UNIVERSIDADE FEDERAL DE VIÇOSA

MARCELO HENRIQUE SHINKODA SANTOS

CREDIT UNIONS AND COMPETITION IN THE BRAZILIAN FINANCIAL INTERMEDIATION SYSTEM

VIÇOSA – MINAS GERAIS
2021

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Thesis submitted to the Applied Economics Graduate Program of the Universidade Federal de Viçosa in partial fulfillment of the requirements for the degree of *Doctor Scientiae.*

Adviser: Marcelo José Braga

Co-adviser: Valéria Gama Fully Bressan

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Assent:

Marcelo Henrique Shinkoda Santos
Author

Marcelo José Braga
Advisor

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ABSTRACT

SANTOS, Marcelo Henrique Shinkoda, D.Sc., Universidade Federal de Viçosa, July 2021. **Credit unions and competition in the Brazilian financial intermediation system.** Adviser: Marcelo José Braga. Co-Adviser: Valéria Gama Fully Bressan

Unlike traditional banks, the reform of credit unions in the national financial intermediation system did not have a specific program named and publicized nationally, as was the Program to Stimulate the Restructuring and Strengthening of the National Financial System (PROER – as is their acronym in Portuguese). However, the reform of credit unions has been based on the north, whereas financial management improved, the Central Bank of Brazil followed with an increasingly flexible regulatory framework. In this sense, since 2000, credit unions gained the "right" to open their banks and expand the municipalities in which they operate, concerning population size. "Resolved" the problem of moral hazard with the creation of a guarantee fund, and in an aggreged form, they reached asset and liability levels close to those of traditional banks. Given this context, this thesis aimed to evaluate the competitive dynamics of credit unions in Brazilian financial intermediation. Specifically, it sought to assess the dynamics of credit unions in the financial inclusion process, comparing them with the dynamics of traditional banks. Furthermore, this thesis also sought to identify the degree of maturity of credit unions from the merger processes between 2008 and 2020. Finally, this thesis sought to verify whether individual credit unions compete with bank branches for inputs in the places where they coexist. In summary, the results indicate that only credit unions (in a set that includes private banks, public banks, credit unions, and FinTechs) are positively associated with financial inclusion in adverse times. Moreover, this relationship is associated with the credit unions' maturity level that competes with bank agencies for input, even in practical entry barriers. Thus, it can be concluded that credit unions' maturity increased between 2008 and 2020 and that they have stood out in the financial intermediation market without losing the cooperative spirit.

Keywords: Credit Unions. Banks. Financial Intermediation. Competition.

RESUMO

SANTOS, Marcelo Henrique Shinkoda, D.Sc., Universidade Federal de Viçosa, julho de 2021. **Cooperativas de crédito e competição na intermediação financeira brasileira.** Orientador: Marcelo José Braga. Coorientadora: Valéria Gama Fully Bressan

Diferentemente dos bancos tradicionais, a reforma das cooperativas de crédito no sistema de intermediação financeira nacional não teve um programa específico nomeado e divulgado nacionalmente tal como foi com o Programa de Estímulo à Reestruturação e ao Fortalecimento do Sistema Financeiro Nacional (PROER). No entanto, a reforma das cooperativas de crédito tem sido baseada em um norte, onde à medida em que a gestão financeira fora aperfeiçoada, o Banco Central do Brasil seguia com uma normativa regulatória cada vez mais branda. Neste sentido, desde 2000, as cooperativas de crédito passaram a ganhar o "direito" de abrir seus próprios bancos e de ampliar os municípios de atuação, em relação à quantidade de população, "resolveram" o problema de risco moral com a criação de um fundo garantidor próprio e juntas alcançaram níveis de ativos e passivos próximos ao dos bancos tradicionais. Diante deste contexto, o objetivo desta tese foi avaliar a dinâmica competitiva das cooperativas de crédito na intermediação financeira brasileira. Especificamente, buscou-se avaliar a dinâmica das cooperativas de crédito no processo de inclusão financeira, comparando as com a dinâmica dos bancos tradicionais. Além do mais, esta tese também buscou identificar o grau de maturidade das cooperativas de crédito a partir dos processos de incorporações ocorridos entre 2008 e 2020. Por fim, esta tese buscou verificar se as cooperativas de crédito individualmente competem com as agências bancárias por insumos nos locais em que elas coexistem. Em resumo, os resultados indicam que das instituições de cunho privado, somente as cooperativas de crédito estão associadas à inclusão financeira em tempos adversos. Essa relação está associada ao nível de maturidade das cooperativas de crédito que competem com as agências bancárias por insumo, mesmo diante de tempestivas barreiras à entrada por parte destas últimas. Assim, conclui-se que as cooperativas de crédito amadureceram entre 2008 e 2020, período de análise desta tese, e que, sem perder o espírito cooperativo, tem se destacado no mercado de intermediação financeira brasileiro.

Palavras-chave: Cooperativas de crédito. Bancos. Intermediação Financeira. Competição.

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ACRONYMS

2SM	Two-sided markets
ABR	Banking representatives' branches
ATT	Average treatment effect on treated
BACEN	Banco Central do Brasil
BB	Banco do Brasil
BIS	Bank for International Settlements
CEF	Caixa Econômica Federal
CEO	Chief Executive Officer
CF	Competitive Fringe
CL	Cosnita-Langlais
COSIF	Accounting plan of national financial system institutions
CR#	Concentration Ratio #
CURSS	Credit Unions Representative Service Stations
CUSS	Credit Union Service Stations
CVM	Brazilian Securities Commission
DBTVM	Gross Expenses with TVM
DCF	Dominant firms with a competitive fringe
DHL	Dalsey Hillbom and Lynn
DOJ	Department of justice
DR	Diversion Ratios
DTC	Direct transmission channels
DUPP	Dominant Upward Price Pressure
EB	Entropy Balance
ECF	Efficiency From a Competitive Fringe
EP	Equilibrium point
ERGM	Exponential Random Graphic Models
ESTBAN	Municipal banking statistics
EU	European Union
FDPP	Fringe Downward Pricing Pressure
FGCOOP	Credit unions guarantee fund
FI	Financial institutions

FINTECHS	Technology companies of credit
FIRJAN	Federation of industries of the Rio de Janeiro state
FTC	Federal Trade Commission
HDI	Human Development Indices
HHI	Herfindahl-Hirschman Index
IBGE	Instituto Brasileiro de Geografia e Estatística
ID	Identification
IFDM	Firjan index of municipal development
IPCA	Broad national consumer index
IV	Instrumental Variable
K&S	Kolay and Shaffer
LI	Lerner index
M&A	Merger or Acquisitions
M4	Fourth level of Monetary Payment Mean
MHDI	Municipal Human Development Index
NCUA	National Credit Unions Administration
PROER	Program to stimulate the restructuring and strengthening of financial system
PSM	Propensity Score Match
QAP	Quadratic Assignment Procedure
RLTVM	Net income with TVM
RM	Relevant Market
SD	Social Distance
SVAR	Structural Vector Autoregression
TNT	Thomas Nationwide Transport
TR	Total revenue
TVM	Marketable securities
UK	United Kingdom
UPP	Upward Pricing Pressure
UPS	United Parcel Service
US	United States of America
VAR	Vector autoregression
WOCCU	World Council of Credit Unions
YCT	Yardstick Competition Theory

CONTENTS

1. INTRODUCTION

1.1 GENERAL CONSIDERATIONS

The capital structure irrelevance principle applies in a financial system where financial intermediaries are homogeneous (KLEIN, 1971). However, financial institutions distinguish themselves into several classes and subclasses. For example, banks split into investment banks, retail banks, thrift banks, and commercial banks. These are profitable institutions that work in the financial systems and share space with the not-for-profit banks (EMMONS; SCHMID, 2000). When not-for-profit firms began to increase in space (as has been happening since the subprime crises in the United States of America – US), the relationship between this banking class and profitable banks won an air of competition (GLASS *et al.*, 2014). Notwithstanding, credit unions are non-profit institutions that seek the maximand the welfare of a group of people with common characteristics and "[…] often play the role of the Grameen Bank by helping out small business" (KLINEDIST, 2012, p.6). Despite the moral values incorporated in credit unions, Egarius and Patrick (2016) have shown that this is not a significant reason for a credit union customer to be an associate member.

Since credit unions are standing out for their recent growing market share, they are beginning to catch the attention of researchers in the world who seek to analyze the competitive role between credit unions and commercial banks (CLARK; S.; NEMANJA, 2018; EMMONS; SCHMID, 2000; FEINBERG; RAHMAN, 2006). At this point, it should be calm in international comparative analysis because the form of regulation of these financial institutions differs for each country, sometimes each region (SNAC, 2016).

In Germany, a pioneer country in the credit union, the regulation is the same for commercial banks and credit unions. The German credit unions supply services for the non-cooperative member and have a portion of the industry market share of about 51%, albeit individually tiny than a commercial bank (CLARK; S.; NEMANJA, 2018). In France, the credit union system exceeds 70% of the market share, being the largest credit union globally, whose penetration market incorporates "nine out of 10 farmers, one in three civilians and one in two companies" (SNAC, 2016).

Brazil is one of the countries with the highest net interest margins in the world's financial intermediary system (WORLD BANK, 2017). According to Santos (2018), the commercial banks that operated in Time Deposits and Loans segments formed a tacit Cartel between 2009-2016. However, according to Shinkoda and Braga (2019), from 2015, banking industries'

conduct became a monopolistic competition. At the same time, the credit unions achieved more outstanding shares in terms of deposits and lending in Brazilian financial intermediation.

With this, the gap in Brazilian regulatory standards between commercial banks and credit unions has been reducing with the Central Bank of Brazil (Bacen) Acts. In 2000 the Bacen reduced the operating restrictions[1] under credit unions, and, in 2010, it allowed the credit unions to operate in all bigger Brazilian cities under pre-determined conditions. Thus, together with other Acts, the credit unions started to operate with products less verticalized concerning those supplied by commercial banks (BACEN, 2000, 2003, 2007, 2010).

In this point, Shleifer (1985, p.326) argues that "welfare losses from unobservable firm differences are small under yardstick competition as long as these differences are small." Therefore, the suspicion arises that the banking industry, where the credit unions have an increasing market share, may is in yardstick competition status, mainly in places where bank branches coexist with services stations of credit unions.

Although this relationship theoretically makes sense, the evidence of competition between credit unions and commercial banks in Brazilian literature is scarce. Thus, the author of this thesis seeks the primary records between commercial banks and credit unions dynamics from 2008 to 2020.

This thesis contains four chapters (one theoretical and three empirical). In the theoretical chapter, the author presents the theoretical base to all empirical chapters. Despite not pointing directly, the conclusions reached after all empirical chapters will be employing a deductive hypothesis approach. Thus, the theoretical chapter seeks to expand the Upward Pricing Pressure for the market with asymmetric or fringe firms, considering the Yardstick Competition Theory from Shlifer (1985) and Ramsey price.

The first empirical chapter treats financial inclusion by analyzing four taxonomies: commercial banks, public banks, credit unions, and tech financial firms (fintech). The discussion is due in crisis times and clarifies the distinction between credit unions and commercial banks (other taxonomies). In addition to expanding its credit services for public and private bank customers, the results also indicate that credit union reduces the market friction for its associates.

Since credit unions are not-for-profitable firms, the author of this thesis defends that the utility of credit unions may be greater than the utility of commercial banks in Bentham's (1789) sense. If consumers' utility is quantitatively different, each different type of company may feel

[1] Geographic in terms of municipal populations and product in terms of service provisions.

the distinct demand variations for apparently homogeneous products and less harmful to the firm's demand with more utility. That is, if a quantitatively different utility assumption is valid, we can identify the firm with the remarkable capacity to promote sustainable financial inclusion. In this point stand out the risk-taking in the competition process.

Thus, in the second empirical chapter, the author analyses the performance of credit unions, where the motivation is the merger and acquisition (M&A) process, considering the inductions by the Central Bank of Brazil (BACEN, 2018) to best practices. The chapter's doubt is if the credit unions became more efficient after the M&A process. Also, the author asks what the maturity level of Brazilian credit unions? The answer complements the first empirical chapter. Credit unions turned more efficient, amplifying their capacity to manage the associate capital and managing larger market share at analyzed period. To the author reach these conclusions, two theories were considered: Competition-Fragility and Competition-Stability.

In Competition-Fragility Hypothesis (e.g., BESANKO; THANKOR, 1993; CARLETTI; VIVES, 2008; CETORELLI; PERETTO, 2000; KEELEY, 1990), the shareholders (or cooperative members) maximize their utility according to the proportion to their share (or their proportion of use of the financial cooperative at the end of period). The agency cost derived from other active members explains this phenomenon (JENSEN; MECKLING, 1976). Marcus (1984, p. 565), analyzing the non-risk-rated deposit, says that as the value of a "bank charter falls, the risk-taking strategy is more apt to dominate. Therefore, current deregulation of the banking industry holds the potential for increases in the incidence of bank insolvency (sic) […]". However, when the firm has a combination of internal governance and outside governance (by shareholders), the dominant strategy depends on the relationship between the chief executive officer (CEO) and manager (ACHARYA; MYERS; RAJAN, 2011; BOYER; PONCE, 2012).

This dual governance seems to be effective in the European credit union because the interaction between firms over there allows a surplus of one credit union to rescue another credit union in the event of insolvency (SNAC, 2016). That is, implicitly, internal and outside supervision exists in the European credit unions. However, the same does not apply in Brazil. According to Braga *et al.* (2006), the Brazilian credit unions are more subject to macroeconomic variations due to a lack of knowledge of the managers and the financial cooperatives' objective foundation.

In addition, the Brazilian credit union system has a vertical structure where some Singles Credit Unions orbit around a Central, and a group of Central form a Confederation[2]. When the firm participates in a complete structure, these single credit unions are in an entire system (e.g., Sicoob, Sicredi, Unicred, Cecred, and Confesol). Thus, the fragility theory may be an issue because the vertical structure of these systems does not always allow the European credit union's dynamics. This is, it is unlikely that a credit union in system A regulates and saves a credit union in a system B.

Then, the efficiency gain may occur from a different mechanism: the Competition-Stability Hypothesis (ALLEN; GALE, 2004; BOYD; NICOLÓ, 2005; MYERS; RAJAN, 1998). In this hypothesis, "[…] more bank competition results in lower economy-wide risk, lower bank capital ratios, more efficient production plans, and Pareto-ranked real allocations" (DE NICOLO; LUCCHETTA, 2009, p.4).

Martinez-Miera and Repullo (2010) say that more or less competitive arrangements raise the financial bank leverage. This choice is not linear and depends on the number of banks and the degree of market concentration. "In general, exist a U-shaped relationship between competition and risk of bank failure" (MARTINEZ-MIERA; REPULLO, 2010, p.3639). In this case, the contrast between fragility and stability theories may be a case of mandate, governance, and management of the portfolio of the respective financial firm.

Before 1971, portfolio diversification theory disregarded financial leverage. Pyle (1971) argued that management could not choose the asset independently of liability yields. Thus, from Markowitz-Tobin's Theory, Hart and Jaffee (1974) tested the liability-asset separation hypothesis. Their results indicated that managerial attitude toward risk determined the optimal point of financial results. Mcfadden (2008) analyzed banks' systemic risk and found a threshold where the bank becomes disenfranchised. In this point, as disutility grows, the monetary authority must intervene in the banks' conduct to prevent its insolvency.

Diversification also may be from M&A cases where the merger between banks increases economic agents' welfare. However, the M&A of two liquid banks has generated relatively worse for depositors than borrowers (BANAL-ESTAÑOL; OTTAVIANI, 2007). In a credit union, where depositors and borrowers are the cooperative members, the loss (from opportunity cost) focuses on the same people. This process makes credit unions one type of mutual financial firm. Thus, it may not be rational for two liquid financial firms to participate in a merger or acquisition process, being more rational the diversification to find firms with different statuses.

[2] See the whole cooperative configuration in National Cooperative Policy defined by Brasil (1971).

Therefore, the third empirical chapter seeks to answer if credit union stations and commercial branch banks compete in places where they coexist. The product of the relevant market analyzed is the deposit, an essential input to any financial intermediation firm increase the market share in loans. The competition analysis considers an entrance simulation of the credit union in the bank branches network (with more nodes) as a spatial diversification. As a result, this chapter indicates that the bank branches adopt entry deterrence, as there are more inputs in the market.

The spatial analysis of financial intermediation has based on six primary kinds of literature:

- Hotelling (1929) and its linear city theory;
- Coase (1937), with property rights theory;
- Salop (1979) and the circular city theory;
- Fujita, Krugman, and Venables (1999) presents the dynamic of urban formation; and
- Krackardt (1987, 1988) and Simpson (2001) analyze the social distance (SD) matrices.

For all these theories, the spatial distance (represented by the cost of transportation) has referred to its literal meaning or its figurative meaning through some degree of vertical product differentiation (NEVEN, 1987).

Inside SD, a specific point of literature treats the network where the focus is on the relationship between firms (BRENNECKE; RANK, 2017; SNIJDERS *et al.*, 2006). The background theory is the transitivity of relations represented by a triad closure and the dyads (SNIJDERS *et al.*, 2006). Empirically, the transitivity relation may occur by contractual relations, input purchases, output supply, services provision, parent-branch, and joint ventures.

In the case of financial intermediation firms, the borrowers and depositors, in aggregate forms, may generate a systematic relationship between these firms by transferring the inputs between various taxonomies of financial firms (CRAIG; KOETTER; KRUGER, 2014; CRAIG; VON PETER, 2014; FERNANDEZ, 2011). In these cases, the systematic transfer degree represents one financial firm's proximity to the other (DING; SICKLES, 2019). It is this proximity that is considered in the third chapter of this thesis.

With these three empirical and one theoretical chapter, this thesis aims to fill a gap in Brazilian literature that studies credit unions and commercial banks' dynamics. In summary, the theoretical chapter allows us to put in just one universe all different taxonomies. With this, the first empirical article envisions the analysis from the utility of lending in different taxonomies. The second chapter brings an article that seeks to find what theories conduct the risk-taking of credit unions (Competition-Fragility or Competition-Stability). Furthermore, the

last chapter seeks to identify the competition between credit unions and commercial banks in the deposit market, considering a spatial differentiation context.

In addition to the General Considerations, this Introduction also contains Problem Statement, Hypotheses, and Aims, and Objectives.

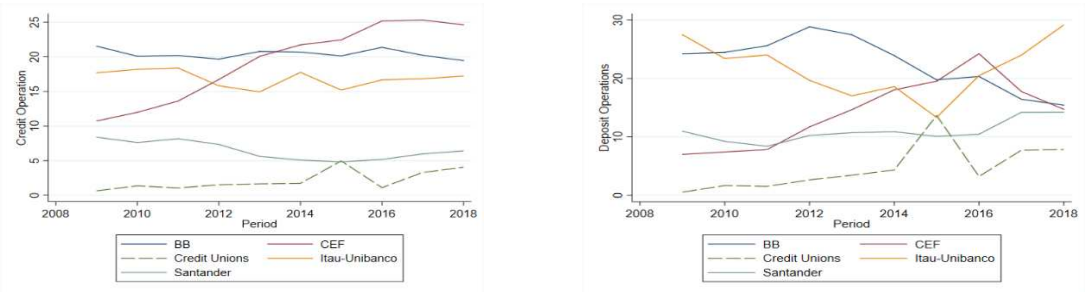
1.2 PROBLEM STATEMENT

The issue involving credit unions and commercial banks in Brazil begins with the Resolution 2,788 of November 2000 that allows these firms to open a commercial bank and operate in the financial system without being subjugated to the contracts of another commercial bank (BACEN, 2000). However, opening its commercial banks makes credit unions adopt the same conditions requested from commercial banks. Thus, to meet all guaranteed points of the Brazilian financial system, opening a bank in Brazil only makes it viable for cooperatives that participate in a vertical system. Otherwise, single credit unions remain restricted to contract with other commercial banks (BACEN, 2000).

Notwithstanding, throughout the 2000s, the restrictions under credit unions were falling, and their participation in large population cities became most common and with less distance exigence of commercial banks, being in some cases considered as subsidy (BACEN, 2003, 2007, 2010). The empirical evidence corroborates this analyzes. When the reader analyzes Panel A in Figure 1.1, it is possible to see the evolution of five major banks (three private and two public) in Loan operations against credit unions' percentage evolution. Panel B presents the development for Time Deposit operations for the same players.

Figure 1.1. Concentration Ratios' development in Credit and Time Deposit Operations of Five Majors' Brazilian Financial Intermediaries and Credit Unions, 2008 to 2018.

Panel A – Credit Operations (%) Panel B – Time Deposit Operations (%)



Source: Elaboration by the author based on Bacen 4010 Report and Bacen Cooperatives' Report. Note: The concentration ratios are for November of each year. BB is Bank of Brazil, CEF is Caixa Econômica Federal (or Federal Savings Bank). Credit Unions is the sum of Single Credit Unions Operations.

