proxy for the possibility of earnings management since the manipulation of gains and losses of fair-valued financial instruments can also be motivated solely by bank's profitability (regardless of

the regulatory capital). These results provide weak evidence on using discretion in valuating assets in Levels 2 and 3 motivated by profitability.

Conversely, the negative coefficient of *EBT x Listed* denotes that having stocks traded in the exchange have a negative impact on *EBT*'s coefficient. Moreover, the joint F-test for the sum of *EBT* and *EBT x Listed* shows that the impact is so big that, for listed banks, the global impact of the *EBT* is significantly negative for both simulations with and without year fixed-effects. These results indicate that, while in non-listed banks, it is uncertain whether the profitability influences Levels 2 and 3 discretion, for listed banks, an increase (reduction) in the profitability reduces (increases) the discretion in Levels 2 and 3 assets valuation. This is an unexpected result, because it suggests that listed banks manipulate the valuation of Level 2 and Level 3 assets more (less) when the profitability goes down (up), while non-listed banks would not. One possible reason is that, due to capital market rules regarding disclosure, listed banks may be more concerned about publicizing bad results than non-listed banks, justifying higher manipulation.

Lastly, we highlight that the results using only Level 3 assets (columns 3 and 4) presented similar results, although most of the joint F-tests did not present statistical significance.

3.5.3. Robustness tests

We conduct some robustness tests to assess whether our results are sensitive to our model specifications and choices of variable proxies. First, we rerun our simulations, including a new variable to control for the discretionary loan loss provision (LLP) expenses (*dLLP*)¹⁹ (results in Appendix 3.1). The literature documents that banks use discretionary LLP to manage earnings and regulatory capital (Ahmed et al., 1999; Anandarajan et al., 2003; Beatty et al., 2002; Beaver & Engel, 1996), and it could be a substitute or complementary method to fair-value accounting discretion. Depending on the availability of discretionary LLP and the earnings/capital target size, the incentive for a manager to use Level 2 and 3 instruments to do RCA would be higher or lower. Yao et al. (2018)

¹⁹ To estimate *dLLP* we based on Beaver & Engel (1996) method consisting in regressing the bank's total LLP against objective (non-discretionary) determinants of the LLP such as the non-performing loans (NPL), loans renegotiations, implicit interest rate, etc., to segregate the non-discretionary part of the LLP (explained by the regressors) from the discretionary part (regression's residuals).

found that using Level 3 assets can be a complementary method of earnings management to the LLP, suggesting that if a bank manager is prone to use discretion to manipulate the reports, he will explore multiple methods to meet his goals. Our coefficients, including *dLLP* are similar with those without it, but *dLLP* is not significant at any conventional level.

Second, we test an alternative proxy for the regulatory capital adequacy and rerun our model, replacing *CAR* for Tier 1 capital adequacy ratio (*CAR_T1*). The results remained robust, although we could not evaluate the results for *POST* because the Tier 1 data is available only after 2013. Furthermore, we substitute the variable *EBT* for the return on equity (*ROE*) to proxy for the bank's performance, obtaining similar results. Yet, the coefficients of *CAR* become insignificant in two of our four scenarios. The results are available in the Appendix 3.2 and 3.3.

Additionally, we perform some further robustness tests to tackle the endogeneity concern. We assume that the share of Level 2 and 3 assets in a bank's fair-value assets is determined by the bank's *CAR*, *EBT*, *lnAssets*, and *pctFVAssets*. Still, the relationship can be reversed or simultaneously determined, uncovering possible endogeneity issues. First, we expect that the *CAR* and *EBT* levels cause a discretionary change in the amount of Level 2 and 3 assets due to the earnings management and regulatory capital arbitrage incentives explained earlier. However, the change intends to influence the *CAR* and the *EBT*, exposing a clear possibility of simultaneous causation. As mentioned in Section 3.3, we dealt with the issue of implementing a common ad-hoc solution by replacing the values of *CAR* and *EBT* with their lagged values to workaround the simultaneity possibility as done similarly by Soumaré et al. (2020) and Tchuigoua (2016). Nevertheless, in this test, we replace all lagged variables by their contemporaneous values and estimate a 2-Stage Least Squares (2-SLS), instrumenting them with their respective lagged values instead. Despite the changes in the p-values of some coefficients, results (in Appendix 3.4) remain qualitatively the same, and the previous conclusions are robust. We underline that the regressions' instruments passed various tests for potential issues (reported in Appendix 3.4), supporting the validity of the instruments (except the regressions using only Level 3 assets that failed to pass the Hausman and endogeneity tests).

Afterwards, we use *lnAssets* and *pctFVAssets* as proxies of the bank's size and business line. We argued in Section 3.3 that bigger banks and banks with a higher share of fair-value assets in their total assets would be more likely to use Level 2 and 3 assets. However, suppose the manager changes the Level 2 and 3 assets ratio by increasing Level 2 and 3 assets or re-evaluating the current assets. The addition would increase the amount of the fair-value assets by the amount of the new or revalued Level 2 and 3 assets. In this case, all other things remain the same (mainly no significant changes in the amortized cost and Level 1 assets), this situation would increase the values of *lnAssets* and *pctFVAssets*, creating endogeneity by reverse causation. However, since there are other multiple factors affecting *lnAssets* and *pctFVAssets*, it is unlikely that a change in *pctFvN2N3* or *pctFvN3* should ultimately determine the values of *lnAssets* and *pctFVAssets*.

Nevertheless, we ran another test to avert the endogeneity concern in our first-step regression. We formulate an alternative model for the first-step regression, using only one explanatory variable to regress against *pctFvN2N3*. The variable is the ratio between Level 1 assets and the bank's total assets (*pctNIAssets*). The rationale behind the model is that any factor that increases/decreases the bank's Level 1 assets relative to its total assets is non-discretionary because Level 1 assets are not subject to discretionary valuation. Therefore, any variation on *pctFvN2N3* driven by the same factor that influences *pctNIAssets* should be non-discretionary. Then, we follow the same procedures by extracting the residuals of the equation as the discretionary fraction estimative and run the second step as usual. Note that *pctNIAssets* is exogenous because *pctFvN2N3* accounts for the relative share of Level 2 and Level 3 assets within fair-value assets. However, for *pctNIAssets* we use the relative share of Level 1 assets within total assets²⁰, and a change in *pctFvN2N3* should not affect *pctNIAssets*.

We report the results of this test in Appendix 3.5 (first step) and 3.6 (second step). Despite the reduction in statistical significance of some coefficients mainly caused by the observations dropped in the process, our results for this test also sustain the qualitative inferences stated in the Results section.

²⁰ If we used both variables' ratios relative to fair-value assets, they would be perfect collinear to each other, because they would sum 100%.

3.6. Conclusion

The objective of our study was to investigate the relationship between the bank's use of higher discretion in estimating the fair value of financial assets and their capital adequacy ratios. We hand-collected 434 bank-year observations from the financial statements of 41 Brazilian bank conglomerates between 2011 and 2022. We found that banks with lower CAR are associated with a higher fraction of discretionarily valued Levels 2 and 3 assets. We also found that this relationship was significantly reduced (if not completely nullified) after the Basel III accord's regulatory change, which recommended removing the AOCI filter, previously instituted to shield the regulatory capital from the impact of AFS unrealized gains and losses. Furthermore, being listed in a stock exchange fully mitigates the relationship between the CAR and the share of Level 2 and Level 3 assets discretionarily measured.

Our findings suggest that banks with lower capital adequacy ratios are more likely to undertake RCA by manipulating the estimates of fair-value assets to ease the regulatory pressure of a potential violation. It also supports the importance of stronger external monitoring exerted by market analysts and independent auditors in listed banks to moderate this practice. The results are consistent with prior literature (Glaser et al., 2013; Yao et al., 2018).

Additionally, the study addresses a concern of Laux (2016) regarding the lack of research investigating the effects of AOCI filter removal. We could conclude that the impact of including AFS unrealized gains and losses in the regulatory capital calculation did not push bank managers to increase the usage of discretion in evaluating Levels 2 and 3 instruments. On the contrary, they reduced the use of discretion. It suggests that banks did not choose to manipulate the fair-value measurements to ease the impact of the AOCI into the CAR; instead, they likely found alternative ways to deal with it. The migration of the AFS to the HTM category is a possible reason suggested by Hamilton (2019) and Kim et al. (2019). Another possibility is that managers prefer to take early actions and realize the gains or losses of the assets before the impact on the CAR becomes too large (Bischof et al., 2021). Furthermore, banks could have more gains than losses registered

under the AOCI account on average, positively impacting the CAR and reducing the necessity of RCA through the discretionary manipulation of Level 2 and Level 3 assets.

This investigation should interest regulators, standard setters, and the accounting profession. In Brazil, Resolution N° 4.818/2020 expanded the application of the IFRS standards for a much larger fraction of the system than Resolution N° 3.786/2009 for financial statements published after 2022. It will present a significant advance in banks' disclosure levels regarding fair-value discretion, and our findings should be useful for bank regulators in their supervision role.

We acknowledge that our study has some limitations. First, we could not investigate the composition of fair-value assets into the HFT, AFS, and HTM categories. This is an opportunity for future studies to explore the cause of the reduction in the coefficients observed in our second hypothesis empirical results. Second, we only analyzed the relation of the fair-value discretion in asset valuation but not into the liabilities. For scope reasons, we did not focus on the fair-valued liabilities because they are less representative of the banks' balance sheets (Oliveira et al., 2021; Yao et al., 2018). However, it can also indirectly manipulate the CAR for RCA, and we suggest that future studies investigate this potential channel. Third, as in any other empirical study, we warn that the results are constricted to our sample size and characteristics, and our conclusions should be generalized with caution.

CONCLUSIONS

In this thesis, we developed three empirical works portrayed in Chapters 1, 2 and 3. The manuscripts focused on investigating the practice of RCA by exploiting accounting standards rules in the Brazilian banking system.

In the first paper, we demonstrated the effects of an accounting-based solution deployed by the Central Bank of Brazil to prevent RCA through shadow banking. The solution consisted of extending the consolidation perimeter of the financial statements to include entities outside the financial system doing financial intermediation without complying with regulatory capital requirements. We showed that it increased the regulatory pressure on the bank conglomerates doing RCA, pushing them to raise their CAR levels compared to the unaffected banks. More specifically, our results concluded that:

- 1.1. The financial institutions affected by the new legislation suffered an increment in their capitalization levels, relative to the unaffected banks. This result strengthens the capital buffering theory in the stream of the literature that researches the effects of increased regulatory pressure on the banking system's capital levels. It extends the works of Furfine (2001), Milne & Whalley (2002), and Pereira & Saito (2015) by adding novel empirical evidence from an unresearched regulatory perspective. Consistent with the referred studies, this study found that increased regulatory pressure led the banks to raise their CAR levels conservatively.
- 1.2. Conversely, the financial institutions affected by the new legislation did not reduce or increase lending in relation to the unaffected banks. We add new evidence to the stream of studies researching the effects of capital requirements on the bank's credit supply since the early 1990s with conflicting results. Contrary to the latest developments, this study did not find an impact on the bank's credit offering caused by increased capital requirements. Moreover, the results are consistent with the extended conclusions of the research on capital buffering theory, which found that short-term adjustments made by less capitalized banks are made preferably in

capital rather than in risk (Furfine, 2001; Milne & Whalley, 2002; Pereira & Saito, 2015).