The credit unions' percentage in Loans and Time Deposit operations in 2009 was at the 19th position and increased to 6th in 2018. In 2015, the credit unions reached third place in Time Deposit concentration and tied with Santander in the Credit Operations. This historical data indicates that the intersection between the credit union and commercial banks may have increased over 2008-2020. Moreover, credit unions' market share has been managed yearly by

fewer firms once expected to become more efficient by the Merger and Acquisitions (M&A) process (BACEN, 2018).

According to Fried, Lovell, and Yaisawarng (1999), there are three perspectives in the banking literature of M&A: increase profitability by cost efficiency, increase profitability by revenue efficiency (mix of product), and increase market power from more profitability. However, there is a fourth unmentioned hypothesis. To Myers and Rajan (1998), the more liquid a firm may be, the more likely it deviates from the proposed project, lowering its indebtedness capacity. This indebtedness of financial intermediary may be from various means, but the more representative is the liability portfolio from the deposit. Thus the liquid financial intermediary firm is incentivized to participate in the M&A process with a less liquid firm because both are complementary. This last perspective makes more sense than the three first analyses because, in essence, the credit union is a non-profit firm whose function involves maximizing its members' utility. Also, efficiency may be a key to improving the chance of survival in a competitive market (CANASSA; COSTA, 2018).

International cases bring some examples of Myeres and Rajan's (1998) hypothesis. Fukuyama, Guerra, and Weber (1999) and Deelchand and Padgett (2009) examined the efficiency gain from M&As in Shinkin (cooperative bank) and Shinkumi bank (Federal Cooperative Bank) in Japan. Their findings showed that smaller banks are not much pressure to become prominent through mergers and acquisitions. Gardem and Ralston (1999) studied the effects of the Australian credit union mergers from the X-efficiency approach. Their primary motivation was the observed increase in the Australian Financial System competition between 1992-1997. However, the findings indicated that gains in allocative efficiency do not result from the merger.

The previous literature and the empirical evidence highlight two different degrees of maturity in bank literature: competition-fragility and competition-stability. In competition-fragility, the market power gain is desirable because it reduces the asymmetric information problem between borrowers and lenders and promotes a higher quality of bank services (PETERSEN; RAJAN, 1995) through a low risk-taking (CARLETTI; VIVES, 2008). Consequently, this creates a relative barrier to entry because the fringe competition supplies poor-quality borrowers (CETORELLI; PERETTO, 2000). However, the competition-stability theorists recently have been refuted the traditional trade-off between market power and bank stability and advocates that increasing competition promotes more stability (BECK; DEMIRGÜÇ-KUNT; MAKSIMOVIC, 2004). In this case, one hypothetical mechanism is the Yardstick Competition Theory (YCT).

The YCT has broad application in political theory[3] and Agricultural Markets (see Sexton, 2014) and indicates that if there are two similar firms in the same place, and one reduces its prices, the Bertrand dynamic occurs between both firms (SHLEIFER, 1985).

Hannan (2002) seeks to assess the competitive impact between commercial banks and credit unions in the United States of America (US) and concludes that credit union represents, in an urban market, a competitive force against commercial banks and thrift institutions. Fiordelisi and Mare (2014) study the growth of importance of cooperative banks in the European Union (EU) system through the relationship between stability and competition for the credit unions institutions in 1998-2009 and concludes that the credit union homogeneity sector affects the bank soundness positively.

In Brazil, as credit unions together increase their share percentage, the financial intermediation that flowed, so 2010, through two main niches comes to rely on profitable firms, public firms, and non-profit firms. In this point, Frame et al. (2003) indicate that "income tax exemption distorts the competitive landscape among depository institutions." However, in Brazil, the structural dependence that credit unions have on commercial banks to offer their financial services may increase their final cost, correcting this possible distortion.

Under the factors listed above and the framework of Brazilian credit unions, the author of this thesis raises three primary issues to answer in each empirical chapter. In short, the issues of this thesis are:

- Is the behavior of credit unions different concerning commercial banks in adverse moments?
- What is the theory responsible for the efficiency variation of credit unions: competition-fragility or competition stability?
- Are service stations of credit unions competing with bank branches for inputs?

The first question is addressed only to credit unions, analyzing the variation in the efficiency. The second and third questions were analyzed considering that firms' different taxonomies are vectors that provide balance to the market, and the applicants choose the taxonomy according to their baskets of characteristics.

The general hypothesis and, Aims and Objectives are presented in the following subsection.

[3] E.g., Ashorth; Heydels, 1997; Besley; Case, 1995; Bordignon; Cemiglia; Revelli, 2004; Caldeira, 2011

1.3 HYPOTHESIS

Considering the Introduction and Problem Statement sections, the author of this thesis presents below the set of three broad hypotheses for each empirical article, presenting the specific hypotheses in each article's content. Thus:

- Financial inclusion is more provable to credit unions than commercial banks;
- The risk-taking control is the main reason for Merger and Acquisition within the credit unions market; and
- The Yardstick Competition Theory applies between credit unions and commercial banks at the municipal level.

1.4 AIMS AND OBJECTIVES

The thesis objectives are split into statements of intent and specifics declarations, as follows:

1.4.1 Objectives

To analyze the credit unions' contributions for the Brazilian National Financial Intermediation System.

1.4.2 Specific Statements

- To evaluate the dynamics of financial firms in the financial inclusion process;
- To compare the maturity degree of the credit union in light of mergers in competition stability and competition fragility hypothesis
- To verify if any competition dynamics for deposits occur between credit unions and commercial banks at the municipal level, considering the observed network.

The first empirical chapter deals with financial inclusion and considers that credit unions and other firms are economically efficient (technical and allocative). This paper's base is on the Upward Pricing Pressure theory, where one firm's existence promotes an opportunity cost on the other. However, since there are market failures, where not all viable projects find financing, this relationship of cannibalization translates into financial inclusion.

Also, the first empirical chapter shows the panorama of Brazilian Financial Intermediation where does is not possible to reject that commercial or private banks promote financial exclusion (credit restriction) in times of crisis. In addition, approaching the public bank-private bank trade-off, the first empirical chapter adds the credit union, which has a different doctrine to this dichotomy. As the credit union market is crescent, to exclude then of the analysis may promote selection bias. In the end, it is possible to reject only the hypothesis that credit unions do not promote financial inclusion.

In the second empirical chapter, based on Competition-Fragility and Competition-Stability, the author relaxes the technical and allocative efficiency assumptions by analyzing credit unions' accounting that participates in mergers, compared with those who have not participated in the M&A process.

As credit unions are essential for Brazilian Financial Intermediation (conclusion from the first empirical article), the second article's contribution is on the risk-taking terms of credit

unions. Furthermore, here, the fragility-stability trade-off has been analyzed to indicate the economic strategies of credit unions. Finally, the research design considers different types of treatment: credit unions with only one merger or acquisition process, credit unions with more than one M&A, and the general case, considering all credit unions that promote M&A. From the results, it is not possible to reject the orientation by fragility in the second case. Likewise, in the first and third cases, does not possible to reject the orientation by stability. Thus, these results seem close to competition and more risk-taking approaches.

The third empirical article analyzes the dynamics between credit union service stations and commercial bank branches in places where these two firms coexist. The Network Model is the strategies to identify if commercial bank branches and credit unions compete for inputs (Deposits), given their characteristics.

The short answer is no. Despite credit unions being more efficient and competitive, credit unions still face the deterrence strategy by traditional banks. The legislation has helped credit unions expand their businesses, but they are still dependent on the bank to offer some services. However, the long answer is yes. The results indicate that credit unions are at the highest level of maturity in municipalities where the deposit is abundant. The entry of credit unions into the banking market promotes statistically significant and negative variations of inputs from traditional banks, indicating a competitive dynamic between the two types of firms in these places.

The general answers show that Brazil's financial intermediation is evolving but long to arrive in developed countries. The main restriction is still structural, and public policies should focus on the private sector since public banks are cast in a system without degrees of freedom. On the other hand, depending on the management of private financial firms, this sector presents the ability to work in the market without impairing financial intermediation efficiency. Finally, it seems that credit unions are a sure path to financial inclusion and the full development of the national financial system.

Beyond the Introduction section, this thesis has three more sections. In the second section, the author presents one broad Theoretical Framework where the author presents a theoretical chapter that turns the UPP theory complete, including an analysis with competitive fringe. Three empirical articles compound the third section, each defined by an article that validates the thesis hypotheses. Finally, the fourth section presents the conclusion.

2 THEORETICAL FRAMEWORK

2.1 UPWARD PRICING PRESSURE IN OLIGOPOLY WITH COMPETITIVE FRINGE

ABSTRACT

Farrell and Shapiro (F&S, 2010) proposed an Upward Pricing Pressure (UPP) approach to merger screening between two symmetrical firms. According to them, this UPP approach is more practical than concentration-based methods. However, it fails because it does not incorporate all the theoretical effects which set the price. This article sets out to close two specific gaps in the UPP. First, the industry's case is addressed, which has a set of firms with asymmetric costs. Mathiesen et al. (2012) show that UPP screening could present a false-positive in asymmetric cases. The present study includes a more efficient competitive fringe in the feedback effects, thereby rectifying pricing pressure's symmetric and asymmetric effects. Second, when competitive fringe firms are price takers, demand's lack of representativeness is addressed. The study shows that the model presented by F&S is valid only for cases where the elasticity of demand is unitary, and there is no other competition in the market. If that is not the case, the original model is biased. Finally, after filling both gaps, the validity of the relevant-market term in industrial organization is discussed and was concluded to be out of date. In this context, the study also brings a relativization to the merger screening routine in a complete model, simplifying the academic application to the daily routine of the market regulator.

Keywords: Upward Pricing Pressure; Competitive Fringe; Dominant Market; Antitrust; Relevant-Market

JEL: L13; L40

2.1.1 Introduction

Concerns about the definition of a relevant market are based on the traditional Structure-Conduct-Performance paradigm. This paradigm makes it difficult for any commission on competition policy to block a merger or acquisition (M.A.) in industries with differentiated products, as there could be correlations between unilateral effects and the Theory of Harm in certain industries (Farrell & Shapiro, 2010, hereinafter referred to as F&S). In addition, as the variance in the structural parameters increases, the arguments for blocking a merger or acquisitions also increase. In this respect, the Councils of the United States of America (U.S.), the United Kingdom (U.K.), and the European Union (E.U.), responsible for merger guidelines, have voiced their concerns over the net pressure on prices in screening mergers, considering that these pressures carry more weight than traditional market shares (OLDALE; PADILLA, 2013).

However, the theory drawn up by F&S contains certain gaps, which require analysis in terms of the validity of merger screening and hypothesis tests. While F&S is concerned with upward pricing pressure (UPP) in a merger screening when the industry has firms with symmetric costs, Mathiesen et al. (2012) showed that UPP could be biased when the industry has firms with asymmetric costs. Furthermore, the antitrust investigation (in the sense of Antitrust law in the U.S. or Competition law in other countries) aims to promote fair competition for the benefit of consumers (GAVIL; FIRST, 2014). The absence of a broader view in the F&S model could lead to an imbalance in the merger screening. Hence, the author of this study understands the F&S theory to be incomplete, and in this chapter, they seek to contribute to a more robust analysis without losing the simplicity.

The chapter presents two main contributions. First, one means of correcting the false-positive in the asymmetric case (presented by Mathiesen et al., 2012) is to incorporate the competitive fringe feedback effect into the original UPP. When doing so, the authors can separate the firms into two groups: the set of firms fighting for market leadership and the group of price taker firms. Its second contribution seeks to complete the F&S model. In doing so, it will be proven that the original UPP is valid only when the elasticity of demand is unitary and fringe competitive is equal to zero. The model also adds an idle capacity index, which corrects asymmetric costs effects on pricing pressure generated by the two firms involved in the merger.

Thus, this chapter aims to extend the UPP literature with a complete[4] theory. The market structure includes the dominant firms, a competitive fringe (with its possible gain in efficiency), the correct elasticity of demand, and an idle capacity index for asymmetric information costs. Even including all these points, in the end, a standard manual is presented with one antitrust regulator routine, showing that the model does not lose its simplicity. Thus, the specific objective of the study is to derive the model in two sequences of regulation:

- The first theoretic sequence demonstrates the UPP case. The regulator is concerned with an efficiency gain in a merger between two fringe firms (labeled as Efficiency from a Competitive Fringe, or ECF regulation case). Rhoades (1985) and Currier (2011) stated that a merger between fringe firms could harm competition, but their findings do not consider the efficiency gain from the arbitrated merger. Thus, when the regulator finds the efficiency gain in the competitive fringe, the authors will prove that fringe firms exert a buffer[5] effect on the dominant firms' pricing pressure.
- The second model demonstrates the case where the regulator seeks the pricing pressure effect of a merger between two firms on the dominant side. Here, the authors relax the efficiency gain hypothesis in the competitive fringe that remains constant (a merger screening between Dominant firms with a Constant Competitive Fringe, or DCF regulation case). This model clearly shows how the UPP is valid only when the elasticity of demand is unitary. In this model, the idle capacity index is also added. It corrects the firms' asymmetrical cost effects involved in a merger.

After the U.S. Department of Justice (DOJ) and the Federal Trade Commission (FTC) updated the Horizontal Merger Guidelines in 2010, the discussion over Diversion Ratios (D.R.) encouraged certain authors to develop new UPP offshoots for merger screening (e.g., Affeldt et al., 2013; Cosnita-Langlais et al., 2017; Mathiesen et al., 2012; Salop & Moresi, 2009; Willig, 2011). Researchers found that UPP is more accurate with these offshoots than traditional market-share arguments (e.g., Garmon, 2017; Miller et al., 2017).

While the UPP literature is concerned with showing accuracy or extending the F&S model, Competitive Fringe researchers, between 2007-2019, were concerned with the

[4] A complete theory does not mean that that theory will be more complex. It is not a question of removing the simplicity proposed by the UPP, but of allowing the screening merger guidelines to be more reliably followed.
[5] The main point of UPP for F&S is the Diversion Ratios between two firms (products) involved in the merger, but the argument of the authors of this study is that opportunity cost should consider all the effects of a market. According to Church and Ware (2000), the function of a competitive fringe is to dampen the price of dominant firms. Thus, we consider the competitive fringe exerts a buffer effect on UPP decision-making of dominant firms.

mechanism which explains the joint analysis of dominant firms and marginal fringe (see the development of literature in next section). Table 2.1 (in the next section of this chapter) shows that the main channels analyzed by the Competitive Fringe literature are the costs, product, place of sale, or between periods, or pass-through costs.

These mechanisms could lead one to believe that it is necessary to define the relevant market. However, the models in this chapter do not require the market definition in its three rigid dimensions (*product*, *geographic*, *and time*). According to the present theory, the researcher only needs to indicate the channel within a convex set to establish the merger screening. All these channels compose the space of pricing strategies, and the models assume that demand perceives when a firm changes its strategy (see Kaplow, 2012). On the supply side, this strategy change will generate some opportunity costs. Such a cost will be reflected in the matrix of Diversion Ratios (see discussions in Epstein & Rubinfeld, 2010; J. Farrell & Shapiro, 2010; Kaplow, 2012).

For clarification, this chapter has been divided into five main sections, in addition to this Introduction. Section 2.1.2 presents the progress of UPP literature and competitive fringe literature and ends with the problem statement. Section 2.1.3 presents the original F&S model. In Section 2.1.4, two types of regulation (DCF and ECF cases) are presented. Section 2.1.5 deals with discussions and empirical implications. Section 2.1.6 translates the academic model into the routine of the market regulator, while Section 2.1.7 presents the conclusion.

2.1.2 Upward Pricing Pressure and Competitive Fringe: Literature and Statement

This section presents articles and studies relevant to the upward pricing pressure (UPP) and competitive fringe (C.F.) literature. The section does not provide an exhaustive survey of the two pieces of literature. However, it is considered that the studies mentioned can situate the contributions of this chapter within the merger screening literature. The time range considered is the 2007 to 2020 period, when the discussion on Diversion Ratios was most intense. First, the UPP literature is presented in chronological order. Then, there is a return in time to present the latest relevant studies on the competitive fringe, also in chronological order, within merger and acquisition literature. The section then finishes with a problem statement.

The present article refers to Farrell and Shapiro (F&S, 2010) as the original UPP. The focus of F&S is on Diversion Ratios between two firms involved in the merger or acquisition process. The UPP literature is based on ideas from Farrell & Shapiro (1990), Werden (1996), and O'Brien & Salop (2000). For Epstein and Rubinfeld (2010), the UPP is a simple method

that seeks to analyze pricing pressure without market definition. According to Simons and Coate (2010), empirical support was lacking in the literature because it is a new approach.

Willig (2011) describes the UPP in a case where firms partially acquire competitor firms. His concerns also apply to differentiated product qualities. According to his findings, the merger alters the qualities of the differentiated products. Mathiesen et al. (2012) state that the original UPP could present false-positive results in merger screening when the firms analyzed are asymmetrical.

Jaffe and Weyl (2013) extend the original version for the non-Bertrand market structure. Their result measures are useful in markets geared towards pass-through rates. Affeldt et al. (2013) extend the original UPP for two-sided markets. Their proposed measure requires an estimate of four sets of Diversion Ratios which can be estimated using demand-side or supply-side data. Interestingly, is that with this method is possible to estimate the pricing pressure in industries that connect two types of demand, such as the credit card market or advertising and newspaper subscriptions. Cosnita-Langlais et al. (CL, 2017) extend the Affeldt et al. (2013) approach taking the feedback effects between each side of the market into account. With feedback effects, CL seeks to observe how a price change on one side of the market affects price on the other side of the market after a merger. For CL, when both sides of a market are considered independent, the UPP is biased and, in certain situations, overstates the result.

Garmon (2017) analyzed a merger simulation between two hospitals by comparing three methods (traditional relevant market, UPP, and willingness-to-pay). His findings indicate that upward pricing pressure and willingness-to-pay "are found to be more accurate at flagging potentially anticompetitive mergers for further investigation than traditional methods" (GARMON, 2017).

To conclude the development of published UPP literature, Miller et al. (2017) investigated the accuracy of UPP by estimating the log-concave demand system and demand with some degree of convexity. Their findings (by Monte Carlo analysis) contribute to the analysis of misspecification of demand, as they conclude that UPP is useful because of its expediency and simplicity.

The market structure with competitive fringe is defined as a set of firms that has a near-full share of the market in an industry, but, beyond this set of firms, there is a competitive fringe that acts in a small space of supply, but without eliminating the possible market power of the dominant firms (CHURCH; WARE, 2000). This generic definition presents many well-known empirical strategies, which, in that article, are called Direct Transmission Channels (DTC). In this context, the present paper shows a different form of DTC.

Bonacina and Gullì (2007) analyze the effect of carbon pass-through on electricity prices due to opportunity cost. The market under analysis considers the competitive fringe based on Borenstein et al. (1999). Bonacina and Gullì (2007) show that the effect of the European Emissions Trading Scheme on electricity costs seems to generate an antitrust concern when there is no excess capacity, and the share of more polluting plants is significantly high. In the same way, the research undertaken by Borenstein et al. (1999) for the U.S. California electricity market presents antitrust concerns when the fringe firm's capacity is drained, and the large player can exercise its market power.

The competitive fringe is also considered on the buyer side (the monopsony case). Here, the dominant firm and marginal firms compete for inputs. Mills (2010) considers that a merger between two dominant firms harms small buyers' bilateral negotiation pricing when the seller has marginal upward costs. The results found by Mills are applicable in the labor market and wage negotiations (e.g., Bonanno and Lopez, 2012; Matsudaira, 2014).

Currier (2011) presents a dominant seller as a regulated price discriminator, where each product is sold in a different market with different prices (Ramsey pricing) and regulation through price capping. These findings are consonant with the results found by Rhoades (1985), where the strategy price of a dominant firm in a competitive market is a decreasing function of fringe size.

The final example of DTC between dominant and fringe firms comes from Channel Coordination literature. Kolay and Shaffer (K&S, 2013) work with a competitive fringe, where the upstream firm acts in the downstream demand market as a price maker. The entry barriers are more significant or smaller in this market type, depending on the dominant firm's pricing definition. The K&S (2013) findings were also found by Pinopoulos (2020), whose study focused on a horizontal merger between upstream firms, considering that one of the merging parties is a vertically integrated firm. Pinopoulos (2020) shows that input price could increase the consumer surplus after a merger process because the downstream firms are cost-efficient.

The empirical studies implicitly interlink the UPP and competitive fringe. A paper by Oldale and Padilla (2013) shows that the U.K. Competition Commission and the European Commission[6], in a timider manner, also considered UPP insights in their screening. In reports of these antitrust agencies, concerns about the effects of prices on markets with a competitive fringe are more transparent. See, for example, the following argument involving TNT, UPS,

[6] For example, where the UPP was considered in order to block a merger, there is the case of the United Parcel Service Inc (UPS - the US) and Thomas Nationwide Transport Express (TNT Express - the Netherlands).

and Dalsey Hillbom and Lynn (DHL) companies in a case judged by the European Commission (EUROPEAN COMMISSION, 2013):

> *Commission assessment of the merger is based on a wide range of quantitative (price concentration, bidding, market shares) and qualitative (internal documents, market investigations) evidence. All these elements taken together and discussed more specifically in this decision indicate that, leaving aside any efficiency gains, the elimination of competition between TNT and UPS is likely to result in higher prices even in the presence of DHL and other fringe competitors*[7][sic].

The underlined phrases clearly show where pricing pressure, efficiency gains, and fringe competition are interlinked. Thus, all firms must be considered in a pricing pressure analysis, not just symmetrical ones. In addition, the literature on competitive fringe presented uses a different approach to demonstrate the DTC between dominant firms and the competitive fringe, and most of these DTCs come from opportunity cost and its implications for market price. This relationship clarifies our concerns to analyze a complete market structure with asymmetrical effects and a demand side. Table 2.1 is a summary of all articles which address UPP and the Competitive Fringe literatures cited in this section:

In short, arguments involving industry and its competitive fringe are present in practice in merger screening, council reports, and research into various economy sections. In competitive fringe analysis, the main issues dealt with are direct transfer channels, which interlink fringe firms and the dominant side. In the UPP literature, there is a gap in analyses where the market structure presents asymmetrical firms. It also presents some gaps in addressing the demand side in a theory which, in principle, seeks to avert harming the consumer. Thus, these gaps reinforce the failings of the original UPP theory, thereby making it more susceptible to flawed screening and criticism in terms of hypothesis tests. On that basis, the following questions emerge:

- Is the UPP approach a complete theory?
- Do efficient fringe firms exert any pricing pressure on the price of dominant firms?

[7] European Commission – Case No COMP/M.6570 – UPS/TNT Express, 2013, p. 144 § 726

Table 2.1. Features of the latest relevant articles published in the UPP and competitive fringe literatures.

Authors	Type	Area	Contribution
Rhoades (1985)	Theoric	CF Literature	CF merger
Borenstein et al. (1999)	Theoric and Empiric	CF Literature	Market Power (Pass-through)
Bonacina and Gullì (2007)	Theoric and Empiric	CF Literature	Opportunity cost (Pass-through)
Salop and Moresi (2009)	Theoric	UPP Literature	Gross UPP
Farrell and Shapiro (2010)	Theoric	UPP Literature	Original UPP
Mills (2010)	Theoric	CF Literature	Monopsony
Willig (2011)	Theoric	UPP Literature	Unilateral effect
Currier (2011)	Theoric	CF Literature	Dominant as a price regulator
Mathiesen et al. (2012)	Theoric	UPP Literature	False-positive (asymmetric case)
Bonanno and Lopez (2012)	Empiric	CF Literature	Wal-Mart case study
Kaplow (2012)	Notes	RM Literature	RM critique
Affeldt et al. (2013)	Theoric	UPP Literature	Two-sided Markets
Jaffe and Weyl (2013)	Theoric	UPP Literature	Wellfare merger
Oldale and Padilha (2013)	Review and Study	UPP Literature	EU Council case
European Commission (2013)	Report	CF Literature	Citation
Kolay and Shaffer (2013)	Theoric	CF Literature	Coordination literature
Coate (2013)	Notes	RM Literature	RM defense
Matsudaira (2014)	Empiric	CF Literature	Labor analyzes
Cosnita-Langlais et al. (2017)	Theoric	UPP Literature	Feedback effects 2SM
Garmon (2017)	Empiric	UPP Literature	UPP screen in Hospital merger
Miller et al. (2017)	Empiric	UPP Literature	UPP (Monte Carlo test)
Dutra and Sarbawal (2019)	Under development	UPP Literature	Cost Efficiencies
Pinopoulos (2020)	Theoric	CF Literature	Vertical Relations

Source: Research Result
Notes: UPP stands for upward pricing pressure, CF for competitive fringe, RM for relevant market, and 2SM for two-sided markets.

Our hypothesis for the first question is that the UPP is an incomplete theory. Thus, the demand side could increase or decrease pricing pressure according to the good type (elastic, inelastic, or unitary). Our hypothesis for the second issue is that a competitive fringe mitigates the opportunity cost promoted by a merger of two dominant firms.

The following sections seek to fill these gaps by presenting our two versions of upward pricing pressure.

2.1.3 The Original Upward Pricing Pressure Model

The Upward Pricing Pressure (UPP) model presented by F&S was designed using ideas from Farrell and Shapiro (1990), Werden (1996), and O'Brien and Salop (2000) as a basis. F&S seeks to find the net effect of a post-merger situation on the old trade-off between price increases and efficiency gains. The original formulation is based on a Bertrand oligopoly[8]. Thus, in a pre-merger situation, single-product firms settle the price independently. In a post-merger situation, the strategies of enveloped firms generate pressures on price and quantity sales because the merger promotes an opportunity cost between enveloped firms[9]. F&S also assumes that all other firms, prices of substitute products, and demand[10] will remain constant. The model is presented with these assumptions in mind and then followed by comments on the UPP.

Let two firms supply a similar product each (Product *1* from firm *1* and Product *2* from firm *2*) whose profit functions, π, are equal to Equation 1. By deriving this equation and making it equal to 0 (to find the optimal value), we have 1.1.

$$\pi_a = (\bar{P}_a - C_a)\bar{Q}_a \quad (1)$$

$$\frac{\partial \pi_a}{\partial P_a} = \bar{Q}_a + \frac{\partial \bar{Q}_a}{\partial \bar{P}_a}(\bar{P}_a - C_a) = 0 \quad (1.1)$$

where $a = (1,2)$, $\bar{P}$ is the pre-merger price of product a and $\bar{Q}$ is the pre-merger quantity of product a from firm a.

With a merger process and keeping price and other products constant, UPP occurs through the *reaction function* of merged firms. Hence, F&S (2010) considered that the cost of any product would be equal to $C_a = \bar{C}_a(1 - E_a)$, where E is efficiency, C is marginal cost, $\bar{C}$ is pre-merger marginal cost and $\bar{P}$ is pre-merger prices. Thus, Equation *1* and its optimal for P_1, after the merger process, is written as

$$\pi_1 + \pi_2 = [P_1 - \bar{C}_1(1 - E_1)]Q_1 + [\bar{P}_2 - \bar{C}_2(1 - E_2)]Q_2 \quad (2)$$

$$Q_1 + \frac{\partial Q_1}{\partial P_1}[P_1 - \bar{C}_1(1 - E_1)] + \frac{\partial Q_2}{\partial P_1}[\bar{P}_2 - \bar{C}_2(1 - E_2)] = 0 \quad (2.1)$$

[8] However, F&S (2010) draws attention to the fact that the balance can be achieved for Cournot's market structure, by following the F&S (1990) procedure.

[9] F&S (2010) considers the opportunity cost as an internal fee, where the managers of the firms involved in the merger consider the products sold as products manufactured by different divisions within the firm resulting from the merger.

[10] It is noteworthy that the F&S are not concerned with the structure of demand, as the idea is to find a net effect signaled by the direction which the price will follow in the post-merger period, Proposition 1 and Corollary of F&S (2010).

Equation *2.1* is the effect of a one-unit increase or decrease in P_1 on the post-merger quantity, *Q*. However, F&S (2010) seeks to find a relative effect on prices when firm *1* decreases its prices, increases the quantity of product *1,* $Q_1 A$nd cannibalizes the quantity of product *2,* Q_2. Thus, dividing Equation *2.1* by $-\frac{\partial Q_1}{\partial P_1}$, using Equation *1.1* in Equation *2.1* and solving the inequation to $E_1\bar{C}_1$, F&S (2010) shows that there is upward pricing pressure for Product *1* if

$$E_1\bar{C}_1 < [\bar{P}_2 - \bar{C}_2(1 - E_2)]D_{12} \quad (3)$$

where $D_{12} = \frac{\partial Q_2}{\partial P_1}\frac{\partial P_1}{\partial Q_1}$ is the diversion rate of Product *1* to Product *2*, at pre-merger prices.

The caveat of Inequality *3* is that the extent of the efficiency of Product *2* is positively related to the UPP in Product *1*. Thus, that could lead to a discussion about the efficiency gain after the merger. To avert that type of criticism, F&S (2010) seeks to evaluate the process from the marginal cost of product 2 in the pre-merger period:

$$E_1\bar{C}_1 < [\bar{P}_2 - \bar{C}_2]D_{12} \quad (4)$$

For a more direct interpretation, F&S (2010) rewrite Equation *4*, defining the relative margin as the Lerner index, $M_a \equiv \frac{P_a - c_a}{P_a}$, for product *1* of firm *1* and product *2* of firm *2*. By resolving the Lerner index for the price minus marginal cost when *a = 2* and for marginal cost when *a = 1*, substituting the result in Inequation *4*, dividing by P_1, and solving the inequality for UPP_1, Inequation *4* is expressed in terms of unit-free[11] variables:

$$UPP_1 = D_{12}\bar{M}_2\frac{P_2}{P_1} - E_1(1 - \bar{M}_1) \quad (5)$$

where $\bar{M}$ is pre-merger margins.

In Equation *5*, the upward pricing pressure is valid if $UPP_1 > 0$. In the symmetric case, Equation *5* becomes:

[11] In Equation (*4*), each variable is expressed in different units (price and cost in monetary units, and efficiency in percentage). In Equation (*5*), all variables are expressed as percentages.

$$UPP_1 = D_a \frac{\bar{M}_a}{1-\bar{M}_a} - E_a \quad (6)$$

It can be inferred from Equation *6* that UPP is true if the pressure on prices ($D_a \frac{\bar{M}_a}{1-\bar{M}_a}$) is higher than the credit efficiency E_a. However, because F&S disregards efficiency credit from Inequality *3*, Equation *6* could generate a false negative if there is a feedback effect by reducing the cost of product 2. In this case, F&S (2010), based on Werden (1996), demonstrated that Equation *6* becomes

$$UPP_1 = \frac{D_a}{1-D_a} \frac{\bar{M}_a}{1-\bar{M}_a} - E_a \quad (7)$$

The following contributions are based on the gaps presented by Equation 7.

2.1.4 Introducing the Dominant Upward Pricing Pressure

The following proposal analyzes a market divided into dominant and marginal firms, called the competitive fringe. In the dominant section, there are two firms while, for the sake of simplicity, the marginal fringe is analyzed as a set of firms that do not threaten the status of the dominant firms. The marginal firms are price takers, and all marginal firms behave in the same manner when there is a variation in the market price. Dominant firms aim to achieve leadership of the dominant group and block any attempt by marginal firms to enter their group. From that environment, it can be assumed that before the merger or acquisition (M.A.), the quantity produced by the dominant firms is

$$\acute{Q}_d = \acute{Q}_I - \acute{Q}_2 - \acute{Q}_F, \quad (8)$$

where *d* is the dominant firm, $\acute{Q}$ is the pre-merger quantity, subscript *I* indicates industry demand, subscript *F* indicates the competitive fringe, and subscript *2* indicates the product *2* is from firm *2,* which has a symmetric cost with firm *d*. The maximization profit of the dominant firm is

$$\frac{\partial \pi_d}{\partial \acute{P}_d} = \acute{Q}_d, + \frac{\partial \acute{Q}_d}{\partial \acute{P}_d} (\acute{P}_d - \mathrm{C}_d) = 0 \quad (9)$$

where acute angles "´" above *C* and *P* and *Q* are the pre-merger variables and help to differentiate the author's model.

Considering that the merger or acquisition procedure occurs between firm *d* and firm *2*, the post-merger dominant quantity, Q, becomes

$$Q_d = Q_I - Q_f \tag{10}$$

$$\text{where } \frac{\partial Q_d}{\partial P_d} = \frac{\partial Q_I}{\partial P_d} - \frac{\partial Q_F}{\partial P_d} \tag{10.1}$$

Profit from the M.A. procedure and its maximization is

$$\pi_d + \pi_2 = \left[\mathrm{P}_d - \acute{C}_d(1 - E_d)\right]Q_d + \left[\acute{P}_2 - \acute{C}_2(1 - E_2)\right]Q_2 \tag{11}$$

$$Q_d + \frac{\partial Q_d}{\partial P_d}\left[\mathrm{P}_d - \acute{C}_d(1 - E_d)\right] + \frac{\partial Q_2}{\partial P_1}\left[\acute{P}_2 - \acute{C}_2(1 - E_2)\right] = 0 \tag{11.1}$$

where, as in F&S, $\mathrm{C} = \acute{C}(1 - E)$.

Equation *10* assumes that firm *d* tries to cannibalize the entire quantity of firm *2*. At the same time, Equation *11.1* represents the profit maximization of the M.A. process. Equation *11.1* can be transformed to represent the opportunity cost of firm *d* trying to cannibalize the whole quantity of firm 2. Thus, solving Equation *9* for Q_d and substituting the result in *11.1* it is possible to arrive at

$$\frac{\partial Q_d}{\partial P_d} E_d \acute{C}_d + \frac{\partial Q_2}{\partial P_d}\left[\acute{P}_2 - \acute{C}_2(1 - E_2)\right] = 0 \tag{12}$$

Substituting Equation *10.1* in Equation *12* and multiplying each term by $\frac{\partial P_d}{\partial Q_I}$

$$\frac{E_d \acute{C}_d}{[\acute{P}_2 - \acute{C}_2(1 - E_2)]D_{d2}} < \frac{1}{1 - D_{dF}} \tag{13}$$

where $D_{dF} = \frac{\partial Q_f}{\partial P_d}\frac{\partial P_d}{\partial Q_I}$ is the diversion rate or the variation in the competitive fringe when the quantity of the industry varies. The D_{dF} can be interpreted as an internal fee that firm *d* pays to try to cannibalize the whole quantity of product *2* from firm *2*. $D_{d2} = \frac{\partial Q_2}{\partial P_d}\frac{\partial P_d}{\partial Q_I}$ is the internal fee that firm *d* pays to cannibalize the whole quantity of product *2*. The E_d and E_2 are the efficiencies of firms *d* and *2,* respectively, and $\acute{C}_d$ and $\acute{C}_2$ are the marginal costs of firms *d* and *2*.

The cannibalization behavior, represented by D_{dF}, is the same as that assumed by F&S. First, firm *d*, now merged, reduces product *d*'s prices, keeping the product price from firm *2* constant. So, no one will demand the product from firm *2*. However, if firms in the competitive fringe are price takers, they will also cut their prices and cannibalize part of the increase[12] in demand or part of the quantity of product *2* from firm *2*. The part cannibalized by competitive fringe firms is considered an internal fee paid by firm *1* when trying to cannibalize the quantity of firm 2 (Q_2).

In the second step, the dominant firm incorporates both internal fees (D_{dF} and D_{d2}) as opportunity costs, and this promotes upward pricing pressure. Again, if there is a competitive fringe, the dominant firm increases the market price to block marginal firms from entering the dominant group. The result is a lower price than that predicted by the original UPP of F&S.

In short, in Inequality *13*, when $D_{dF} = 0$, we return to F&S's basic analysis. However, the question becomes interesting when $|D_{dF}| \neq 0$. In this case, one cannot stop at the simple variation given by Inequality *13*, and the analysis in the literature on competitive fringes can be applied. In the proposed environment, the regulator could come across two different cases. First, there is the case where the efficiency of competitive firms is attractive (ECF case). Second, there is the case where the regulator only looks at the effect of the competitive fringe in terms of Diversion Ratios (internal fee), disregarding the fact that marginal firms are efficient, and analyzes the pricing pressure in the merger between dominant firms (DCF case).

2.2.4.1 The Case of the Efficient Competitive Fringe

When the competitive fringe presents an efficiency gain, the change in the supply capacity of marginal firms could be potentializing the internal fee. To show this process, the well-known procedure presented by Church and Ware (2000) is used to construct the margins replacing the Lerner index utilized by F&S. Thus, consider substituting Equation *10.1* of the previous section in Equation *9* and then rearrange the terms to obtain the pre-merger margins:

$$\left(\acute{P}_d - \acute{C}_d\right) = \frac{Q_d}{\left(\frac{\partial Q_I}{\partial \acute{P}_d} - \frac{\partial Q_F}{\partial \acute{P}_d}\right)} \qquad (14)$$

[12] We can consider a closed market where demand cannot now increase or a market where people's preferences are based on the price of goods. We prefer to consider the second option, taking into consideration that, according to Berry (1994), there is an out-side good, or that there is dead weight loss in balance of market, or, yet, that between merger process the economically active population grows. In these cases $Q_I > \bar{Q}_I$.

dividing both sides of Equation *14* by $\acute{P}_d$, multiplying and dividing the right side by Q_I, we arrive in:

$$\frac{(\acute{P}_d - \acute{C}_d)}{\acute{P}_d} = -\frac{1}{\left(\frac{\partial Q_I}{\partial \acute{P}_d} - \frac{\partial \acute{Q}_F}{\partial \acute{P}_d}\right)}\left(\frac{Q_d}{Q_I}\right)\left(\frac{Q_I}{\acute{P}_d}\right) \tag{14.1}$$

Putting the $\left(\frac{Q_I}{\acute{P}_d}\right)$ in the Equation 14.1 denominator and multiplying the $\frac{\partial \acute{Q}_F}{\partial \acute{P}_d}$ by $\frac{\acute{Q}_F}{\acute{Q}_F}$

$$M_a \equiv \frac{[\acute{P}_d - \acute{C}_d]}{\acute{P}_d} = \frac{s_d}{\eta_s^F s_F - \eta} \tag{14.2}$$

where $\eta_s^F = \frac{\acute{P}_d}{\acute{Q}_F}\frac{\delta \acute{Q}_F}{\delta \acute{P}_d}$, $\eta = \frac{\acute{P}_d}{Q_I}\frac{\delta Q_d}{\delta \acute{P}_d}$, and Q_I is the total market demand. Thus, s_d is the market share of the leader (dominant firm) (CR2), s_F is the market share of the fringe firms, η_s^F is the elasticity of supply of the fringe, and η is the elasticity of market demand.

As in F&S, Inequality *13* can be rewritten as $E_1\acute{C}_1 < \frac{[\acute{P}_2 - \acute{C}_2]D_{d2}}{1 - D_{dF}}$. Now, divide this inequality by $\acute{P}_2$. Considering the symmetric case in the dominant side (Firm *d* and Firm *2*) and solving for Fringe Downward Pricing Pressure (FDPP), it can be seen that the pricing pressure is valid when Equation *15* is greater than zero.

$$FDPP = \acute{P}_2 \frac{D_{d2}}{(1 - D_{dF})} \frac{s_d}{(\eta_s^F s_F - \eta)} - E_1\acute{C}_1 \tag{15}$$

Unlike F&S (Equation 7), in our Equation *15* there is no symmetry between the Diversion Ratios D_{d2} and D_{dF}. However, the *compensating marginal* cost of M.A. between firm *d* and firm *2* can be incorporated. Following Werden (1996), and considering the symmetry between firm *d* and firm *2*, one obtains

$$FDPP = \acute{P}_2 \frac{D_{d2}}{(1 - D_{dF})(1 - D_{d2})} \frac{s_d}{(\eta_s^F s_F - \eta)} - E_1\acute{C}_1 \tag{16}$$

Equation *16* can be divided into pre-M&A and post-M&A periods. The results are given by adopting Proposition 1 of F&S as our Lemma 1:

Lemma 1. (*Pre-M&A and post-M&A efficiencies*): When prices are functions of cost, the prices in pre-M&A and post-M&A efficiencies are represented by

$$P^{*}\acute{C}_1(1-E_1) > P^{*}\acute{C}_1(1-\hat{E}_1) \quad (17)$$

where $\hat{E}_1$ is the pre-M&A efficiency, and E_1 is the post-M&A efficiency.

It is interesting that, in Equation *16,* the higher the elasticity of demand, η, the more likely it is that there will be pressure on prices. In other words, the lower the competition in the industry, the more likely it is that there will be some pressure on prices. Nonetheless, by definition, competition increases as one gets closer to the competitive fringe if this is true. So, because s_d and s_F could be negatively connected[13], a positive variation in the market share of the dominant firm could cause price increases, as long as the Diversion Ratios $\frac{D_{d2}}{(1-D_{dF})(1-D_{d2})}$ remain constant.

Finally, the channel which links both markets (fringe and dominant) become evident in the interaction between the elasticity of fringe supply and the share of competitive fringe. From this point, the following proposition can be made, which helps prove the hypothesis that the competitive fringe exerts a buffer effect:

Proposition 1: Suppose that the *upward pricing pressure* exceeds zero after the merger or acquisition between two dominant firms. Suppose a merger or acquisition also occurs between two firms in the competitive fringe. In that case, the competitive fringe will act as a buffer on the upward pricing pressure of the entire market.