- 1.3. The results indicate that extending the consolidation perimeter of the bank conglomerates can be an effective prudential supervision solution to enhance and strengthen the banking system. They show that the new standard promoted an elevation in the impacted banks' capitalization levels and did not impact their credit supply.
- 1.4. Lastly, this paper contributes to the literature investigating the practical effects of new accounting standards in the banking industry, extending the stream resumed by Beatty & Liao (2014). It can be of value for both accounting standards researchers and policymakers.

In the second paper, we discussed the practice of regulatory capital arbitrage in the Brazilian banking system, examining the association of managerial discretion in LLP recognition and the bank's capital adequacy ratio. In our analysis of the national GAAP (BRGAAP), we evaluate whether banks with lower CAR use more discretionary LLP, and if this relationship is linear or depends on the bank's characteristics. Moreover, we checked whether the same behavior could be verified for the publications made under international standards. In summary:

- 2.1. Our findings show that, under the BRGAAP, poorly capitalized banks have lower amounts of discretionary LLP, suggesting that managers reduce discretionary loan provisioning to avoid a regulatory violation.
- 2.2. Moreover, we found that this relationship is not linear, being moderated for listed, state-owned and foreign-controlled banks, indicating that external oversight, corporate governance, and ownership type can mitigate the practice
- 2.3. Conversely, this behavior is not found in the data derived from publications under international standards. This could be attributed either to the lack of a direct benefit, provided the CAR is computed using only BRGAAP data, or to the specificity of the international standard definitions regarding the LLP constitution

2.4. These results are of particular interest to bank regulators concerned with regulatory capital arbitrage, and accounting standard setters can learn from empirical evidence derived from an alternative GAAP other than the international standard. Furthermore, we contribute to the literature on banking regulation by exploring the research question using a methodological approach to estimate the discretionary LLP different from previous studies (Bouvatier & Lepetit, 2008; Kim & Kross, 1998; Kund & Neitzert, 2020; Leventis et al., 2011; Pérez et al., 2008).

2.5. Furthermore, we help clarify existing divergences in the RCA literature by adding new evidence regarding the bank's characteristics that can affect managers' opportunistic behavior. Lastly, we add to the literature on alternative accounting standards new empirical evidence regarding the practice of RCA by exploring the impact of different standards simultaneously, a novelty in this type of literature.

In the paper 3, we investigated the relationship between the bank's use of higher discretion in estimating the fair value of financial assets and their capital adequacy ratios. We found that:

3.1. Banks with lower CAR are associated with a higher fraction of discretionarily valued Levels 2 and 3 assets. Our findings suggest that banks with lower regulatory capital are more likely to undertake RCA by manipulating the estimates of fair-value assets to ease the regulatory pressure of a potential violation.

3.2. We also found that this relationship was significantly reduced (if not completely nullified) after the Basel III accord's regulatory change recommended removing the AOCI filter, previously instituted to shield the regulatory capital from the impact of AFS unrealized gains and losses. We could conclude that the impact of including AFS unrealized gains and losses in the regulatory capital calculation did not push bank managers to increase the usage of discretion in evaluating Levels 2 and 3 instruments.

- 3.3. On the contrary, they reduced the use of discretion. It suggests that banks did not choose to manipulate the fair-value measurements to ease the impact of the AOCI into the CAR; instead, they likely found alternative ways to deal with it. The migration of the AFS to the HTM category is a possible reason suggested by Hamilton (2019) and Kim et al. (2019). Another possibility is that managers prefer to take early actions and realize the gains or losses of the assets before the impact on the CAR becomes too large (Bischof et al., 2021). Furthermore, banks could have more gains than losses registered under the AOCI account on average, positively impacting the CAR and reducing the necessity of RCA through the discretionary manipulation of Level 2 and Level 3 assets.
- 3.3. Furthermore, we add that being listed in a stock exchange fully mitigates the relationship between the CAR and the share of discretionary Level 2 and Level 3 assets. It underlines the importance of stronger external monitoring exerted by market analysts and independent auditors in mitigating this practice.
- 3.4. The results are consistent with prior literature (Glaser et al., 2013; Yao et al., 2018) and address the call of Laux (2016) for research investigating the effects of AOCI filter removal.
- 3.5. This investigation should interest regulators, standard setters, and the accounting profession. Using Level 2 and 3 instruments for RCA is likely a matter of greater concern in other countries. We recall that the relationship between Level 3 assets and Tier 1 capital in Brazil is one of the lowest in the world (Oliveira et al., 2021), and we could still find evidence of RCA. Therefore, the RCA issue in countries with higher ratios may be of greater concern for bank regulators.
- 3.6. Lastly, it is worth noting that our findings can help discuss the trade-off between providing investors with more uniform and transparent information and managerial opportunistic behavior. While extending the adoption of IFRS standards for the banking system uniformizes and increases comparability among other banks and non-banking firms, it threatens the regulators'

objectives by providing arbitrage opportunities. Therefore, it is important for regulators to acknowledge the potential unintended consequences of adopting an accounting standard so they can address it with specific adjustments focusing on their own goals (Brüggemann et al., 2013).

To wrap-up, this thesis argues that (i) accounting and regulatory standards provide opportunities through which banks can deploy RCA; (ii) the higher the discretion allowed by the rule, the larger the gap and the incentives for the managers undertake the arbitrage; (iii) knowing these gaps is important so the regulators can act to prevent the undesired behavior; and (iv) as argued by Gerding (2016), every attempt to close a gap resulted in new forms of regulatory arbitrage, and “so it goes”, therefore, we have no ambitions that our work is definitive, but just a new piece of research to be followed by countless others in the future.