Proof: A set Q is defined to be "convex" whenever $\forall Q_d, Q_F \in Q$ and $\gamma \in [0,1]$, then $\gamma Q_d + (1-\gamma)Q_f \in Q$. Suppose also that $\underset{t\to\infty}{D}_{dF,t} = \partial Q_F/\partial P^{*}$ and $\underset{t\to\infty}{\eta}\,{}^{F}_{S} = \frac{\partial Q_F}{\delta P^{*}}\frac{P^{*}}{\acute{Q}}$, where $Q_d, Q_F, P^{*} \in R^{+}$ and therefore $\underset{t\to\infty}{D}_{dF,t}$, $\underset{t\to\infty}{\eta}\,{}^{F}_{s,t} \in R^{+}$ is a convergent sequence in t > 0. Now, define the function $P^{*}(C)$ as a monotonic relationship between marginal costs and prices after the merger or acquisition. Applying this mapping to $\underset{t+b}{\eta}\,{}^{F}_{s,t}$, and considering the convexity of Q, it will be seen that the post-M&A competitive fringe elasticity of supply is greater than that of the pre-M&A competitive fringe elasticity of supply: $\underset{t+b}{\eta}\,{}^{F}_{s,t} > \eta^{F}_{s,t}$. This result increases the denominator of the upward pricing pressure component of Equation *16*,

[13] As proof of our proposition, we show that s_d and s_F are results of a convex set.

$\acute{P}_2 \frac{D_{d2}}{(1-D_{dF})(1-D_{d2})} \frac{s_d}{(\eta_s^F s_F - \eta)}$ and reduces the pressure on prices in all industries (note that $\acute{P}_2$ remains constant in pré-merger values). Thus, Proposition *1* is true even when the first term of the proposition is false, and the competitive fringe acts as a buffer against the pressure on prices. ■

Proposition *1* clarifies that the price transmission channel is carried out via the supply elasticity of the competitive fringe as all firms lie in a convex set. In this case, the proposition can be extended:

Corollary 1: Suppose that one firm from the competitive fringe adopts new efficiency practices. By means of Equation *16,* with everything else constant, these new practices promote a downward pricing pressure on the entire market.

Proposition 1 and its first Corollary show that, in addition to the feedback effect presented by F&S, in a market where the competitive fringe presents an efficiency gain, the upward pricing pressure will cancel the downward pricing pressure caused by the competitive fringe for the final price of the whole market to rise. The regulator or antitrust agency could block the M.A. on the leaders' side to protect competition and the end consumer's purchasing power when this occurs.

Finally, Proposition 1 does not conflict with F&S:

Corollary 2: Suppose that the first and second terms of Proposition *1* together are false. Hence, with everything else constant, utilizing Equation *13*, it can be seen that Proposition 1 is true if and only if the diversion rate between the leader and the competitive fringe (D_{df}) is equal to zero.

The only time that both terms of Proposition *1* can be false is when the industry under analysis does not have a competitive fringe. This case is presented in Equation *13,* and, from our perspective, it is the case presented by F&S with D_{1f} equal to zero.

2.2.4.2 The Case of the Dominant Firms with Competitive Fringe

The regulator focuses on the structural break promoted by more efficient managers in the competitive fringe in the ECF case. In this approach, the merger screening between symmetric firms remains a secondary form because the F&S already presented its effect on the original UPP. Thus, our contribution in Equation *16* is with the full feedback net effect, incorporating the part of the asymmetric efficiency gain case in the F&S model. However, considering that the competitive fringe is constant (or in other words, it will not present any efficiency gain during the dominant firm merger), the focus will be on the dominant side. In that case, the regulator has a second problem with the original F&S approach because the screening of mergers that harm consumers occurs using supply-side data considering only two firms, disregards the idle capacity, and therefore a biased price balance.

According to the principle of microeconomic theory, firms increase or decrease the quantities offered as prices increase or decrease. While demand increases or decreases, the quantity demanded is inversely proportional to price variations (*petrĕu* principle of the economy). Equilibrium occurs when supply equals demand. For the author, the problem occurs because F&S assumes the supply-side data (margins between Equations *4* and *5*) considering that demand elasticity is unitary, but empirically, market balance does not always occur when point elasticity of demand is equal to one.

One way of seeing how a merger can harm society is to look at the total surplus (consumer surplus plus producer surplus), maximizing the consumer surplus restricted to the producer surplus. From this procedure, it can be shown that the F&S model is once again incomplete. That is done through the second proposition:

Proposition 2: Imagine a dominant market structure that disregards the variation of efficiency in competitive fringe firms. If a merger or acquisition occurs between two firms on the dominant side, then the opportunity cost of dominant firms depends on internal fees (D_{d2} and D_{dF}), the elasticity of demand, and an idle capacity index.

Proof: take the following assumptions: $R(q_i, p_i) = \sum_{i=1}^{n} p_i q_i$ is the firm's revenues, $C(q_i)$ the cost function of firm *i*, $CS(q_i, p_i) = \int_0^{p_i} Q_I(q_i, p_i)dp - \sum_{i=1}^{n} p_i q_i$ is consumer surplus, and $PS(q_i, p_i) = \sum_{i=1}^{n} p_i q_i - C(q_i)$ is producer surplus (where *i* is the product *i* of firm *i*). Considering that $i, j \in \mathbb{Z}^+$, we can set up the original Ramsey[14] pricing maximization problem:

[14] Originally from A Contribution to the Theory of Taxation by Ramsey (1927).

$$\max_{p} CS(q_i, p_i) \ \ subject\ to\ PS(q_i, p_i) \geq 0 \tag{18}$$

Considering the P.S. corner solution, substituting the P.S. solution in C.S. and applying Lagrange's method to Equation *18*

$$L = \int_0^{p_i} Q_I(q_i, p_i)dp - C(q_i) - \lambda\left(\sum_{i=1}^{n} p_i q_i - C(q_i)\right) \tag{19}$$

Solving only the integral and considering that Q_I is a linear function

$$L = q_i p_i - C(q_i) - \lambda\left(\sum_{i=1}^{n} p_i q_i - C(q_i)\right) \tag{20}$$

As the original diversion rate is $\left|\frac{\partial q_j}{\partial q_i}\right|, i \neq j$, Equation *20* can be solved in the same way as Ramsey (1927) did, deriving it through quantity.

$$\frac{\partial L}{\partial q_i} = p_i - \frac{\partial C}{\partial q_i} - \lambda p_i - \frac{\partial p_i}{\partial q_i} q_i \lambda + \frac{\partial C}{\partial q_i}\lambda = 0 \tag{21}$$

$$(p_i - cmg) - (p_i - cmg)\lambda - \frac{\partial p_i}{\partial q_i} q_i \lambda = 0 \tag{21.1}$$

where $cmg = \frac{\partial C}{\partial q_i}$

$$(1-\lambda)(p_i - cmg) = \frac{\partial p_i}{\partial q_i} q_i \lambda \tag{21.2}$$

$$(p_i - cmg) = q_i \frac{\partial p_i}{\partial q_i} \frac{\lambda}{(1-\lambda)} \tag{22}$$

As in the ECF case, Inequation *13* is considered. So, considering the absolute term of Equation *22* and substituting it in Inequality *13*, disregarding efficiency, one has

$$E_i \acute{C}_i < q_i \frac{\partial p_i}{\partial q_i} \frac{\lambda}{(1-\lambda)} \frac{D_{d2}}{(1-D_{dF})} \tag{23}$$

Dividing both sides of Inequation *23* by $P^*$and solving for Dominant Upward Pricing Pressure (DUPP)

$$DUPP = \frac{1}{\eta}\frac{\lambda}{(1-\lambda)}\frac{D_{d2}}{(1-D_{dF})(1-D_{d2})} - \frac{E_i \acute{C}_i}{P^*} \quad (24)$$

As F&S states that $\acute{C}_i = P^*(1 - M_i)$ and substitute this in Equation *24*. Also, divide both terms of Equation *24* by $(1 - M)$.

$$DUPP = \frac{1}{\eta}\frac{\lambda}{(1-\lambda)}\frac{1}{(1-M)}\frac{D_{d2}}{(1-D_{dF})(1-D_{d2})} - E_i \quad (24.1)$$

where $\eta = \frac{P^*}{q_i}\frac{\partial q_i}{\partial p}$ is the elasticity of demand, and $\frac{\lambda}{(1-\lambda)}$ is an idle capacity index.

From *24.1*, the pressure on prices should consider factors other than supply-side margins. Such factors also provide the opportunity cost in the dominant firm. ■

Proposition *2* states that in the case where there is no efficiency gain in competitive fringe, the opportunity cost also occurs by factors other than margins provided by F&S. In this case, the regulator sees the industry as a *contestable market*. At this point, the dominant players seek to prevent new entrants to the dominant side. As in the ECF case, our analysis can be extended.

Corollary 3: Imagine that the first and second terms of Proposition *2* together are false. So, *ceteris paribus*, at least a price pressure is given by the ECF case.

When the two terms of Proposition *2* are false, and the market structure considers the competitive fringe, the pricing pressure should consider the possible efficiency break (positive or negative) in marginal firms. Otherwise, the industry structure could be a monopoly. In this line, the last extension of Proposition *2* makes the bias from the original UPP evident.

Corollary 4: Equation *24.1* is the same model presented by F&S if, and only if, the diversion ratio between marginal firms and dominant players is statistically equal to zero, and price-elasticity of demand is unitary.

Proof: Take Equation *22* and divide it by P^*. The result is $\frac{(P^* - cmg)}{P^*} = \frac{1}{\eta}\frac{\lambda}{(1-\lambda)}$, where η is the same elasticity of demand as Equation *24*. If $\eta = 1$, then $\frac{(P^* - cmg)}{P^*} = \frac{\lambda}{(1-\lambda)} \equiv M$ of the F&S model, where *M* is the same margins of the original UPP model. Substituting this in *24.1*

produces $\frac{1}{1}\frac{\bar{M}}{(1-\bar{M})}\frac{D_{d2}}{(1-D_{dF})(1-D_{d2})} - E_i$, where $\bar{M}$ is pre-merger margins. Finally, if $D_{dF} = 0$, and considering the pre-margins, then we have the original UPP for symmetric cases, $\frac{\bar{M}}{(1-\bar{M})}\frac{D_{d2}}{(1-D_{d2})} - E_i$, as reported by F&S (in this article referenced in Equation *7*). ■

From the fourth Corollary, the bias of the original UPP can occur through the elasticity of demand (when price elasticity is not unitary) or the internal fee provided by a competitive fringe (when this diversion rate is not equal to zero), or through both. When there is no competitive fringe and the elasticity of demand is not unitary, the index of the firms' idle capacity, $\frac{\lambda}{(1-\lambda)}$, is also decisive in establishing pricing pressure. In this case, this index tends to correct any deviation from cost asymmetry or technological asymmetry between the firms involved and thereby solves the false-positive problem.

For example, take a product that is efficiently sold online to the whole of U.S. by firm *A* and the same product is sold in one county only in the U.S. by firm *B*. These products are the same but are sold by different distribution channels. Despite being different, both firms' pricing strategies are linked in the extensive-form game, where each player has its set of strategies, and the union of sets forms the strategy space. Each strategy taken in this space promotes a reaction in demand. The UPP captures this effect (cannibalization effect of F&S), and the price elasticity of demand acts as a scalar quantity that processes the effect (UPP vector) to its real magnitude. Furthermore, both firms have different costs and technologies. The firm with the highest cost can be interpreted as an unresolved idle capacity (or the additional cost can be considered shadow price) that also affects demand. This idle capacity is rebalanced by the index presented.

Therefore, the original UPP is correct only when the price-elasticity point is equal to 1, and there are no other competing firms in the market. Otherwise, the F&S model is biased. Thus, we have shown that the original UPP is only part of a complete theory.

2.1.5 The Universe Set vs. Relevant Market – A Discussion

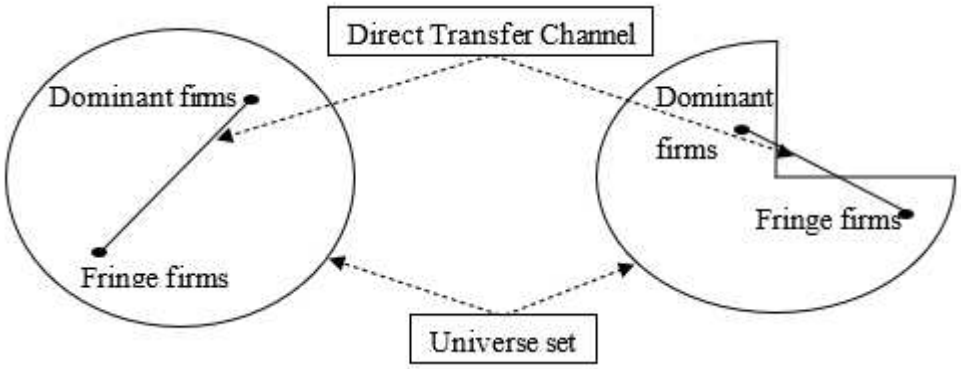
In this section, the author proposes to look at the *universe set* instead of the *relevant market*[15]. They want to analyze the UPP in a whole industry to find the net effect of pressures

[15] In its geographic, product, and time definitions.

on price after a merger. In particular, they believe that there is a *direct transmission channel* (DTC) where the pressure goes from fringe firms to dominant firms and vice-versa.

This DTC does not necessarily need to be a relevant market in its total definition (*product, time, and place*). However, the analyses still need dominant and fringe firms to be in a convex set (Figure 2.1). Without DTC, the pricing pressure, as in the original UPP, could be spurious, and it cannot be said that there is a net causal effect. As seen in the literature review section, in part of the competitive fringe, the channel between dominant and fringe firms could be the pass-through cost, vertical integration, a monopsony market, products, place.

Figure 2.1. Universe Set of Product Definition in a Convex and Concave Set



Source: Designed by the authors, based on **Sundaram (1996)**
Note: The Universe set is a convex region of Euclidean space which, in the definition of the relevant market, could be the product, geographic, or time.

In Figure *2.1*, the left set is convex because any two points can be interlinked by a straight-line segment contained within the set under analysis. Mathematically: $\forall\, d, f \in \overline{\mathrm{Q}}, \forall\, \gamma \in [0,1], \gamma \mathrm{d} + (1-\gamma)\mathrm{f} \in \overline{\mathrm{Q}}$. The universe set on the right side of Figure *2.1* is concave because part of the straight line is outside the universe set.

Proposition *1* states that the *universe set* is understood as any *definition* that composes the relevant market (*geographic*, *product, time, or any* definition that generates an opportunity cost, in the F&S sense), and each *definition* can be independent.

Returning to the example in the penultimate paragraph of the last section, the regulator could be vulnerable when defining the relevant market in all its definitions. However, it is thought that the regulator is safer if they set the DTC. In Proposition *2*, the regulator disregards the efficiency gain from the competitive fringe and considers that DTC is perceived by the demand-side, where the price-elasticity captures this effect. In Proposition *1*, there is a channel other than the demand-side, the efficiency gains from the competitive fringe. Furthermore,

when the competitive fringe is not present, then the demand side is a DTC, as when the price elasticity of demand is unitary (in this case, the DTC interlinks firm *1* with firm *2*).

F&S clarifies that there is no concern in defining the relevant market and that the purpose of the UPP is only to verify the pressure on prices caused by the merger. However, they fail to disregard the demand-side as a constraint on rising prices. Thus, the demand is the leading channel between any product that participates in a merger screening, principally because prices are a monotonic function of costs, and each price has its elasticity point (the function between price and elasticity is a bijection). Thus, the price elasticity of demand needs to be statistically significant for the effect on prices to be considered a causal effect. From it, the diversion rate and net effect of pricing pressure can be more safely interpreted.

2.1.6 The simplification for Everyday Screening

The presentation of the original F&S model is carried out to simplify the merger screening process within the antitrust regulator. The presentation in this article, including a competitive fringe, may sound like a more complex screen than it is. Thus, based on what is already consolidated in Industrial Organization, this section brings a simple manual with a fast proxy to avert the merger block by false-positive cases.

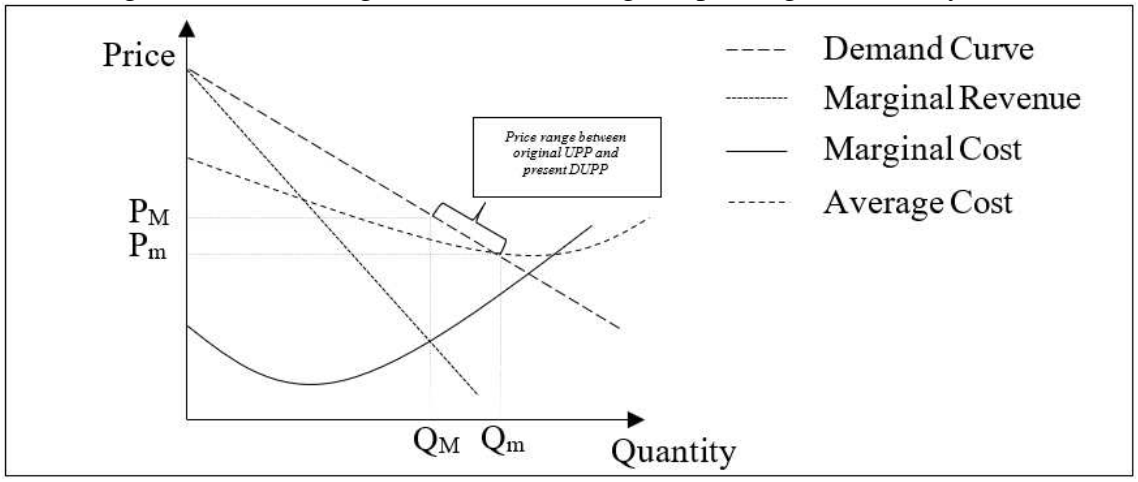
The maximal logic price pressure under the original F&A model is monopoly price because the screening in that model starts from profit maximization. Otherwise, the logical maximal price pressure is less than the monopoly price, as seen in both models developed here. Nevertheless, what is the bottom price limit?

See that Proposition *2* concludes that with or without efficiency gain, the competitive fringe promotes a downward price pressure on the prices of dominant firms. This pressure sounds like a contestable market, as the dominants may feel threatened by fringe firms. Thus, the logic of dominant firms' strategy is not the monopoly price because the price strategy will allow the competitive fringe to increase their margins, make more investments and, shortly, compete for a place on the dominant side. In a contestable market, a logic price co-occurs as the average cost (MARTIN, 2010). No accident, the Hamsey price, also known as second best, occurs when the price is equal to the average cost. That is why Ramsey's price is used to finds the complete theory in the present study.

Thus, in a simpler merger screening, surely the price will stay between monopoly price and second-best price, depending on competitive fringe threatening the dominant side. Thus, be P_M and $Q_{.M.}$ monopoly price and quantity respectively, and P_m and Q_m the contestable market

price and quantity respectively. Considers too that average cost is greater than marginal cost and crosses the demand curve when are declining (original Ramsey market). We can draw that PM is greater than Pm and that QM is fewer than Qm with these assumptions. The range between two prices allows us to build the probability of false-positive in the merger screening with the original UPP. Figure *2.2* presents these two characteristics.

Figure 2.2. Price range in M&A screenings, depending on the analyzed market



Source: Designed by the author.

The average cost in Figure *2.2* represents the exact average cost of a natural monopoly. In this case, we can interpret that competitive fringe promotes, by opportunity cost, a greater fixed cost that increases the total cost of dominant firms. Thus, the average cost crosses the demand curve when it is declining, and, after the merger, the marginal firm will cannibalize part of the demand if the dominant firm strategy chooses the ordered pair (Q.M., PM). On the other hand, if the two-tuple (Q_m, P_m) is the dominant strategy chosen, then deterrence is established, and the competitive fringe remains constant.

Thus, more simply, the fundamental difference between the original UPP and DCF models occurs in the margins. In the original UPP, the margins are from $\frac{(P^* - cmg)}{P^*}$, while in the DCF, the margins are $\frac{(AC - cmg)}{P^*}$, and where AC is the average cost. To illustrate takes the same example from F&S (2010, p.12), where the efficiency credit is 10%, and the Diversion Ratios between dominant side firms is 30%. Now includes the Diversion Ratios between the dominant merged firm and competitive fringe firms in 20%. For simplicity, consider the price elasticity of demand equal to 1 in equation 24.1. In the original UPP (D_{dF}=0) the margins need to be greater than 23%, or in a more accurate test greater than 17%. However, if the competitive

fringe exists, the true margins will be greater than 19%, or in a more accurate test, greater than 13%.

The example results indicate that a merger screener that disregards a total market may overestimate the margins and unnecessarily block the merger, generating a false positive alert. *Ceteris Paribus*, the D_{dF} needs to be fewer than 1.25% for the ECF to be equal to original UPP margins. Something hard to find in countries with developed venture capital.