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APPENDICES

Appendix 2.1. First-step robustness tests

Independent Variables	(1)	(2)	Dependent variable: LLP (BRGAAP)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>LWO</i>	0.131* (0.0754)		0.0529 (0.0750)		0.136* (0.0785)		0.0527 (0.0814)	
<i>ΔNPL</i>	0.196** (0.0805)	0.190** (0.0741)			0.219*** (0.0802)	0.213*** (0.0751)		
<i>NPL</i>			0.443*** (0.0841)	0.463*** (0.0817)			0.473*** (0.0955)	0.493*** (0.0888)
<i>Reneg</i>	0.0305 (0.0187)	0.0277 (0.0186)	0.0288* (0.0168)	0.0276 (0.0166)	0.0314* (0.0180)	0.0273 (0.0181)	0.0293* (0.0159)	0.0278* (0.0161)
<i>LoA</i>	-0.0000908 (0.00896)	-0.00483 (0.0101)	-0.00238 (0.00750)	-0.00399 (0.00804)	0.000160 (0.00912)	-0.00416 (0.0103)	-0.00242 (0.00759)	-0.00380 (0.00824)
<i>ΔLoans</i>	0.00306 (0.00332)	0.00294 (0.00326)	0.00369 (0.00375)	0.00363 (0.00362)	0.00287 (0.00283)	0.00264 (0.00280)	0.00343 (0.00331)	0.00333 (0.00319)
<i>ALL</i>	0.0556 (0.0734)		0.0110 (0.0672)		0.0564 (0.0779)		0.00635 (0.0750)	
<i>Interest</i>	0.151*** (0.0259)	0.167*** (0.0252)	0.120*** (0.0238)	0.124*** (0.0224)	0.163*** (0.0277)	0.181*** (0.0262)	0.126*** (0.0245)	0.130*** (0.0236)
<i>GDP</i>	-0.0454 (0.0290)	-0.0496 (0.0295)	-0.0472* (0.0250)	-0.0494* (0.0266)	-0.112*** (0.0287)	-0.108*** (0.0279)	-0.103*** (0.0284)	-0.103*** (0.0260)
<i>Unemploy_{ent}</i>	-0.176*** (0.0426)	-0.164*** (0.0456)	-0.138*** (0.0399)	-0.134*** (0.0418)	-0.142*** (0.0397)	-0.138*** (0.0359)	-0.113*** (0.0357)	-0.113*** (0.0290)
<i>Selic</i>	-0.0536*** (0.0198)	-0.0548** (0.0221)	-0.0573** (0.0247)	-0.0574** (0.0265)	-0.0410 (0.0323)	-0.0363 (0.0289)	-0.0538* (0.0293)	-0.0539* (0.0271)
<i>EPU_{br}</i>	0.000045** (0.000021)	0.000046** (0.000021)	0.000037* (0.000019)	0.000037* (0.000020)				
<i>EUI_{br}</i>	-0.000039 (0.000075)	-0.000066 (0.000073)	-0.000025 (0.000068)	-0.000030 (0.000065)				
<i>FXrate</i>					-0.0113 (0.00675)	-0.0104 (0.00663)	-0.00566 (0.00750)	-0.00509 (0.00740)
<i>C-Risk</i>					-0.000584 (0.00285)	-0.000684 (0.00281)	-0.00233 (0.00284)	-0.00251 (0.00302)
N	426	426	426	426	426	426	426	426
R-sq	0.749	0.740	0.772	0.771	0.746	0.737	0.770	0.769
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	no	no	no
Clusters (banks)	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4. Column 1 presents the results of the base model (Table 2.3, Column 1). Column 2 incorporates the robustness test (A) – removal of LWO and ALL. Column 3 incorporates the robustness test (B) – swap of DNPL for NPL.. Column 4 incorporates the robustness tests (A) and (B). Column 5 incorporates the robustness test (C) – swap of EPUbr and EUlbr by FXrate and C-risk. Column 6 incorporates the robustness tests (A) and (C). Column 7 incorporates the robustness tests (B) and (C). Column 8 incorporates the robustness tests (A), (B) and (C).

Appendix 2.2. Second-step robustness tests

Panel 2.2.1 – Base model (equation 2)

Independent Variables	Dependent variable: $dLLP$ (1 st step residuals from columns 1-8 in Appendix 2.1) (BRGAAP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>CAR</i>	0.0342*** (0.00673)	0.0253** (0.0104)	0.0153** (0.00592)	0.0135** (0.00636)	0.0320*** (0.00790)	0.0171 (0.0148)	0.0142* (0.00809)	0.0118 (0.00835)
<i>Listed x CAR</i>	-0.0242* (0.0140)	-0.0205 (0.0153)	-0.0182 (0.0142)	-0.0187 (0.0151)	-0.0188 (0.0149)	-0.00999 (0.0175)	-0.0140 (0.0167)	-0.0134 (0.0172)
<i>State x CAR</i>	-0.0344*** (0.0111)	-0.0326*** (0.0109)	-0.0336* (0.0176)	-0.0332* (0.0194)	-0.0303 (0.0180)	-0.0189 (0.0193)	-0.0304 (0.0198)	-0.0297 (0.0209)
<i>Foreign x CAR</i>	-0.0216* (0.0117)	-0.0152 (0.0140)	-0.00130 (0.0103)	-0.00250 (0.0100)	-0.0209* (0.0122)	-0.00776 (0.0170)	-0.00274 (0.0112)	-0.000408 (0.0113)
<i>EBTP</i>	0.0376 (0.0298)	0.0216 (0.0329)	0.0311 (0.0306)	0.0375 (0.0267)	0.0514* (0.0298)	0.0239 (0.0422)	0.0468 (0.0331)	0.0392 (0.0378)
<i>Listed x EBTP</i>	-0.0318 (0.0342)	-0.0488 (0.0380)	-0.0604 (0.0413)	-0.0794* (0.0432)	-0.0392 (0.0319)	-0.0479 (0.0450)	-0.0678 (0.0430)	-0.0659 (0.0481)
<i>State x EBTP</i>	0.0875 (0.0591)	0.114* (0.0657)	0.0914 (0.0672)	0.0965 (0.0712)	0.0468 (0.0530)	0.0746 (0.0562)	0.0760 (0.0695)	0.0776 (0.0719)
<i>Foreign x EBTP</i>	-0.00344 (0.0380)	-0.00391 (0.0390)	-0.0179 (0.0352)	-0.0221 (0.0325)	-0.0195 (0.0374)	0.00191 (0.0465)	-0.0303 (0.0359)	-0.0226 (0.0401)
<i>Listed</i>	0.00578** (0.00275)	0.00581* (0.00306)	0.00575* (0.00290)	0.00641** (0.00317)	0.00496* (0.00273)	0.00424 (0.00332)	0.00511 (0.00312)	0.00508 (0.00325)
<i>State</i>	0.00152 (0.00297)	0.000329 (0.00314)	0.00114 (0.00424)	0.000747 (0.00471)	0.00224 (0.00384)	-0.000615 (0.00422)	0.00129 (0.00476)	0.00105 (0.00502)
<i>Foreign</i>	0.00286 (0.00224)	0.00163 (0.00298)	-0.000305 (0.00221)	-0.000244 (0.00221)	0.00312 (0.00227)	0.000160 (0.00343)	-0.000173 (0.00221)	-0.000752 (0.00226)
<i>Size</i>	0.0000952 (0.000146)	0.0000324 (0.000179)	0.0000543 (0.000159)	0.0000273 (0.000164)	-0.0000037 (0.000155)	-0.000127 (0.000193)	-0.0000827 (0.000182)	-0.0000933 (0.000185)
N	401	400	401	401	401	400	401	401

R-sq	0.094	0.066	0.072	0.085	0.089	0.065	0.082	0.081
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	no	no	no
Clusters (banks)	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4. Columns defined as per Appendix 2.1

Panel 2.2.2 – Swap of EBTP for ROE

Independent Variables	Dependent variable: <i>dLLP</i> (1 st step residuals from columns 1-8 in Appendix 2.1) (BRGAAP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>CAR</i>	0.0396*** (0.00724)	0.0290** (0.0114)	0.0229*** (0.00605)	0.0218*** (0.00609)	0.0400*** (0.00780)	0.0226 (0.0157)	0.0235*** (0.00708)	0.0205*** (0.00722)
<i>Listed x CAR</i>	-0.0314** (0.0126)	-0.0240 (0.0144)	-0.0236* (0.0118)	-0.0237* (0.0122)	-0.0288** (0.0131)	-0.0153 (0.0172)	-0.0216 (0.0140)	-0.0197 (0.0142)
<i>State x CAR</i>	-0.0493*** (0.0109)	-0.0482*** (0.0114)	-0.0469*** (0.0120)	-0.0461*** (0.0134)	-0.0369*** (0.0123)	-0.0256* (0.0139)	-0.0393*** (0.0101)	-0.0386*** (0.0112)
<i>Foreign x CAR</i>	-0.0265** (0.0125)	-0.0185 (0.0149)	-0.00877 (0.0104)	-0.0106 (0.00973)	-0.0284** (0.0126)	-0.0129 (0.0180)	-0.0119 (0.0105)	-0.00890 (0.0105)
<i>ROE</i>	-0.0000439 (0.00560)	-0.00431 (0.00646)	0.00218 (0.00383)	0.000903 (0.00384)	0.00309 (0.00644)	-0.00125 (0.00676)	0.00282 (0.00473)	0.00207 (0.00453)
<i>Listed x ROE</i>	-0.00663 (0.00589)	-0.00729 (0.00718)	-0.0117*** (0.00420)	-0.0122*** (0.00432)	-0.0102* (0.00568)	-0.0111 (0.00664)	-0.0125** (0.00471)	-0.0128*** (0.00465)
<i>State x ROE</i>	0.00349 (0.00643)	0.00772 (0.00825)	0.00321 (0.00590)	0.00501 (0.00621)	0.00521 (0.00502)	0.00976* (0.00567)	0.00839 (0.00512)	0.00898 (0.00538)
<i>Foreign x ROE</i>	-0.00241 (0.00569)	0.00177 (0.00658)	-0.00635 (0.00402)	-0.00510 (0.00401)	-0.00531 (0.00657)	-0.00187 (0.00709)	-0.00766 (0.00520)	-0.00690 (0.00507)
<i>Listed</i>	0.00738*** (0.00243)	0.00625** (0.00300)	0.00662*** (0.00216)	0.00679*** (0.00222)	0.00730*** (0.00248)	0.00544 (0.00342)	0.00640** (0.00252)	0.00621** (0.00256)
<i>State</i>	0.00585*** (0.00191)	0.00510** (0.00197)	0.00552** (0.00226)	0.00502* (0.00256)	0.00374* (0.00214)	0.00123 (0.00256)	0.00364* (0.00191)	0.00338 (0.00213)
<i>Foreign</i>	0.00408 (0.00254)	0.00225 (0.00322)	0.00150 (0.00208)	0.00151 (0.00199)	0.00474* (0.00251)	0.00160 (0.00365)	0.00181 (0.00211)	0.00123 (0.00213)
<i>Size</i>	0.000122 (0.000182)	0.000109 (0.000200)	0.000114 (0.000175)	0.000105 (0.000180)	0.0000201 (0.000189)	-0.0000547 (0.000209)	-0.0000311 (0.000200)	-0.0000299 (0.000202)
N	399	398	399	399	399	398	399	399
R-sq	0.084	0.072	0.089	0.103	0.081	0.078	0.102	0.108
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes

Year FE	no	no	no	no	no	no	no	no
Clusters (banks)	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4. Columns defined as per Appendix 2.1

Panel 2.2.3 – Swap of CAR for T1-CAR

Independent Variables	Dependent variable: $dLLP$ (1 st step residuals from columns 1-8 in Appendix 2.1) (BRGAAP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>T1-CAR</i>	0.0178** (0.00858)	0.0215** (0.00902)	-0.000202 (0.00807)	-0.000190 (0.00732)	0.00872 (0.0117)	0.0115 (0.0116)	-0.00732 (0.0117)	-0.00623 (0.0109)
<i>Listed x T1-CAR</i>	-0.0309*** (0.00989)	-0.0365*** (0.0106)	-0.0127 (0.0126)	-0.0142 (0.0126)	-0.0180 (0.0130)	-0.0244* (0.0134)	-0.00174 (0.0155)	-0.00349 (0.0154)
<i>State x T1-CAR</i>	-0.0237 (0.0190)	-0.0311 (0.0205)	-0.0297 (0.0226)	-0.0353 (0.0224)	-0.0312* (0.0182)	-0.0255 (0.0184)	-0.0190 (0.0210)	-0.0183 (0.0206)
<i>Foreign x T1-CAR</i>	-0.0147 (0.0115)	-0.0179 (0.0129)	0.00270 (0.0108)	0.00263 (0.0105)	-0.00756 (0.0144)	-0.00977 (0.0147)	0.00851 (0.0136)	0.00754 (0.0131)
<i>EBTP</i>	0.0551 (0.0453)	0.0137 (0.0602)	0.0685* (0.0358)	0.0664* (0.0347)	0.0541 (0.0521)	0.0185 (0.0642)	0.0717 (0.0434)	0.0710 (0.0426)
<i>Listed x EBTP</i>	-0.0623 (0.0490)	-0.0470 (0.0595)	-0.104** (0.0420)	-0.117** (0.0441)	-0.0492 (0.0523)	-0.0430 (0.0618)	-0.0910* (0.0465)	-0.0950** (0.0463)
<i>State x EBTP</i>	0.125* (0.0737)	0.131 (0.0789)	0.118* (0.0650)	0.113* (0.0640)	0.0753 (0.0537)	0.0904 (0.0568)	0.124* (0.0626)	0.119* (0.0636)
<i>Foreign x EBTP</i>	-0.0263 (0.0511)	0.00104 (0.0642)	-0.0561 (0.0424)	-0.0560 (0.0416)	-0.0318 (0.0571)	0.00376 (0.0683)	-0.0578 (0.0468)	-0.0568 (0.0461)
<i>Listed</i>	0.00648*** (0.00237)	0.00698*** (0.00248)	0.00499* (0.00251)	0.00575** (0.00253)	0.00434 (0.00260)	0.00539* (0.00267)	0.00308 (0.00269)	0.00354 (0.00263)
<i>State</i>	-0.00152 (0.00389)	-0.000753 (0.00436)	-0.000983 (0.00419)	-0.000270 (0.00404)	0.00139 (0.00352)	-0.0000015 (0.00371)	-0.00194 (0.00413)	-0.00201 (0.00408)
<i>Foreign</i>	0.00182 (0.00272)	0.00153 (0.00311)	-0.000306 (0.00254)	-0.000490 (0.00253)	0.00120 (0.00308)	0.000135 (0.00331)	-0.00134 (0.00271)	-0.00131 (0.00264)
<i>Size</i>	0.0000070 (0.000180)	-0.0000779 (0.000210)	-0.000174 (0.000164)	-0.000252 (0.000180)	-0.000128 (0.000180)	-0.000250 (0.000209)	-0.000307 (0.000194)	-0.000338* (0.000197)
N	298	300	298	299	298	299	298	298
R-sq	0.080	0.070	0.085	0.101	0.051	0.059	0.089	0.095
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	no	no	no

Clusters (banks)	41	41	41	41	41	41	41	41
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Cluster-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4. Columns defined as per Appendix 2.1