2.1.7 Conclusion

The focus of merger screening by the Federal Trade Commission (FTC) and other antitrust agencies throughout the world has been F&S's Upward Pricing Pressure (UPP). However, the F&S proposal presents certain gaps that could lead to incorrect results in some cases. This article set out to fill two specific gaps with a complete theory. First, it sought to resolve the case where the industry has a set of symmetric firms and other groups of asymmetric firms. Mathiesen et al. (2012) have shown that the UPP screening could present false-positive results in asymmetric cases. The competitive fringe was included in the feedback effects to correct this, thereby rectifying pricing pressure's symmetric and asymmetric effects. Second, it sought to resolve the lack of representativeness of demand in a theory that seeks to avoid harming the consumer. The author showed that the model presented by F&S is valid only in the case where the elasticity of demand is unitary.

The background to their two specific cases is the market structure where there are dominant firms (and therefore symmetrical in terms of their costs) and a competitive fringe (a set of symmetrical firms, in terms of their costs to their peers, but asymmetrical in their costs to dominant firms). Two hypotheses were raised under this market structure: first, that the UPP model is incomplete, and second, that a competitive fringe promotes a downward pricing pressure effect (buffer effect) in the F&S UPP model. To test these hypotheses, two models were designed, which represented two cases: that of the gain in efficiency in a competitive fringe (ECF) and that of dominant firms with a competitive fringe (DCF).

The results show less pressure on prices in both cases (ECF and DCF) than in a market without a competitive fringe. However, this result is valid in a scenario where there is a convex set between dominant and fringe firms. In addition, the results are different according to the case considered. In the ECF case, the pricing pressure effect occurs through the elasticity of supply of fringe firms and the diversion ratio between fringe and dominant firms. In the DCF case, the channel between dominant and fringe firms is only the internal fee paid by the

dominant firm to try to cannibalize the total products of firm *2*. This internal fee is the price paid by the dominant firm to prevent competitive fringe firms from entering a dominant group.

Furthermore, in the DCF case, it was also shown that the F&S model is correct (in the search for a causal effect) only when the price elasticity of demand is unitary and there are no more competitive firms. The absence of competitive fringe is the significant gap in the F&S model. Thus, the two issues raised were resolved without refuting our hypotheses. In short, the original UPP model is incomplete because the competitive fringe and demand side is misrepresented. In asymmetrical cases, the competitive fringe exerts downward pricing pressure on the merger of two dominant firms because it establishes a lower price to prevent marginal firms from entering the select group of dominant firms.

After presenting the two cases, the relevant market issue was discussed. It was concluded that the term used in the industrial organization is currently out of date. Today, the universe set is the more appropriate term because the market regulator, public policymaker, or researcher need only consider this set as convex.

In conclusion, it is proposed that the cases presented here be analyzed with empirical data and that the theoretical biases found in this article be compared and quantified in practice.

3 APPLIED FRAMEWORK

3.1 FINANCIAL INCLUSION, CROWDING-OUT EFFECT, AND BANKING DELINQUENCY

ABSTRACT

This article analyzes the financial inclusion or exclusion in the Brazilian financial intermediation market from 2008 to 2020. The crowding-out effect hypothesis between private and public financial firms was considered under crises frameworks. To fill a gap in the Brazilian financial literature, the author includes the credit unions in the analysis, expanding the public-private dichotomy to profitable, non-profitable, and public financial firms' orientation. Thus, the author adapted the Berry (1994) procedure to estimate the demand, obtaining demand elasticity and Diversion ratios, considering the Upward Pricing Pressure theory. Furthermore, a structural VAR also was estimated to evaluate the effect of delinquency under elasticities. From the results, the crowding-out effect is present between public and commercial banks, while credit unions expand bank loans in adverse times.

Keywords: Financial Inclusion; Upward Pricing Pressure; Crowding-out Effect; Banking delinquency.

JEL: G21, L13, L38

3.1.1 Introduction

This chapter aims to evaluate the responses to the price of financial institutions in the downstream lending market. Specifically, it seeks to assess how much consumer delinquency can promote upward or downward pressure on the prices of loans from private banks, public banks, and credit unions. In addition, it seeks to identify whether the marketable securities (TVM, as it is the acronym in Brazil) are one of the spillover mechanisms between delinquency and financial inclusion or exclusion.

In Brazil, there are three main structures of financial intermediation in the downstream loans market (Public Banks, Private Banks, and Credit Unions) and an inherent structure (FinTechs) that, according to Frost et al. (2019), is still incipient.

According to Sanches e Silva Junior (2012), the dichotomy Public-Private Banks dates to the 1960s. However, through the current Brazilian conjuncture, the debate has focused on the dynamics raised after implementing the Program to Stimulate Restructuring and Strengthening the National Financial System (PROER, as the program acronym in Portuguese) in 1995. See, for example, Nakane and Wientraub (2005), Levy Yeyati, Micco and Panizza (2007), Sanches, Silva Júnior and Srisuma (2018), and Passos and Modenesi (2020).

Nakane and Wientraub (2005) assessed whether the privatization process of public banks, encouraged by the Central Bank of Brazil (Bacen) after the PROER, promoted changes in the total productivity of the factors. The study indicated that public banks were less productive than private banks and that privatization was beneficial to the whole sector. On the other hand, Levy Yeyati, Micco, and Panizza (2007) highlight the social side of public banks and indicate that the actions of these institutions in times of adversity have been beneficial to maintain the credit supply in Latin American countries. Moreover, the efficiency of the two banking structures may be interdependent, where the private banks' efficiency depends on how public banks are manageable and vice versa (LEVY YEYATI; MICCO; PANIZZA, 2007).

For Brazil, this complementarity between public and private banks was tested by Sanches and Silva Junior (2012) and Sanches, Silva Júnior, and Srisuma (2018). Without identifying its mechanism, these studies have indicated that the interaction between these two structures promotes a profit spillover from public to private banks. Thus, these studies conclude with a possibility of competition between public and private banks in the personal credit and invoice discounting relevant markets. At the same time, durable goods assets are held mainly by public banks.

Passos and Modenesi (2020) analyze the monetary policy power under public and private bank credit. Their findings indicate that monetary policy seems more efficient when public banks expand their credits than their private peers do since private banks are associated with more persistent price puzzle behavior. According to their findings, the public banks have lower interest rates flexibility resulting in less spillover to the economy, but that may "enhance overall monetary policy goals in times of financial fragility" PASSOS AND MODENESI (2020).

The above articles evaluate financial intermediation through the debate between public and private banks and exclude credit unions from their analysis. The credit union firms, whose Central Bank of Brazil (Bacen) restricted the field of activity to categories of workers with a common interest, begin to increase their share in lending relevant markets with the possibility of accepting cooperative members without category ties from 2003 (BACEN, 2003).

In addition, over the first two decades of the 2000s, Bacen guidelines also have allowed credit unions to act in increasingly populous municipalities. That is, credit unions were authorized to operate in municipalities with up to 750,000 inhabitants between 2003 and 2007 (BACEN, 2003), in municipalities with up to two million inhabitants between 2007 and 2010 (BACEN, 2007), and municipalities with populations above two million inhabitants after 2010 (BACEN, 2010).

The issue is that with the expansion of the credit union in the space and the reduction in the restriction on new associations, the debate, which until then is dichotomous, necessarily needs to be broader, because, from 2003, the downstream lending market has: commercial banks with social content (Public – *Banco do Brasil*, BB, and *Caixa Econômica Federal*, CEF); for-profit banks (Private Banks); and non-profit institutions (Credit Unions).

In Brazil, the Secretariat Federal Revenue does not tax the cooperative society acts (BRASIL, 1971). In the Brazilian intermediation financial system, cooperative society acts are loans and banking services granted to credit union members to achieve their social objectives. Thus, besides being a non-profit association, credit unions authorized by Bacen, theoretically, have particular tax and competitive advantages over commercial banks.

Given this context, the second empirical chapter of this thesis evaluates the evolution of the accounting indicators of credit unions. In summary, that study indicates that credit unions are increasingly their manager professionalization. The evolution of their indicators results in a more competitive process, explaining the reduction in the number of credit unions aligned with the strengthening of the cooperative credit system.

Together[16], credit unions reached the third position between 2008 and 2019 regarding the market share percentage of total liabilities and the fourth national placement in the percentage of the loan market in the same period (see Figure 1.1 in the introduction of this thesis). Thus, from these shreds, disregarding the credit unions data in bank lending econometric analyses is the same as running the risk of selection bias. Therefore, this chapter contributes to the literature by expanding the dichotomous debate between public and private banks, including non-profit taxonomy named credit unions.

The identification strategy adopted in this chapter to identify the taxonomies' behaviors was to estimate the price elasticity of demand for each quarter between March 2008 and December 2020 by adapting the Barry procedure (1994). Then, the research design sought to evaluate the price response behavior against structural innovations on the delinquency of each taxonomy.

Two are the highlights steps of the adopted procedure: The first refers to adapting Berry Nests' (1994) calculations to the Diversion Ratios. These ratios have the objective of evaluating which analyzed taxonomies holds the possibility of expanding credit. The second is that the author calculates the Logit Odds Ratio considering the payment options M4 (from the Monetary Economy). Also, in the second highlight step, the Diversion Ratios (in Farrell and Shapiro, 2010 sense) are estimated to credit unions, private and public banks. Thus, the term representing the constant is to Diversion Ratios for all other firms (in this article, these firms are considered the FinTechs) under the authorization of Bacen, other than credit unions, public banks (BB and CEF), or private banks (other Anonymous society – SAs).

The estimates of Diversion Ratios indicate the average possibility that one firm belonging to a given taxonomy increases its share from the share of another taxonomy. However, considering that only the possibility of expanding credit, under assets of another taxonomy, is not enough for financial inclusion to occur, it turns necessary to analyze which structure does, considering times of crisis. Thus, with the series of estimated elasticities, the structural auto-regressive models (SVAR) and the Cholesky decomposition allowed evaluating consumer delinquency's impacts on the lending demand behavior.

In other words, it is possible to simulate the behavior of financial intermediation through a structural innovation, assuming that such economic shock would affect the lending demand

[16] Adding the assets of all credit unions as it happens with banks that add, for each brand, the assets held by all bank branches. What allows the sum of the assets of the credit unions regardless of the brands is the doctrine, which is the same and regulated by law 5.764/1971.

through an unexpected increase in consumer delinquency[17]. At this moment, it sought to identify whether the securities market is a spillover mechanism of the inclusion or exclusion process in each taxonomy. In the present chapter, "financial inclusion" is a term that represents the deadweight loss reduction, and "financial exclusion" is a term that represents the excess burden increase.

The evidence that public and private banks are complementary[18] allows this study strategy to bring the term "crowding-out" from Macroeconomics to the Banking Economy. In the Banking Economy, this term starts to indicate that credit expansion of public banks at adverse times necessarily needs inputs obtained by two[19] means: bank deposits or in the TVM market. The assumption is that deposits are constant in the short term (see the lock-in effect in Silva and Lucinda, 2017), so public banks would only have the high liquidity securities market to deal with credit smoothing in adverse times.

There are two main assumptions within this analysis: [i] in times of crisis, private banks and credit unions will positively change net income with TVM. In contrast, public banks will resort to the securities market, reducing their net incomes or increasing their gross expenses with TVM to compensate for the fall in credit in the downstream market[20] (crowding-out effect). [ii] the delinquency promotes an upward pricing pressure in the loan supply, being responsible for the restriction on credit in all taxonomies.

The first findings partially confirm the second hypothesis because, at adverse times, only private banks are associated with an immediate restriction on supplied loans, remaining with the restriction until the third quarter after the delinquency shock. At the same time, private banks reduce their TVM expenses. However, they do not increase their net incomes.

About public banks, the results also show an association with an immediate restriction of credits and an increase in their expenses with TVM without reducing their net incomes. Thus, as early as the first quarter, public banks softened the credit restriction. However, as Levy Yeyati, Micco, and Panizza's (2007) findings, the public banks cannot permanently expand bank loans, which is useful only as a softener in moments of monetary contraction.

Credit unions, on the contrary, and perhaps because of the presence of cooperative acts, do not restrict loans as an immediate response to the crisis. Instead, the behavior of credit unions

[17] The relationship with COVID-19 pandemic situation is valid as an example of a negative economic shock over financial intermediation.
[18] See the relevant litherature in the first paragraphs of this thesis.
[19] In macroeconomics, the crowding-out effect would be the same as that analyzed for expanding public expenditures that may occur through market financing or by increasing the tax burden.
[20] Contrary movements occur in periods of economic expansion, when public banks reduce their participation in the credit market to the detriment of an increase in the participation of private banks (see Carmago, 2009).

is associated with positive Diversion Ratios. Also, about the first hypothesis, the results for credit union indicates an immediate reduction in the expenses with TVM, being the only taxonomy that increases their incomes in the TVM market after the shock on the delinquency.

In addition to this section, the chapter presents five more parts. The second section discusses the theoretical model, the identification strategy, and the econometric procedures; the third section is dedicated to the presentation and discussion of the data; the fourth section presents the results; the fifth section is dedicated to the discussion of the results and their implications of public policy. Finally, it concludes.

3.1.2 Methodology

3.1.2.1. The Universe Set

To meet the research's objectives of this chapter, first, this section presents the universe set. That is, among others, the relevant market and its three dimensions (product, geographic space, and time). The analyzed data come from the 4010 Report of the Central Bank of Brazil (Bacen). The products are the loans supplied internally (Brazil) by commercial banks (public and private) and credit unions. The period comes from 2008 to 2020.

A caveat needs to be made. One of our objectives is to analyze the trade-off between credit unions, public and private banks. The option by the 4010 Report against the 4040 Report is because the 4040 does not bring the public banks (*Banco do Brasil* and *Caixa Econômica Federal*) as a conglomerate before 2011. Besides, some credit unions do not participate in a complete system (Singular, Central, and Confederation), staying out of cooperative arrangements. The same occurs with small and local banks. Thus, the universe set of this research is best represented by 4010 Report than 4040.

When analyzing the financial inclusion associated with access to credit, an important issue arises regarding banks' market shares and their behavior over time. For example, the policymaker or antitrust regulator may ask how to analyze market share from accounting data if this data does not contain the viable projects that have declined loan applications? Alternatively, how to avert selection bias excluding FinTech because there are no data in the analyzed market?

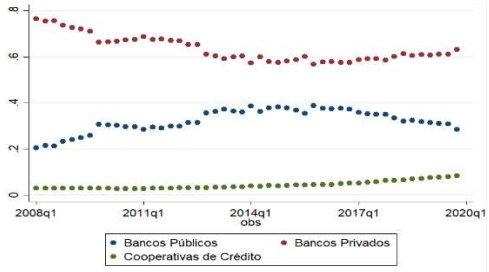
Analyzing each bank's market share through the concentration ratio (CR#) and Herfindahl-Hirschman Index (HHI) without considering the outside good creates a sense that there is no market failure in the analyzed industry. However, as bank loans are, in theory, the "creation of money," the constructs of these indices, considering the total payment options

available on the market (unit of means of payment of the monetary economy known as M4), reveals the existence of market failures in the lending industry (Figure 3.1.1).

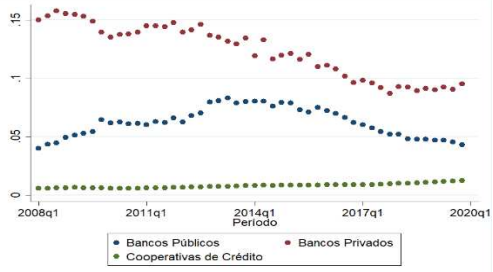
Figure 3.1.1 in Panel A shows that, between 2008-2019, whenever public banks expand their loans, private banks contract it and vice versa. However, this relationship is not seen in the real market, as the credit expansion of public banks may occur at a higher rate than private banks' credit retraction.

Figure 3.1.1. The behavior of the bank concentration disregarding and considering financial inclusion.

Panel A - Plot without Outside-Good



Panel B - Share with Outside-Good



Note: In Panel A, the ratio between the sum of all market parcels of the respective banks on the industry's total loans is calculated. In Panel B, in red, the ratio of loans made by the respective banks about the total means of payment available in each quarter (M4) is calculated).

Panel B considers the calculation according to the procedure proposed by Santos (2018). First, the market share of public and private banks was estimated considering the total payment using the M4 currency unit. Through this procedure, the reader can see that the credit smoothing of public banks was until mid-2014 and that, unlike Panel A, both public banks and private banks began to restrict credit from 2015 onwards.

Thus, the behavior of Panel B, Figure 3.1.1, clarifier that to assess financial inclusion in the credit market, the policymaker or the antitrust regulator must be aware of a broader universe, considering the entire universe in which the bank competes in addition to loans made by financial firms. Mathematically, this broader universe is known as a convex set, where the possibility of credit expansion becomes real when considering all the agents and vectors involved in the market. Empirically, besides the assets registered in the banks, Panel B also considers the currency held by the public and other securities accepted as collateral.

This same convex set makes it possible to analyze and compare the strategies of different financial institutions in an econometric model because it is possible to draw a line between any of the Bacen authorized financial firms without this line to pass out of the set. If this line was statistically significant, Panel A, Figure 3.1.1, might result in selection bias.

As an empirical effect, it is considered in this paper that this line is precisely the mechanism for transmitting the strategies of one financial institution to another, which by hypothesis are the marketable securities (TVM).

3.1.2.2. The Process of Identifying Demand

To estimate the demand considering the outside good, the procedure adopted in this research is an adaptation of Berry's Nested Logit model (1994). The process to be adopted will seek to identify the demand and the Diversion Ratios for public banks, private banks, credit unions, and financial technology companies (fintech).

Thus, be the loan offered by the bank *j* (*j = 1, 2,..., J*) in the quarter *t* (*t=1, 2, ..., T*) by which associates the amount, $q_{j,t}$, to the price set, $p_{j,t}$. These banks are subject to the set of covariates, $B_{j,t}$, that shift their demand curve over time. Now, suppose that the matrix of covariates, $B_{j,t}$, is observed over time and that, as prices, these are linearly independent. In these conditions, the demand curve takes the following forms:

$$\mathrm{d_{j,t}} \equiv \mathrm{d}\left(\mathrm{q_{j,t}}, \mathrm{o_{j,t}}\right) \qquad (1)$$

where $d\left(q_{j,t}, o_{j,t}\right) = ln\ (s_{j,t}/o_{j,t})$. Berry's (1994) procedure used to calculate the market share $(s_{j,t} = e^{u_j}/\sum_{k=1}^{J} e^{u_k})$ from utility $(u_{j,t} = \delta_{jt} + \zeta_{igt} + (1-\sigma)\epsilon_{ij,t})$ supplied by financial firm *j,* under outside good, $o_{j,t}$. Also, $\delta_{jt} = \beta p_{j,t} + x'_{j,t}\alpha + \xi_j$ is the basket of characteristics of financial firm *j* in period *t*. Finally, $o_{j,t} = (1 - s_{j,t})$.

In the original Nested Logit, "for consumer *i*, the variable ζ is common to all products in group *g* and has a distribution function that depends on σ, with $0 \leq \sigma < 1$ (BERRY, 1994, p. 252). However, the procedure adopted in this chapter differs from Berry (1994) since the variable ζ becomes the possible choice for consumer *i,* who is currently in group *g*. That is, while Berry envisions the possibility that the consumer does not have acquired any products, evaluating the possibilities of choosing a particular group by its characteristics. This research proposal envisions that the consumer is already consuming a specific product belonging to group *g* but evaluates the opportunity cost of migrations its consumption to the other groups.

Suppose the consumer, *i*, is acquiring the product *j* belonging to group *g,* and the other groups participate in the same convex set (relevant market). In this case, the other groups are a complement of group *g* in this set. Therefore, computing product $j \in g$ of the market share remains the same as that presented by Berry (1994), namely:

$$\bar{s}_{(j/g),t}(\delta,\sigma) = \frac{e^{\frac{\delta_{j,t}}{1-\sigma}}}{D_g} \quad (2)$$

where the denominator is represented by: $\mathrm{D_g} \equiv \sum_{\mathrm{j}\in \jmath_{\mathrm{g}}} \mathrm{e}^{\frac{\delta_{\mathrm{jt}}}{1-\sigma}}$; and $\{\jmath_{\mathrm{g}} \in \jmath\}$.

However, if consumer *i* is in group *g*, the probability of choosing the exact product *j* depends on all the characteristics of that group not having been exhausted. Otherwise, the probability should be without replacement. Thus:

$$\bar{s}_{g,t}(\delta,\sigma) = \frac{D_g^{1-\sigma}}{\sum_{\kappa} D_{\kappa}^{1-\sigma}}, \text{ where } \{\kappa \subset \jmath \mid \kappa \notin \jmath_{\mathrm{g}}\} \quad (3)$$

Equation (3) numerator remains the same as Berry (1994), but the denominator changes. In the corner solution, $\mathrm{C}_{\jmath}^{\mathrm{g}}$, κ represents the groups complementary to *g*. In this case, the probability is only different from an empty set if the demand changes between existing taxonomies. On the otherwise, in the $\mathrm{C}_{\jmath}^{\jmath_{\mathrm{g}}}$ case the consumer is enjoying the first chosen event.

E.g., suppose two black balls and four blue balls are into a random bag. The $\mathrm{C}_{\jmath}^{\jmath_{\mathrm{g}}}$ occurs in the first event occurrence, per example, one black ball. The first event occurred, but there is still a positive probability that the result will happen again. Now, suppose that the second event registers another black ball. Thus, the probability of the next event being a black ball is zero. In the third event, it just can be a blue ball, representing the $\mathrm{C}_{\jmath}^{\mathrm{g}}$ case. In this research design, the color in the balls represents the taxonomy characteristics observed by demand side. When these characteristics run out, the consumer changes his criteria and chooses another ball (taxonomy).

From both cases of Equation 3, the procedure to reach the demand equation is the same as Barry (1994) indicated. That is, the mean utility levels expression is:

$$ln\left(\frac{s_{j,t}(\delta,\sigma)}{s_{o,t}(\delta,\sigma)}\right) = ln\left(\frac{\bar{s}_{(j/g)t}(\delta,\sigma)\bar{s}_{g,t}(\delta,\sigma)}{s_{o,t}(\delta,\sigma)}\right) \equiv ln(s_{j,t}) - ln(s_{o,t}) = \frac{\delta_{j,t}}{(1-\sigma)} - \sigma ln(D_{g,t}),$$

where $s_{o,t}(\delta,\sigma) = \frac{1}{\sum_{\kappa} D_{\kappa}^{1-\sigma}}$ (4)

To find the value D_g, just divide the Equation (*3*) by and $s_{o,t}(\delta,\sigma)$, take the Neperian logarithm of this division that finds $ln(D_{g,t}) = [ln(s_{g,t}) - ln(s_{o,t})]/(1-\sigma)$. Replacing this

relationship in Equação (*4*), isolating for the odds ratios, and considering that j contains Public Banks (1), Private Banks (2), Credit Unions (3) and FinTech, the identification of demand is:

$$ln(s_{j,t}) - ln(s_{o,t}) = \beta p_{j,t} + x'_{j,t}\alpha + \sum_{j=1}^{3} \sigma_j ln(\bar{s}_{(j/g),t}) + \xi_{j,t} \qquad (5)$$

While the nests of the original Nested Logit will indicate the plus variation in the probability that a consumer chooses the niche *g* about a benchmark, Equation (5) is the probability of a company expanding its characteristics concerning another group to avert that a particular consumer *i* migrate[21]. In our balls example, this behavior is like a determined taxonomy (supposing a taxonomy represented by black ball) putting a blue ball with a stripe containing the word that says "Black" in the random bag. Not per hour, the variation of the group's market κ share concerning j_g, the $\left[ln(\bar{s}_{(j/g),t})\right]$ finds support in the cannibalization[22] ratio proposed by Farrell and Shapiro (2010). That is, the expansion may be a false merger or acquisition between the taxonomies because, in truth, despite the write says black, the ball is blue. Thus, we will call the adapted Berry's (1994) Nested Logit as Cannibal Logit.

Empirically, in the banking case, this occurs when credit unions, private or public banks launch their FinTech. Alternatively, when private banks provide solidarity loans (non-profit) as a gateway to developing communities. In general, any case in which something predetermined starts to assume characteristics of other predetermined points can be detected by this estimation of Diversions Rations.

- the 1% increase in the Diversion Ratio is associated with x% of cannibalization of another taxonomy (σ_j is positive);
- the -1% reduction in the Diversion Ratio indicates that the analyzed taxonomy lose x% for the complementary taxonomy (σ_j is negative); or
- not cannibalization ratios when coefficients σ_j are statistically insignificant.

The last case may occur when the taxonomy characteristics do not run out, when the competitive case between taxonomies is in balance (numerator and denominator varies in the same proportions), or when the numerator is equal to zero. Thus, the correct interpretation depends on the previous framework analysis.

Following Berry (1994), the price elasticity of demand comes through the following Equation:

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[21] For example, a commercial bank opens a *fintech* in order to get closer to this new category of loans.

[22] Regardless of whether a merger occurs or not. It simply represents competition between niches of different doctrines: profit, non-profit and social demand.

$$e_{j,t} = \beta_t\left(1 - s_{j,t}\right) \quad (6)$$

Equation (*6*) is the well-known Logit price elasticity of demand. The Appendix brings the proof that in the probability without replacement, the second term of the Canibal Logit is equal to zero. The logic behind this analysis is "short-sighted" because, in the Multinomial Logit, the choices should be mutually exclusive. Thus, even though the ball is with a word that says black, in truth, it is blue, making the second term of Cannibal Logit an empty set and zero on the photography in time *t*. On the other hand, if different from zero, elasticities would be counted with double counting.

3.1.2.3. Econometric Procedures

Berry (1994) indicated the Instrumental Variable (IV) econometric procedure to estimate Equation (*5*). In this sense, the IV procedure adopted in this article is the Ordinary Least Squares to estimate the first stage and the Quantile Regression Model to estimate the second stage. This relationship was necessary because the distribution of firms is asymmetric.

There were 1,533 credit unions in the data, 189 private banks, and only two public banks. However, only public banks had more market share than all credit unions combined (Figure 1 of the previous section).

Thus, the objective of estimating the first stage, in the case of price, was to seek only not correlated instruments with the second stage error term that can shift the supply, identifying the demand in the second stage estimates. In the case of Diversion Ratios, the objective of the first stage was to correct the endogeneity problem seeking only not correlated instruments with the second stage error term, without shifters.

The research design predicts to transform all variables in *Z-score* before estimating the first stage. However, first, the variables went through the nominal adjustment process. After, all variables turned to the logarithm scale. These processes aimed to capture the average effects of competition on prices and Diversion Ratios in the first stage, considering a normal distribution of all variables.

Even if the variables are standardized, the result predicted in the second stage would have an asymmetric distribution. As the Diversion Ratios of the three taxonomies were in the same model, the predicted data will contain many zero in the observation that does not refer to the particular type of firm. For example, in the Diversion Ratio column of credit unions, the lines with observations for the Diversion Ratio of public banks were represented by zero. Thus,

when estimating on average, zeros had a substantial weight on the coefficients down. Therefore, estimating the second stage for the median is expected to find estimates without this bias on the coefficients.

The models will include the interaction between the Diversion Ratios and the price variable with a dummy representing each quarter. Briefly, the Equations (7) set will make up the first stage, where each Equation will be estimated separately. The Equação (*8*) represents the model in the second stage.

$$\begin{cases} \ln(p_{j,t}) = \theta_0^{fs1} + \ln\left(y\_ser_{j,t}^{'}\right)\theta_1^{fs1} + \ln\left(class\_loan_{j,t}^{'}\right)\theta_2^{fs1} + \ln\left(liab_{j,t}^{'}\right)\theta_3^{fs1} + \varepsilon_{j,t}^{fs1} \\ \ln(D_{go,j,t}) = \theta_0^{fs2} + \ln\left(y\_ser_{j,t}^{'}\right)\theta_1^{fs2} + \ln\left(l\_clas_{j,t}^{'}\right)\theta_4^{fs2} + \varepsilon_{j,t}^{fs2} \\ \ln(D_{coop,j,t}) = \theta_0^{fs3} + \ln\left(y\_ser_{j,t}^{'}\right)\theta_1^{fs3} + \ln\left(l\_clas_{j,t}^{'}\right)\theta_4^{fs3} + \varepsilon_{j,t}^{fs3} \\ \ln(D_{po,j,t}) = \theta_0^{fs4} + \ln\left(y\_ser_{j,t}^{'}\right)\theta_1^{fs4} + \ln\left(l\_clas_{j,t}^{'}\right)\theta_4^{fs4} + \varepsilon_{j,t}^{fs4} \end{cases} \quad (7)$$

$$d_{j,t} = \alpha_0 + \beta\ln(\hat{p}_{j,t}) + \sigma_1\ln(\widehat{D}_{go,j,t}) + \sigma_2\ln(\widehat{D}_{po,j,t}) + \sigma_3\ln(\widehat{D}_{coop,j,t}) + \sum_{t=1}^{T-1}\varphi_t E_t + \sum_{t=1}^{T-1}\sigma_{1,t}E_t\widehat{D}_{go,j,t} + \sum_{t=1}^{T-1}\sigma_{2,t}E_t\widehat{D}_{po,j,t} + \sum_{t=1}^{T-1}\sigma_{3,t}E_t\widehat{D}_{coop,j,t} + \sum_{t=1}^{T-1}\beta_t E_t\ln(\hat{p}_{j,t}) + \varepsilon_{j,t} \quad (8)$$

where the variables with hat in Equation (*8*), are the estimates of the dependent variables of the first stage.

In Equation (*8*), these variables were estimated for firms keeping fixed periods (quarters), represented by the binary variables given by E_t. The parameters σ_j are coefficients representing the base period (March 2008), the coefficients $\sigma_{j,t}$ are the quarterly variations concerning the base period. Similarly, there is the evaluation of the coefficient β and β_t that make up the calculations of price elasticity of demand (Equation *6*) for each period.

The instrumental variables were chosen based on the validity of the Sargan, F Statistics, Underidentification, and Ramsey RESET tests.

To correct the error in the matrix of variance and covariance estimated by the quantile regression model in Equation (8), the *Huber/White/Sandwich* procedure was used (HUBER, 1967; WHITE, 1980). Also, the strategy considers performing the following test to validate the results: the Sargan Tests, Weak Identification of the Instruments Test (Wald), Identification of the System (Cragg-Donald-Wald), and validity of the specification (Ramsey Reset).

Obtained the price-elasticities of demand, three impulse response analyses, through the structural vector autoregression (known as SVAR or Structural Var), were estimated individually to evaluate the response of the price elasticity of demand through an innovation shock in the delinquency of consumers.

Given the estimation of the SVAR, the econometric procedure performed the Supreme Wald tests of structural breakage to evaluate the premise that the times series are stationary.

The specification was the same as the SVAR. The procedure also performed the Augmented Dickey-Fuller for unit-root and the co-integrating rank test between pairs of times series.

The structural shock was made in consumer delinquency. The data present each firm's observations that make up public banks, private banks, and credit unions. However, these variables are considered at inner means in the impulse-response, with a cutoff of 25% up and down.

The econometric procedure adopted is Cholesky's identification, which is well documented in the literature (e.g., Amisano & Giannini, 1997; Lütkepohl, 2013; Pfaff, 2008). The following Equations represent the estimated system:

$$\begin{cases} A(I_K - A_1L - A_2L^2)e_t = A_1v_{1,t} = B_1r_{1,t} \\ A(I_K - A_1L - A_2L^2)f_t = A_2v_{2,t} = B_2r_{2,t} \\ A(I_K - A_1L - A_2L^2)g_t = A_3v_{3,t} = B_3r_{3,t} \end{cases} \quad (9)$$

$$\mathrm{A} = \begin{bmatrix} 1 & 0 & 0 \\ . & 1 & 0 \\ . & . & 1 \end{bmatrix} \text{ and } \mathrm{B} = \begin{bmatrix} . & 0 & 0 \\ 0 & . & 0 \\ 0 & 0 & . \end{bmatrix} \quad (10)$$

In Equation (*9*), L represents the lag operator, $v_{i,t}$ represents the technological shock, with a covariance matrix ℵ, and the vector $r_{i,t}$ is a set of exogenous and independent error terms known as structural innovations. Also, A_i *and* B_i are non-singular matrices with imposed restrictions that will ensure the identification of the system and the non-contemporary relationship of one variable over the other. The Equation in the reduced form, as presented in Equation (*9*), can be rewritten as $v_{i,t} = A_1^{-1}B_1r_{1,t}$, and the covariance matrix is $\aleph = v_{i,t}v'_{i,t}$.

The lag-order selection statistics for SVAR are through the bank loan cycle for each bank taxonomy. The cycle was defined by the quarters according to the order test of lags using the Akaike, Schwarz, and Hannan and Quin criteria.

Finally, three systems were estimated, each for one bank taxonomy. The used times series are the price elasticity of demand, securities (according to niches j), and the observed delinquency by the respective niches of banks. The times series are in quarters.

Two models were estimated, the first considering net income from securities of high liquidity (TVM) and the second considering the gross expenditure with TVM. The analysis of both models considers the assumption that net income can rise through a positive change in gross revenue, maintaining the expense constant, or an adverse change in gross expenditure, *ceteris paribus*. Thus, the analysis of the models becomes complementary.

When matrix A of Equation (*10*) has a lower diagonal, the order occurs first in the provision of doubtful credits, following to the net income (model 1) or gross expense (model 2) obtained with TVM of the respective type of bank and finally in the price elasticity of the demand. The model will also be analyzed in upper diagonal where the order occurs first in price elasticity of demand, flowing to net security income (model 1) or gross security expenditure (model 2), and, finally, to consumer delinquency. These two orders seek to find the Granger causality sense.

Finally, since the price elasticity of demand is, by definition, a negative value, to facilitate the visual analysis, the research design considers the analysis of this variable in absolute values. Thus, after structural shock, a positive response of price elasticity is associated with an increase in financial exclusion, and a negative variation is associated with a reduction in deadweight loss.

3.1.2.4. Descriptive Data and Statistics

The econometric processes presented in subsection 3.*1.2.3* contain two parts (demand estimation and later structural shock analysis). However, the data that went through these estimates has undergone some transformations. This section presents these transformations, explaining the reason and objective of each step adopted in the variables. The follows of this section's paragraphs are in the order in which each transformation occurs in the routine.

Initially, all variables were corrected using the Broad Consumer Price Index (IPCA, the acronym in Portuguese), considering December 2019 as the basis. The research follows to compute variables representing the Diversion Ratios and the dependent variables. Later, because the estimated model is in the log-log structure, all variables were passed to the logarithmic scale, considering the Napierian logarithm.

When comparing the different financial institutions, an apparent problem arises because each firm has a different objective function (social, non-for-profit, and profitable). On the other hand, all firms are under the same Central Bank patterns (4010 reports). However, this is not enough to avoid statistic comparison problems between niches. Thus, all variables used in the first stage of demand estimation are into Z-Score's indices. In the second stage, de research design predicts this transformation only the variable $d_{j,t}$. Table 3.1.1 presents the descriptive statistics of the variables used in estimating demand and the structural model's impulse response.

Table 3.1.1. Descriptive statistics of the variables used to estimate the demand curve and for the analysis of Impulse Response.

Variables used in demand analysis					
Variables / Scale	Obs.	Average	Standard Deviation	Min	Max
Outside - Good (%)	82,752	0.99	0.00	0.94	1.00
Share in relation to M4 (%)	82,752	0.01	0.00	0.00	0.05
$d_{j.t}$ (Logarithmic scale)	61,946	0.00	1.00	-8.64	4.41
Diversion Ratio - Private Bank	5,807	0.00	1.00	-5.92	2.30
Diversion Ratio - Public Bank	96	0.00	1.00	-2.95	1.12
Diversion Ratio - Coop Credit	56,043	0.00	1.00	-10.17	2.87
Loans (Logarithmic Scale)	61,946	16.08	2.38	-3.91	26.19
Price (Logarithmic Scale)	61,816	0.00	1.00	-20.32	17.13
Bank liabilities (Logarithmic Scale)	49,989	0.00	1.00	-5.85	3.70
Customer income (Logarithmic Scale)	50,609	0.00	1.00	-5.70	3.82
Class (Logarithmic Scale)	62,252	0.00	1.00	-48.53	0.65
Variables used in Impulse Response analysis					
Variables / Scale	Obs.	Average	Standard Deviation	Min	Max
Net Income – TVM of Public B.	48	24.72	2.76	22.56	35.07
Net Income – TVM of Private B.	48	18.54	2.76	16.44	28.80
Net Income – TVM of Credit Unions	48	12,11	2.93	9.61	23.39
Gross Expenditure - TVM of Public B.	48	22.19	0.74	20.42	23.59
Gross Expenditure – TVM of Private B.	48	16.17	0.64	14.83	17.38
Gross Expenditure - TVM of Credit Unions	48	8.00	0.88	5.80	10.51
Provision Public B.(Logarithmic Scale)	48	25.52	2.78	23.19	35.80
Provision Private B. (Logarithmic Scale)	48	18.88	2.68	16.95	28.73
Provision Credit Unions (Logarithmic Scale)	48	14.55	2.94	11.82	25.63

Source: Research data. Note: All variables are in the December 2019 value considering the IPCA. Variables with a standard Diversion equal to 1 are Z-Score indices. The Outside good, Share about the M4, and the Loans are not in Z-Score and were presented to demonstrate their distribution before the transformations. The variables presented in the Impulse Response analysis were also not normalized because the transformation of these is performed inside the model. All variables used the data contained in the Report 4010 of the Central Bank of Brazil (Bacen). The M4 was also obtained from the Bacen. The Loans is represented by code COSIF 31000000. The Provision Variable is represented by code COSIF 16900008.

After the first stage, the prediction of Diversion Ratios (or cannibalization Ratios) presented *missing values* in the observations referring to the other niches. The research design indicates that the data in the second stage needs to be a convex set. Thus, these missing values need to be turned into zeros when not belonging to their taxonomies. For example, the observations of the estimated variable for the cannibalization of credit unions were transformed to zero when the respective observations refer to public banks or private banks. The same was the case for public banks about the observations of credit unions or private banks, and private banks about credit unions or public banks.[23]

The variable *Bank Liabilities* represent the financing capacity of banks that are the time deposits maintained by banks in their service portfolio, different from the cash deposits representing the variable *Customer Income*. The *Class* represents the percentage of loans classified by Bacen being of at least quality *B* (on a scale of nine risk categories that goes from

[23] This explains why the median is used and not the average as a measure of central trend.

Aa to *h*, being *Aa* the categories with the lowest risk and *h* the categories with the highest risk)[24]. About the total loans of the financial institution in the *quarter t*. The price is the ratio between income stemming from loans and total loans for each quarter.

Finally, the variables used in the Impulse Response analysis represent the inner mean, considering the upper and lower limit of 75% and 25%, respectively, of all observations within each quarter. From this inner mean, possible firms with accountability problems or firms that act upstream, distorting the behavior of variables in the downstream market, were filtered.

3.1.3 Findings

This section is divided into two parts. The first part treats the evolution of the price elasticity of demand and the cannibalization ratios analysis between 2008 and 2019. In this first analysis, there are considerations about the taxonomies and the possibility of financial inclusion or exclusion. From the demand analysis, the results of the Impulse Response analysis are presented, considering the SVAR model. In this second analysis, the evaluation is on the price response after a shock on delinquency, measured by the provision for doubtful credit (COSIF Account 16900008).

3.1.3.1. Analysis of Demand and Financial Inclusion

The Ramsey test was performed for each of the evaluated quarters, considering *k=3*. Only the first quarter of 2008 is marginally statistically significant (presented in table 3.1.2). The parameters for the other quarters do not reject the null hypothesis (Table A3.1.6). According to Huang et al. (2008), when Berry's (1994) model is poorly specified, the bias of the coefficients does not tend to be higher than 10%. In this research, despite the Ramsey test being satisfactory, these bias margins also are considered.

Regarding instruments utilized, these also seem to be valid because the null hypothesis of the Sargan-Hansen test is not rejected, indicating that the excluded instruments are correctly excluded in the restricted model. Finally, the instruments do not seem to be weak, as the statistics of Cragg-Donald reject the null hypothesis.

After considering the validity of the estimation, we can analyze the results. In this sense, the first point to be considered is that the price elasticity of demand is negative. The values for each period are negative and statistically significant, varying only in their dimension, maximum

[24] For more details on classes and risks, you can check the Financial System Standards Manual (BACEN, 1964)

and minimum points (Figure 3.1.2). The complete results are in Table A3.1.1, in the Appendix section of this article.

Table 3.1.2. Instrument identification and demand specification test.