Panel 2.2.4 – Swap of EBTP for ROE and CAR for T1-CAR

Independent Variables	Dependent variable: $dLLP$ (1 st step residuals from columns 1-8 in Appendix 2.1) (BRGAAP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>T1-CAR</i>	0.0167 (0.0109)	0.0213** (0.00901)	0.0000321 (0.0104)	0.000647 (0.00996)	0.00909 (0.0137)	0.0121 (0.0113)	-0.00736 (0.0127)	-0.00610 (0.0121)
<i>Listed x T1-CAR</i>	-0.0305** (0.0118)	-0.0351*** (0.00992)	-0.0117 (0.0133)	-0.0129 (0.0131)	-0.0201 (0.0150)	-0.0248* (0.0128)	-0.0018 (0.0161)	-0.0034 (0.0159)
<i>State x T1-CAR</i>	-0.0436** (0.0202)	-0.0481** (0.0190)	-0.0418** (0.0201)	-0.0429** (0.0189)	-0.0372 (0.0232)	-0.0286 (0.0219)	-0.0281 (0.0183)	-0.0259 (0.0173)
<i>Foreign x T1-CAR</i>	-0.0136 (0.0143)	-0.0167 (0.0134)	0.00293 (0.0132)	0.00223 (0.0129)	-0.00788 (0.0170)	-0.00945 (0.0155)	0.00920 (0.0154)	0.00805 (0.0150)
<i>ROE</i>	-0.00452 (0.0103)	-0.0152* (0.00831)	-0.00551 (0.00797)	-0.00543 (0.00764)	-0.000478 (0.0106)	-0.0133 (0.00851)	-0.00538 (0.00868)	-0.00560 (0.00833)
<i>Listed x ROE</i>	0.00141 (0.0108)	0.00466 (0.00879)	-0.00269 (0.00891)	-0.00485 (0.00908)	-0.00118 (0.00952)	0.00298 (0.00821)	0.00106 (0.00849)	0.000281 (0.00838)
<i>State x ROE</i>	0.00747 (0.0124)	0.0140 (0.0106)	0.00795 (0.0118)	0.00829 (0.0117)	0.00876 (0.00855)	0.0179** (0.00737)	0.0145 (0.00964)	0.0143 (0.00956)
<i>Foreign x ROE</i>	0.00487 (0.0111)	0.0136 (0.00932)	0.00260 (0.00872)	0.00197 (0.00836)	-0.00275 (0.0114)	0.00648 (0.0102)	-0.00407 (0.00952)	-0.00414 (0.00919)
<i>Listed</i>	0.00529* (0.00278)	0.00545** (0.00210)	0.00308 (0.00268)	0.00367 (0.00269)	0.00415 (0.00315)	0.00448* (0.00249)	0.00148 (0.00304)	0.00187 (0.00300)
<i>State</i>	0.00342 (0.00273)	0.00344 (0.00245)	0.00290 (0.00288)	0.00292 (0.00277)	0.00269 (0.00366)	0.000461 (0.00352)	0.000341 (0.00277)	0.0000540 (0.00266)
<i>Foreign</i>	0.000912 (0.00322)	0.000465 (0.00269)	-0.00135 (0.00286)	-0.00132 (0.00281)	0.00113 (0.00361)	0.0000294 (0.00300)	-0.00178 (0.00317)	-0.00167 (0.00309)
<i>Size</i>	-0.0000297 (0.000227)	0.0000365 (0.000243)	-0.000133 (0.000213)	-0.000187 (0.000214)	-0.000168 (0.000230)	-0.000123 (0.000238)	-0.000317 (0.000240)	-0.000333 (0.000241)
N	298	300	298	299	298	299	298	298
R-sq	0.080	0.070	0.085	0.101	0.051	0.059	0.089	0.095
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	no	no	no
Clusters (banks)	41	41	41	41	41	41	41	41

Cluster-robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Variables definitions as per Tables 2.1, 2.2 and 2.4. Columns defined as per Appendix 2.1

Appendix 3.1. Second-step regression – robustness test including dLLP

Independent Variables	Dependent variables			
	DpctFvN2N3		DpctFvN3	
	(1)	(2)	(3)	(4)
CAR	-0.780*** (0.288)	-0.667** (0.285)	-0.495*** (0.159)	-0.496*** (0.155)
CAR x Listed	1.153*** (0.242)	1.124*** (0.239)	-0.0478 (0.133)	-0.0520 (0.130)
CAR x POST	0.591** (0.286)	0.428 (0.283)	0.396** (0.158)	0.406*** (0.154)
EBT	0.801* (0.437)	0.451 (0.429)	0.383 (0.241)	0.409* (0.233)
EBT x Listed	-2.901*** (0.674)	-2.576*** (0.666)	-0.783** (0.372)	-0.792** (0.362)
Listed	-0.178*** (0.0416)	-0.184*** (0.0410)	0.0195 (0.0229)	0.0188 (0.0223)
POST	-0.159*** (0.0517)	-0.133*** (0.0512)	-0.0778*** (0.0285)	-0.0800*** (0.0278)
dLLP	-0.533 (0.816)	-0.483 (0.801)	0.326 (0.450)	0.386 (0.436)
N	397	411	397	411
Clusters	41	41	41	41
R-squared	0.115	0.111	0.053	0.054
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes
Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$				

Notes: dLLP is the estimated discretionary Loan Loss Provisions. Other variables defined as per Tables 3.1 and 3.4.

Appendix 3.2. Second-step regression – robustness test (replacing CAR for Tier-1 CAR)

Independent Variables	Dependent variables
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	DpctFvN2N3		DpctFvN3	
	(1)	(2)	(3)	(4)
CAR-T1	-0.187* (0.114)	-0.153 (0.113)	-0.124** (0.0572)	-0.119** (0.0556)
CAR-T1 x Listed	1.093*** (0.232)	1.015*** (0.234)	-0.0107 (0.117)	-0.0119 (0.115)
EBT	0.957** (0.458)	0.482 (0.456)	0.284 (0.230)	0.343 (0.224)
EBT x Listed	-3.009*** (0.672)	-2.662*** (0.675)	-0.656* (0.338)	-0.713** (0.332)
Listed	-0.148*** (0.0350)	-0.145*** (0.0353)	0.00981 (0.0176)	0.00886 (0.0174)
N	335	349	335	349
Clusters	41	41	41	41
R-squared	0.104	0.095	0.032	0.030
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Notes: *CAR-T1* represents a bank's Tier-1 capital adequacy ratio at year $t - 1$, measured by the division of its regulatory Tier-1 capital and the risk-weighted assets (RWA). Other variables defined as per Tables 3.1. and 3.4.