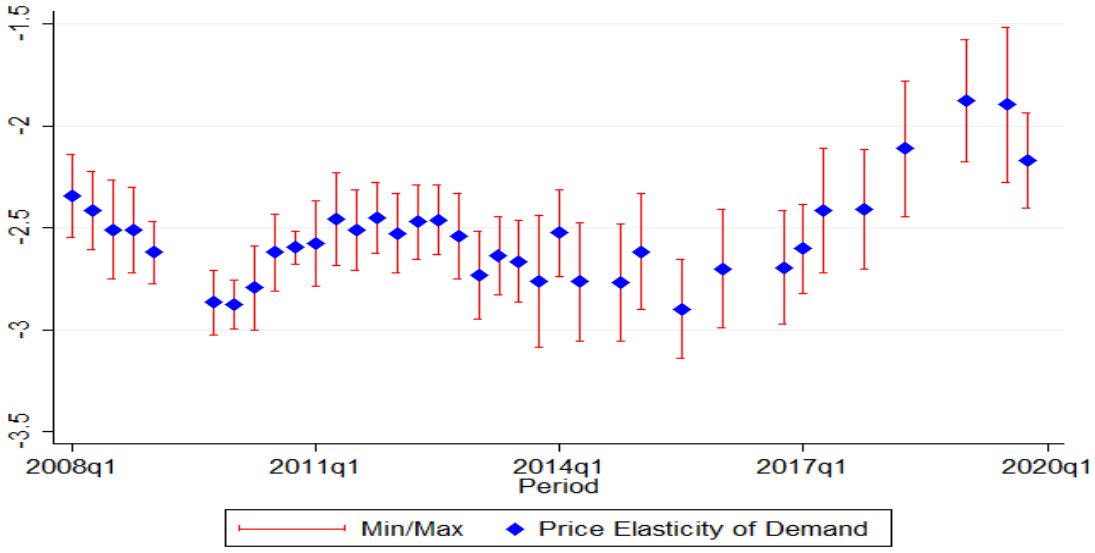
Tests	Obs	χ^2 *or F*	P-Val
Sargan-Hansen	45,735	0.00	1.00
Cragg-Donald (Wald) - F Statistics	45,739	3,795.64	0.00
Diversion Ratio Privat Bank- Statistics F	45,739	2.432.01	0.00
Diversion Ratio Public Bank - Statistics F	45,739	201.53	0.00
Diversion Ratio Coop, Credit - Statistics F	45,739	16,908.01	0.00
Price of Loans - F Statistics	45,739	1,168.59	0.00
Cragg-Donald (Wald) - Subidentification	45,739	11,387.86	0.00
Ramsey RESET (*k = 3*)	45,739	2.78	0.10

Source: Research Result. Note: Cragg-Donald's F statistic is the well-known Weak Identification test, which indicates the maximum relative bias of instruments under the actual value of single endogenous variables. The bias found is less than 5% for all variables. Stock and Yogo's (2005) critical values are 16.85 for relative bias of 5% and 10.27 for relative bias of 10%. When the values of Cragg and Donald (1993) presented in the chi-square column are higher than the critical of Stock and Yogo, the relative bias is less than the respective range.

Figure 3.1.2 shows that, in the mean, the demand for downstream loans is elastic throughout the analyzed period. These findings indicate that market conduct is closer to an oligopoly. However, the variation in the price elasticities indicates that the market has become more competitive after 2015. Thus, this behavior is associated with monopolistic competition. This relationship opposes the elasticities degree presented by Nakane, Alencar, and Kanczuk (NAK, 2006). The main difference between the present findings and those studies is the outside-good considerations. NAK (2006) seeks one proxy to person demand, while here, the analysis is for each monetary unity.

The analysis presented here tends to be more realistic, as the combination found by NAK (2006) has little variability and can be challenged given the different combinations of accounts among bank branches that people can hold. In the monetary unity analysis, we have a comprehensive analysis of demand in each bank, considering their currency creation paper and the interactions with the demand. Thus, the price elasticities here are most realistic than price elasticities from that work paper.

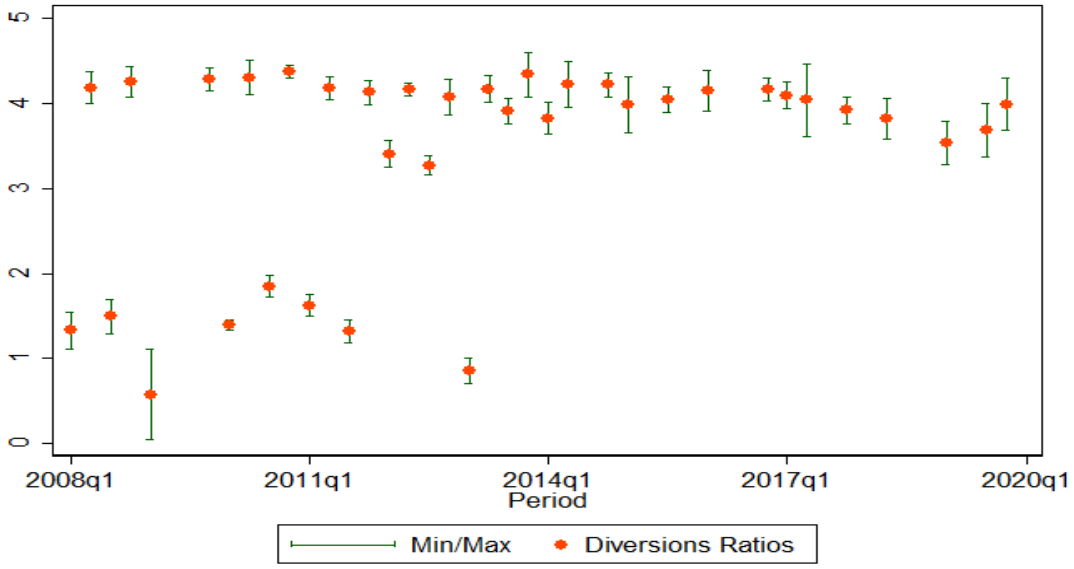
Figure 3.1.2. Evolution of demand price elasticity between 2008 and 2019.



Source: Research Result. Note: hypothesis tests and their statistics can be found in Table A3.1.1 in the Appendix. The minimum and maximum values represent the minimum and maximum elasticities of each analyzed period.

The private banks' cannibalization ratio is statistically significant at 1% and remained for the analyzed period (Table A3.1.2). These findings indicate that when private banks expand lending supply by one standard deviation (SD), demand for loans shows a positive change of about 3.99 standard deviations, above the benchmark SD (FinTech), in December 2019. Figure 3.1.3 shows the evolution of the diversion ratio of private banks:

Figure 3.1.3. Diversion Ratios of private banks between 2008 and 2019

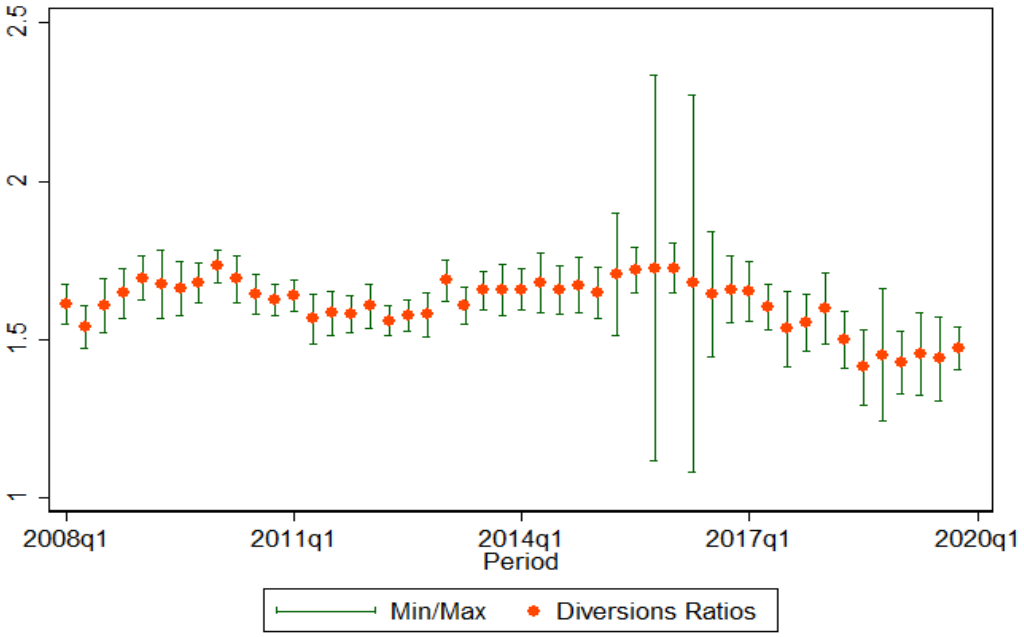


Source: Research Result. Note: hypothesis tests and their statistics can be found in Table A3.1.2 in the Appendix. The minimum and maximum values represent the minimum and maximum elasticities of each analyzed period.

The results for private banks show their flexibility to assume the characteristics of other taxonomies, be they social, techs, or non-profitable contents. In addition, when the other taxonomies reduce their credit, the private bank may increase its supply by 3.99 SD above the constant (FinTech). However, the association of these findings with Panel B (Figure 3.1.1) shows that, for the whole analyzed period, the performance of private banks is related to a restriction of credit in the downstream market. Thus, although private banks cannibalize the demand of public banks, credit unions, or FinTech, in total, this relationship occurred in the context of credit restriction.

The behavior of cannibalization ratios of credit unions is shown in Figure 3.1.4.

Figure 3.1.4. Diversion Ratios of credit unions between 2008 and 2019



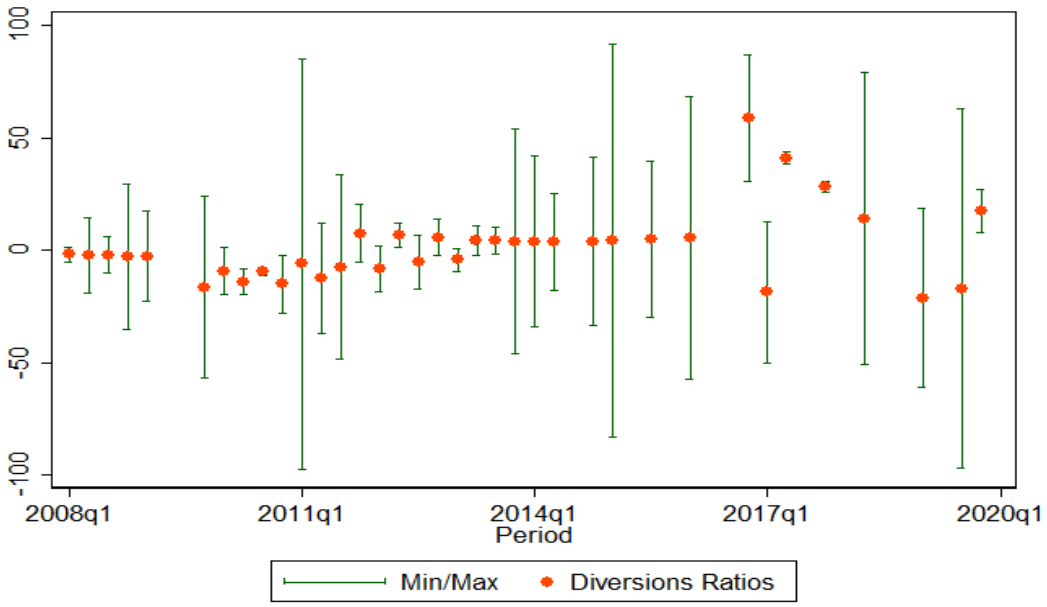
Source: Research Result. Note: hypothesis tests and their statistics can be found in Table A3.1.3 in the Appendix. The minimum and maximum values represent the minimum and maximum elasticities of each analyzed period.

According to the analysis of the entire period, when credit unions increase their cannibalization ratios by one standard deviation, compared to other financial institutions, about 1.47 standard deviations from their median loans were injected above the constant ratios into the economy in the last quarter of 2019. This result means that given a reduction in the verticalization degree of the product, credit unions were able to expand their loans under its complementary taxonomies by approximately 1.47 standard deviations, about FinTech, in the last quarter of 2019.

Throughout the period, the diversion ratios of credit unions were positive. Thus, by associating the results of Figure 3.1.4 with Panel B of Figure 3.1.1, it is possible to conclude that the period's credit unions' performance is slightly associated with the financial inclusion framework.

Finally, evaluating the cannibalization ratios of public banks, we note that they present statistically non-significant ratios (Table A3.1.3 in the Appendix of this article) or are awfully close to zero (Figure 3.1.5). This result indicates that most of the time, both the numerator (variation of loans from these banks) and the denominator (variation of loans from other taxonomies) presented the same proportion of variations and, in the same sense, making them non-significant in most quarters analyzed. For example, if public banks decrease their lending by 1% and other taxonomies (in the denominator) decrease to 1% in the same quarter, the variation is statistically insignificant.

Figure 3.1.5. Diversion Ratios of public banks between 2008 and 2019



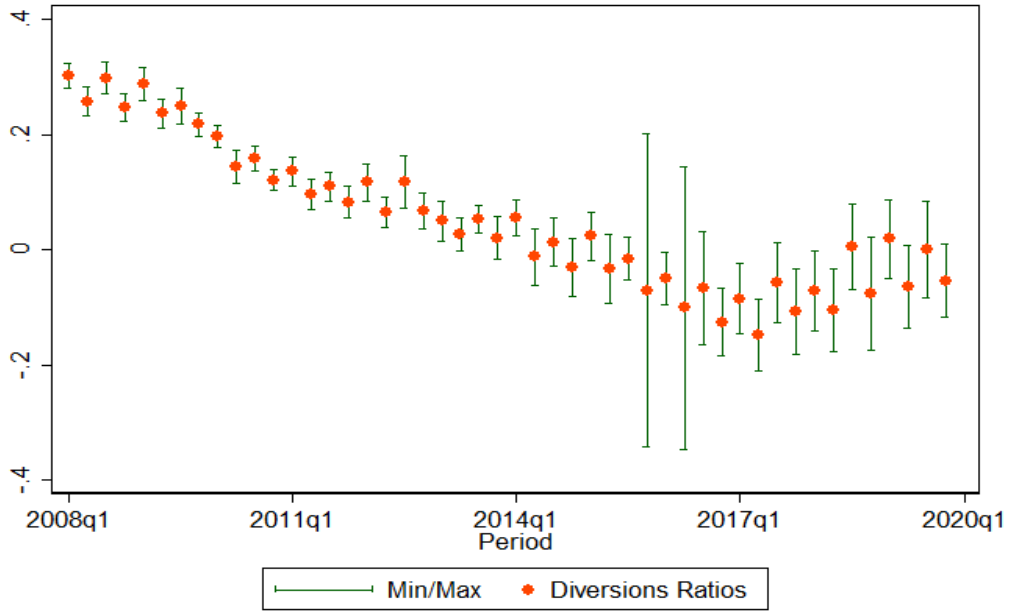
Source: Research Result. Note: hypothesis tests and their statistics can be found in Table A3.1.4 in the Appendix. The minimum and maximum values represent the minimum and maximum elasticities of each analyzed period. Specifically for public banks, the periods shown are limited to a minimum and maximum of 100 standard Diversions.

In addition, only two banks are operating in the downstream market: *Banco do Brasil* and *Caixa Econômica Federal*. Each of these banks presents its social demand functions, but different functions among themselves. Thus, another hypothesis of non-statistical significance may be associated with contradictory conducts that make the numerator equal to zero, regardless of the variation in the denominator. In this case, the statistically significant results

may be associated with periods in which both banks' conduct was coordinated in the same sense. However, considering panel B of Figure 3.1.1, these variations (aggregated for two public banks) were not null in the period. Thus, the first explications for the public banks are more realistic to present analysis.

Finally, the diversion ratios of technology companies are evaluated in Figure 3.1.6.

Figure 3.1.6. Diversion Ratios of technology companies (FinTech) between 2008 and 2019



Source: Research Results. Note: hypothesis tests and their statistics can be found in Table A3.1.5 in the Appendix. The minimum and maximum values represent the minimum and maximum elasticities of each analyzed period.

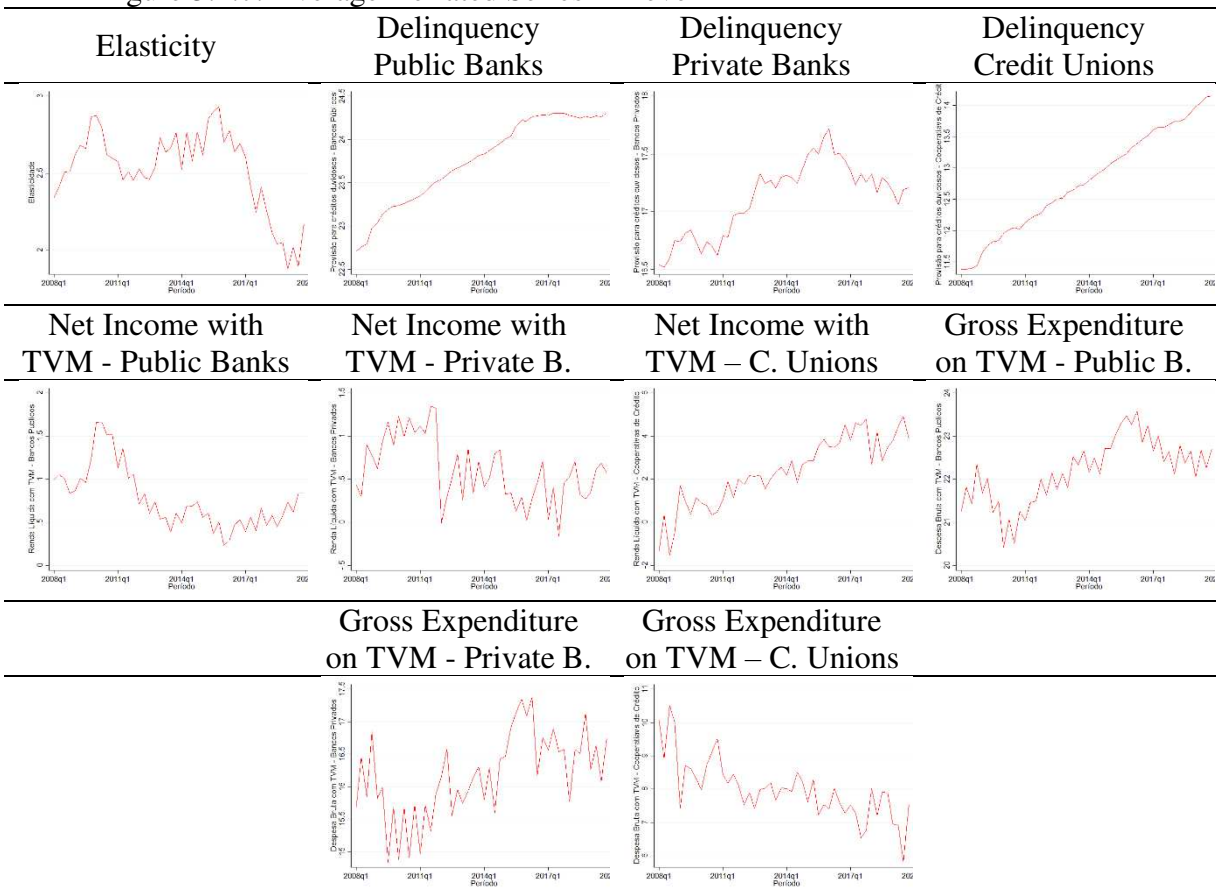
The estimated results for technology companies are present in Table A3.1.5 in the Appendix. Unfortunately, there is no data available from these companies between 2008 and 2019 to assess M4. Thus, we indicate that these institutions' ratio of financial insertion in 2008 was 0.30 standard deviation. It fell to close to zero in 2019, having its last statistically significant effect in the fourth quarter of 2018, with a negative cannibalization ratio of 0.10 standard deviation.

3.1.3.2. Delinquency and Financial Inclusion

The previous findings identified financial institutions' niches (taxonomies) that can expand loans under other taxonomies in addition to the downstream demand elasticity in this market. Now, the author seeks to answer whether financial inclusion or exclusion (the price elasticity of demand) has any contemporaneous relationship with delinquency, evaluating the two hypotheses assumed in the introduction of this chapter.

Following the research design, Figure 3.1.7 shows the evolutions of times series in the logarithmic scale at December-2019 prices.

Figure 3.1.7. Average Deflated Series in Level



Source: Research Result. Note: The values presented represent the mean inner of each analyzed niches, except the elasticity that is the internal average of the estimated elasticity s. For the internal average, a higher and lower cut of 25% was considered. The horizontal axis represents the period in quarters (2008 to 2019). The vertical axis represents the variables.

The values in table 3.1.3.7 represent the behavior of the inner mean of the selected series, considering a higher and lower cutoff of 25%. A critical point in these series is their stationarity conditions. Looking closely, it appears that in addition to being non-stationary, some of them contain structural breaks. What is more, they do not seem to have the same short-term or long-term trends (co-integrated). Thus, first, to increase the validity of the times series' structural break on their average trend, the Wald Supreme test for structural breakage was performed for all variables. This result is present in Table 3.1.3.

Table 3.1.3. Structural breakage analysis of variables on the logarithmic scale.

	Type of differentiation	S. Wald	Sig.	P-value	Estimated Date of Structural Breakage
Elasticity	level	93.39	***	0.00	Q3 2017
Expense G	level	77.24	***	0.00	Q2 2013
Income TVM G	level	97.14	***	0.00	2012 Q1
Delinquency G	level	146.96	***	0.00	Q2 2013
Expense P	level	41.17	***	0.00	2014 Q4
Income TVM P	level	17.77	***	0.00	Q3 2015
Delinquency P	level	154.35	***	0.00	Q3 2012
Expense C	level	37.10	***	0.00	2011 Q4
Income TVM C	level	93.71	***	0.00	2011 Q4
Delinquency P	level	134.15	***	0.00	Q2 2014

Source: Research Result. Note: the test was performed considering the period between the first quarter of 2008 and the fourth quarter of 2019. A sub-sample was taken comprising the first quarter of 2010 to the first quarter of 2018. Each variable was evaluated separately. P refers to private banks, G refers to public banks, and C refers to credit unions. *** p<0.01; ** p<0.05; * p<0.1.