Appendix 3.3. Second-step regression – robustness test (replacing EBT for ROE)

Independent Variables	Dependent variables			
	DpctFvN2N3		DpctFvN3	
	(1)	(2)	(3)	(4)
CAR	-0.595** (0.263)	-0.559** (0.261)	-0.380*** (0.131)	-0.376*** (0.129)
CAR x Listed	0.877*** (0.226)	0.883*** (0.224)	-0.156 (0.113)	-0.165 (0.111)
CAR x POST	0.466* (0.274)	0.350 (0.271)	0.324** (0.137)	0.332** (0.134)
ROE	0.118** (0.0584)	0.116** (0.0572)	0.0558* (0.0292)	0.0517* (0.0283)
ROE x Listed	-0.255*** (0.0849)	-0.246*** (0.0837)	-0.126*** (0.0424)	-0.118*** (0.0413)
Listed	-0.146*** (0.0413)	-0.152*** (0.0408)	0.0374* (0.0206)	0.0368* (0.0201)

POST	-0.136*** (0.0500)	-0.118** (0.0496)	-0.0675*** (0.0250)	-0.0696*** (0.0245)
N	406	420	406	420
Clusters	41	41	41	41
R-squared	0.091	0.091	0.065	0.062
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes
Robust standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01				

Notes: *ROE* represents the bank's return on equity (net profits divided by equity) at year $t - 1$; Other variables defined as per Tables 3.1. and 3.4.

Appendix 3.4. Second-step regression – 2-SLS robustness test with instrumental variables

Independent Variables	Dependent variables			
	DpctFvN2N3 (1)	(2)	DpctFvN3 (3)	(4)
CAR _t	-1.024* (0.591)	-0.847 (0.585)	-0.971*** (0.315)	-0.973*** (0.309)
CAR _t x Listed	1.973*** (0.420)	1.928*** (0.415)	-0.193 (0.224)	-0.205 (0.219)
CAR _t x POST	0.734 (0.588)	0.478 (0.583)	0.857*** (0.313)	0.873*** (0.308)
EBT _t	1.911* (1.063)	1.212 (1.056)	0.962* (0.566)	1.019* (0.558)
EBT _t x Listed	-5.965*** (1.386)	-5.243*** (1.376)	-1.468** (0.739)	-1.514** (0.726)
Listed	-0.280*** (0.0663)	-0.288*** (0.0656)	0.0510 (0.0353)	0.0523 (0.0346)
POST	-0.178* (0.0975)	-0.134 (0.0966)	-0.151*** (0.0520)	-0.155*** (0.0510)
N	397	411	397	411
Clusters	41	41	41	41
R-squared	0.022	0.024	0.023	0.020
Bank F.E.	yes	yes	yes	yes
Year F.E.	no	yes	no	yes
Underidentification test (H ₀ : Model is underidentified)	105.865***	105.601***	105.865***	105.601***

<i>Anderson canon. corr. LM stat)</i>				
Weak identification test (H ₀ : Model is underidentified) <i>Cragg-Donald Wald F statistic</i>	28.290	27.870	28.290	27.870
Overidentification test Sargan-Hansen statistic (H ₀ : Instruments are valid)	0.000*** (equation exactly identified)	0.000*** (equation exactly identified)	0.000*** (equation exactly identified)	0.000*** (equation exactly identified)
Endogeneity test of endogenous regressors (H ₀ : Endogenous variables are exogenous)	15.462***	16.322***	8.487	8.764
Hausman Specification Test (H ₀ : GMM and OLS are both consistent)	13.49*	14.87**	6.74	6.92

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Instrumented variables: CAR_t, CAR_t x Listed, CAR_t x POST, EBT_t, EBT_t x Listed

Instruments: CAR, CAR x Listed, CAR x POST, EBT, EBT x Listed

Notes: CAR_t represent a bank's capital adequacy ratio at year *t*, measured by the division of its regulatory capital and the risk-weighted assets (RWA). EBT_t represent the ratio between a bank's earnings before taxes and its total assets at year *t*; Other variables defined as per Tables 3.1. and 3.4.

Appendix 3.5. First-step regression – robustness test (alternative first-step specification)

Independent Variables	Dependent variables pctFvN2N3	
	(1)	(2)
pctN1Assets	-1.298*** (0.120)	-1.283*** (0.120)
N	422	422
Clusters	41	41
R-squared	0.722	0.734
Bank F.E.	yes	yes
Year F.E.	no	yes

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Notes: The dependent variable is pctFvN2N3, representing the ratio between a bank's sum of Levels 2 and 3 assets and its total fair-value measured assets. pctN1Assets represents the ratio between a bank's Level 1 assets and its total assets.

Appendix 3.6. Second-step regression – robustness test (alternative first-step specification)

Independent Variables	Dependent variables DpctFvN2N3	
	(1)	(2)
CAR	-0.967*** (0.335)	-0.979*** (0.345)
CAR x Listed	0.729*** (0.193)	0.780*** (0.202)
CAR x POST	0.918*** (0.339)	0.913*** (0.349)
EBT	0.646* (0.363)	0.617* (0.349)
EBT x Listed	-2.089*** (0.438)	-2.006*** (0.436)
Listed	-0.139*** (0.0348)	-0.144*** (0.0361)
POST	-0.189*** (0.0679)	-0.189*** (0.0697)
N	411	411
Clusters	41	41
R-squared	0.097	0.096
Bank F.E.	yes	yes
Year F.E.	no	yes
Robust standard errors in parentheses		
* p<0.10, ** p<0.05, *** p<0.01		

Notes: Variables defined as per Tables 3.1. and 3.4.