The result presented in Table 3.1.3 confirms the suspicion that all variables considered for the analysis of SVAR may have at least one structural break that may implicate bias in the results. Therefore, all series were calculated in their first difference, and a new structural breakage test was realized. The results of these second tests are present in Table 3.1.4.

Table 3.1.4. Structural break analysis of variables in differences

variable	Type of differentiation	S. Wald	Sig.	P-value	Estimated Date of Structural Breakage
Elasticity	First Difference	2.70		0.61	-
Expense G	First Difference	0.69		1.00	-
Income TVM G	First Difference	0.22		1.00	-
Default G	First Difference	22.55	***	0.00	2016 Q1
Default G	Second Difference	0.48		1.00	-
Expense P	First Difference	0.29		1.00	-
Income TVM P	First Difference	0.16		1.00	-
Default P	First Difference	1.66		0.87	-
Expense C	First Difference	0.52		1.00	-
Income TVM C	First Difference	0.23		1.00	-
Default C	First Difference	1.05		1.00	-

Source: Research Result. Note: the test was performed considering the period between the first quarter of 2008 and the fourth quarter of 2019. A sub-sample was taken comprising the first quarter of 2010 to the first quarter of 2018. Each variable was evaluated separately. P refers to private banks, G refers to public banks, and C refers to credit unions. *** p<0.01; ** p<0.05; * p<0.1.

Table 3.1.4 shows that after passing through the first difference, only the delinquency of the public banks continued with a statistically significant structural breakage in the first quarter of 2016. Thus, this variable was worked in the second difference, which proved to be without structural breakage.

Finally, to ensure that all variables became stationary, the Augmented Dickey-Fuller test was also performed. The test result is present in Table 3.1.5:

Table 3.1.5. Analysis of the series' unit-root.

Variable	Lags	Test	Sig
Elasticity	1	-4.15	***
Expense G	1	-2.97	**
Income TVM G	1	-3.17	**
Default G	1	-8.54	***
Expense P	1	-5.19	***
Income TVM P	1	-4.63	***
Default P	1	-4.55	***
Expense C	1	-7.45	***
Income TVM C	1	-3.56	***
Default C	1	-4.80	***

Source: Research results. Note: the test was performed considering the period between the first quarter of 2008 and the fourth quarter of 2019. All variables were tested for only one lag. Each variable was evaluated separately. P refers to private banks, G refers to public banks, and C refers to credit unions. *** p<0.01; ** p<0.05; * p<0.1. The null hypothesis is that the variable contains a unit root.

Based on the relative guarantee that the variables became stationary after the differentiation process, it is left to the analysis of the structural VAR, always considering the technological shock of one standard deviation in the delinquency time series. Together with the Matrix of Contemporaneous Impacts, the estimated Cholesky decomposition also is evaluated. The latter represents the immediate impact decomposed for each series, according to the pre-restriction.

Thus, two models are analyzed for each taxonomy. In the first model, the hypothesis raised considers that delinquency does not suffer contemporaneous shocks given by percentage variations in net income with Securities (RLTVM) or elasticity. RLTVM may suffer contemporaneous influence from consumer delinquency, but it does not suffer from elasticity. Finally, elasticity can be influenced simultaneously by RLTVM and delinquency, but it does not influence contemporaneously any of the other variables. The second model follows the same sequence as the first. However, it replaces net income with gross securities expense (DBTVM). Thus, both models bring complementary results.

Tables 3.1.6, 3.1.7, and 3.1.8 show the results for public banks, commercial banks, and credit unions, respectively. To analyze the Granger causality existence, the inverse of variables (upper diagonal matrix A) for these two models are present in the Appendix of this article. The objective of these analyses is to bring a robustness test for the present findings.

From these considerations, now, it is possible to start the analysis of SVAR results. Table 3.1.6 shows that the contemporaneous impact of delinquency on elasticity reflects a negative and statistically significant public banks elasticities of demand. However, from Cholesky's Decomposition, it is perceived that shock in the delinquency of public banks produces a positive initial impact on elasticity, indicating that an increase in the delinquency of public banks promotes an increase in deadweight loss. Also, the shock of delinquency on net

income is not statistically significant, indicating that the income with TVM is a mechanism between delinquency and financial inclusion or exclusion. On the other hand, delinquency seems to affect the gross expenditure positively (Decomposition Matrix of Model 2), indicating that the expenses with TVM may be a mechanism between delinquency and financial inclusion or exclusion.

Table 3.1.6. Contemporaneous Impact Matrices and their Cholesky Decomposition – Public Banks

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	$0.02***$	0	0	$Eq.I$	0.02	0	0
	$Eq.R$	1.02	$0.12***$	0	$Eq.R$	-0.02	0.12	0
	$Eq.E$	$-2.05***$	-0.10	$0.10***$	$Eq.E$	0.04	-0.01	0.10
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	$0.02***$	0	0	$Eq.I$	0.02	0	0
	$Eq.D$	$-5.22***$	$0.16***$	0	$Eq.D$	0.10	0.16	0
	$Eq.E$	$-2.35***$	0.04	$0.10***$	$Eq.E$	0.04	-0.01	0.10

Source: Research results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 15 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

In the end, when evaluating Cholesky's Decomposition for both (model 1 and model 2), the magnitude of the relationship between delinquency and elasticity is practically the same.

An interesting case for public banks occurs in the inverse analysis (Table A3.1.9). In both analyses, delinquency affects the financial inclusion or exclusion (elasticity) as the elasticity affects the delinquency with the same sign. These findings show that there is a correlation between these two variables. However, the TVM expenses react meaningfully only to delinquency. That is, the variation of price elasticities of demand does not significantly affect TVM expenses of public banks. This result shows a possible temporal mechanism in the Granger sense, confirming the TVM expenses as a mechanism in the public bank case. Also, the expenditure with TVM does not affect the elasticity separately but affects contemporaneously[25] with the delinquency. That is, the expenditure with TVM only affects the price elasticity of demand when it is motivated by delinquency.

[25] Remembre that $v_{i,t} = A_1^{-1}B_1 r_{1,t}$, thus *t* calculate the inverse of A_1 includes the TVM expenses.

The findings presented in Table 3.1.7, more specifically the Cholesky's decomposition of the first model for private banks, show that a shock in delinquency is associated with a positive variation in elasticity. However, the variation does not occur through net income with TVM but rather through reducing TVM expenses.

See the second model that the effect of delinquency on TVM expenditure is statistically significant in the contemporaneous impact matrix. The decomposition of this variable shows that the effect of delinquency on expenses is negative. The same occurs when a shock directly affects TVM expenses, as it has a negative and significant relationship with elasticity.

Table 3.1.7. Contemporaneous Impact Matrices and their Cholesky Decomposition – Private Banks

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	0.07 ***	0	0	$Eq.I$	0.07	0	0
	$Eq.R$	-0.24	0.18 ***	0	$Eq.R$	0.02	0.18	0
	$Eq.E$	-0.34 **	-0.02	0.07 ***	$Eq.E$	0.02	0.00	0.07
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	0.07 ***	0	0	$Eq.I$	0.07	0	0
	$Eq.D$	0.38 ***	0.18 ***	0	$Eq.D$	-0.03	0.18	0
	$Eq.E$	-0.43 ***	-0.22 ***	0.07 ***	$Eq.E$	0.02	-0.04	0.07

Source: Research results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 15 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

If an increase in delinquency promotes financial exclusion, an increase in the financial exclusion of private banks also promotes delinquency (Analyzes of Table 3.1.7 and Table A3.1.10). As in public banks, there is an association between these two time-series for private banks, but there is no Granger sense for private banks. An increase in delinquency reduces the expenses of the private bank, but a structural shock in the elasticity promotes an expansion of expenses with TVM.

Ceteris Paribus, the expansion on expenses with TVM may be from the increase of deadweight loss. This movement in the demand curve makes up the private bank to seek more TVM since this can have a greater return than lending. On the other hand, a positive variation in delinquency inhibits private banks' supply, reducing their correction movements of technical reserves through TVM as collateral to Central Bank. Therefore, there are two specific moments with differences in the analysis for the private bank but do not have the Granger causality.

The analysis of contemporaneous shocks and their decompositions under the price elasticity seems relatively stable to credit unions (Table 3.1.8). These findings are because there

is no statistical significance in analyzing the simultaneous shocks of this variable on market elasticity. However, in both models, the effects indicate a marginally negative relationship of TVM and price elasticity.

Table 3.1.8. Contemporaneous Impact Matrices and their Cholesky Decomposition – Credit Unions.

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	$0.02***$	0	0	$Eq.I$	0.02	0	0
	$Eq.R$	$-7.98**$	$0.31***$	0	$Eq.R$	0.12	0.31	0
	$Eq.E$	-0.23	-0.39	$0.09***$	$Eq.E$	-0.00	-0.01	0.09
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	$0.02***$	0	0	$Eq.I$	0.02	0	0
	$Eq.D$	$8.44***$	$0.27***$	0	$Eq.D$	-0.13	0.27	0
	$Eq.E$	-0.25	$-0.09*$	$0.09***$	$Eq.E$	-0.01	-0.02	0.09

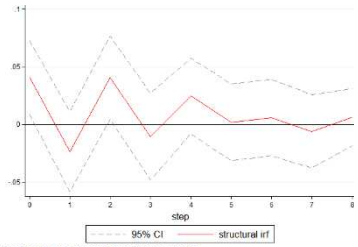
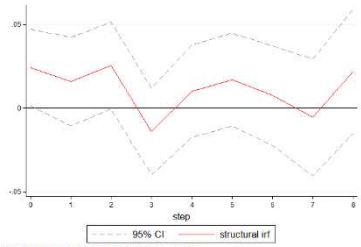
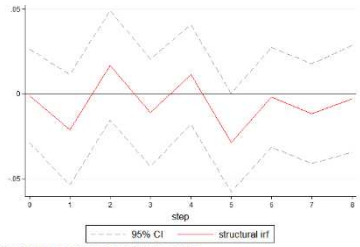
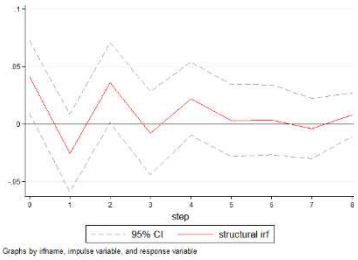
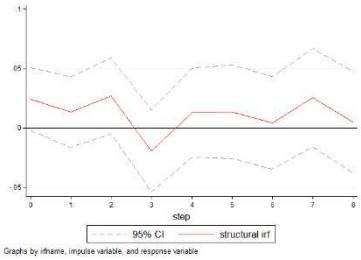
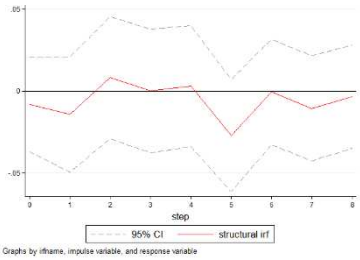
Source: Research results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 15 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

In Table A3.1.11, the delinquency of credit unions affects the net income (positively) and expense (negatively), showing that the risk-taking seems to be more controlled in the credit union. On the other hand, the demand does not affect at 5% significance the net income or expenses with TVM. In the end, there is no correlation between delinquency and demand behavior for credit unions.

Figure 3.1.8 shows the analysis of the impulse response of delinquency on the price elasticity of demand for public banks, commercial banks, and credit unions. The graphs are for eight quarters after the structural shock. The periodicity order follows the complete cycle of the average loans made by the niches (criteria lag from Akaike, AIC, Information of Schwarz, SBIC, or the Information of Hannan and Quinn, HQIC, both presented in Table A3.1.7).

The two models presented in the Figure 3.1.8 show that the main difference between niches is the immediate strategy. For public and private banks, the variation in delinquency is associated with an immediate credit restriction. It is impossible to dissociate the slightly lower average from the reference average about the credit unions. However, in this niche, the shock takes more than one quarter to take effect to down on elasticity.

Figure 3.1.8. Analysis of impulse response of delinquency on the elasticity-price of demand.

model	Public Banks	Private Banks	Credit Unions
Model 1			
Model 2			

Source: Research results. Note: Model 1 considers net income from high liquidity securities as a transmission mechanism. Model 2 considers only gross expenditure on securities of high liquidity.

This result is in line with the expectations. While private banks and at least one of the public banks are concerned about the interests of their shareholders, credit unions are possibly concerned about cooperative acts. In this case, the credit union works like mutual credit. Thus, the decision to restrict credit considers the interests of cooperative members and their respective businesses (agricultural, work, health, among others) before following the market trend. In addition, the lending of credit unions is accompanied by an educational approach, aiming at developing the cooperative member and the place where he is.

3.1.4 Public Policy Implications

The results presented in this research indicate a crowding-out effect in the financial intermediation market. This result is because the public banks' expenses with TVM affect the demand behavior only motived by delinquency, with a Granger causality. In other words, as the private banks restrict the credit for at least three quarters after the increase in the delinquency, the public banks need to increase their expenses with TVM to create currency and increase their credit supply one quarter after exogenous chock on delinquency. As these increases with TVM expenses affect accountability, the public banks need to restrict credit again in the second quarter. These movements persist up to one year when the demand behavior returns to the point before the innovation on delinquency. On the other hand, the commercial

banks continue with a more considerable standard deviation after chock, and credit unions remain as before the delinquency innovation, with fewer meaningful movements.

These findings align with what is expected since public banks soften the credit restriction in the next period. On the other hand, due to demand analysis, private banks and credit unions seem to be the only ones to promote financial inclusion under their complementary taxonomy. However, in adverse times, only credit unions seem to make this. Remember that cannibalization rations of credit unions are positive and that the framework also shows a credit expansion. In contrast, the private banks show a negative trend, despite the positive cannibalization ratios. Also, the increase in the net income from reducing the expenses in adverse moments shows that credit unions are less propensity to risk-taking than public banks. Thus, it is possible to highlight credit unions as a model for financial inclusion in the Brazilian financial intermediation system.

The present results do not invalidate the inclusion of credit unions in analyses involving financial intermediation. On the contrary, the difference in its behavior for private banks reinforces the character of a downstream institution about for local development (MENEZES; LAJUS, 2016). Also, their presence in the market is meaningful in the demand analysis. According to Westley and Shaffer (1999), Latin American credit unions support smaller projects than private banks. However, the results for credit unions in the present research show that both niches have cycles with the same amount of months, indicating that private banks and credit unions lending are similar.

In any case, considering adverse times, a possible regulation could consider the way credit cooperatives are manageable, or at least part of it, that considered financial awareness. In any case, the results indicate that companies that obtain mutual credit are associated with less market friction than companies seeking credit in private banks. This analysis is relatively essential, especially for the decision-making of companies that anticipate receivables and need working capital to maintain themselves.

Finally, it is worth talking about the policy implications of FinTech in the national retail lending market. According to the studies of Frost et al. (2019) published by the Bank for International Compensation (BIS), FinTech accounts worldwide for approximately 0.5% of total loans in the downstream market. The finding presented in the cannibalization ratio analysis is not far from the results found by the work published by BIS. It can be said that their share in the Brazilian retail market is approximately 0.40% at the end of 2019. This value is within the range of another scientific research carried out on the subject in Brazil. For Frost et al. (2019), the market share of FinTech ranged between 0.3% and 0.6% in 2017 in Brazil.

However, these technology companies are far from promoting financial inclusion more markedly to the point of accompanying the global financial disintermediation. It is emphasized that this analysis does not disaggregate the loans made by private banks through their various platforms, considering as FinTech only companies without any physical agency.

The low representativeness of technology companies in the Brazilian market can be because of the concentrated market of inputs (deposits) on the four banks (two public and two commercial) and credit unions (when analyzed together). In this sense, to expand the credit in the market, the technology companies are under financial intermediation rates. Another way to increase its lending is from the initial public offering (IPO), debentures issues, venture capital, or stock of money held by the public. These cases require greater marketing investment, which is considered a lost cost that increases the project risk.

3.1.5 Conclusion

The present chapter aimed to evaluate how consumers' delinquency observed by public banks, private banks, and credit unions affect financial inclusion in Brazil from 2008 to 2020. The hypothesis considers that provision for dubious credit represents the delinquency observed. The expenses or net income with securities (TVM) may be the channel between consumer delinquency and bank behavior in financial inclusion or exclusion. In addition, this article analyzed the framework for four different financial institutions: public banks, private banks, single credit unions, and in a complementary way to FinTech.

Two were the assumed hypotheses, where the first is summarized in the existence of the crowding-out effect (public banks seek inputs in the markets of securities to smooth the restriction of credit promoted by private banks). The second hypothesis predicts that delinquency promotes an upward pressure on the price of all taxonomies lending carried out in the downstream market, increasing the deadweight loss in the economy. Thus, Nested Logit by Berry's discrete choice model analysis (1994) was adapted to capture the diversion ratios (Farrell and Shapiro cannibalization effect, 2010) estimates and the price elasticity of demand. Subsequently, a structural VAR model was used to evaluate the behavior of market elasticity in the face of variations in delinquency suffered by three of the four niches of financial institutions (Public Banks, Private Banks, and Credit Cooperatives).

The results for private banks are associated with a restriction of credit immediately to positive shock on delinquency. Given these scenarios, private banks take at least three quarters to return to the reference average, spending most of their lending cycle in position above the

reference line. On the other hand, the results for public banks are associated with a possible immediate credit restriction. However, unlike private banks, these soften the credit restriction as early as the first quarter. These results indicate the crowding-out effect in the Brazilian loan market, both between public and private banks and between public banks and credit unions, because the TVM expenses are an identified channel between delinquency and price elasticities behavior.

Concerning credit unions, it is perceived that these are the only ones capable of promoting financial inclusion with results associated with effective inclusion. The results of impulse response are associated with less financial friction of borrowers of these companies in times of crisis. Furthermore, in addition to the positive cannibalization ratios, it is perceived that the amount operated by credit unions shows an upward trend over the period analyzed.

Finally, about FinTech, it can be concluded that the participation of these firms in the market is still incipient and that there is a possible barrier to entry in these markets, given the concentration of inputs in fell banks. This result is aligned with the literature that addresses the theme.

For future research, it is recommended to evaluate the available FinTech data. This new online niche can be analyzed more widely, highlighting its effects on financial inclusion and its potential for public policies. Also, another possible research agenda is how the credit unions support the adverse times without to promotes financial exclusion?

3.1.6 Appendix for "Financial Inclusion, Crowding-out effect, and banking delinquency between 2008-2019."

The present objective is to demonstrate how Equation 6 was found. In addition, this Appendix also presents the gross results that complement the conclusion presented around the chapter.

To begin, remember that Equation (1) is $\mathrm{d_{j,t}} \equiv \mathrm{d}(\mathrm{q_{j,t}}, \mathrm{o_{j,t}})$, representing the Logit model. The well-known linearization of the Logit model considers the following odds ratios:

$$\mathrm{d_{j,t}} \equiv \frac{s_j}{(1-s_j)} \tag{A1}$$

where $s_j = \frac{e^{u_j}}{(1+e^{u_j})}$, $(1 - s_j) = \frac{1}{(1+e^{u_j})}$, and utility $u_{j,t} = \beta p_{j,t} + x'_{j,t}\alpha + \xi_j$

See that the outside good was normalized to zero and $e^0 = 1$. Appling our adapted the Berry procedure, we will have Equation 5, as demonstrated in the text $\mathrm{L_{j,t}} = ln(s_{j,t}) - ln(s_{o,t}) = \beta p_{j,t} + x'_{j,t}\alpha + \sum_{j=1}^{3} \sigma_j ln(\bar{s}_{(j/g),t}) + \xi_{j,t}$. Also, remember that $\bar{s}_{(j/g),t}$ comes from $\bar{s}_{g,t}(\delta, \sigma) = \frac{D_g^{1-\sigma}}{\sum_\kappa D_\kappa^{1-\sigma}}$, Thus, we can derive the $\mathrm{d_{j,t}}$ relation to price, considering $\mathrm{L_{j,t}}$. Making this, we have:

$$\frac{\partial \mathrm{d_{j,t}}}{\partial \mathrm{p_{j,t}}} = \frac{\left[\beta e^{u_j}(1+e^{u_j}) - \beta e^{2u_j}\right]}{(1+e^{u_j})^2} \frac{(1-s_j)}{(1-s_j)^2} + \frac{[\sigma_{j,t}\beta e^{u_j}(1+e^{u_\kappa})]}{(1+e^{u_\kappa})^2} \frac{(1-s_j)}{(1-s_j)^2} \tag{A2}$$

The second term of A2 does not have $-\beta e^{2u_j}$ derivate because, in the elasticities, we consider the corner solution, where $\{\kappa \subset j \,|\kappa \notin j_g\}$. Thus, multiplicating the A2 by $\frac{\mathrm{p_{j,t}}}{\mathrm{d_{j,t}}}$ we have:

$$\frac{\partial \mathrm{d_{j,t}}}{\partial \mathrm{p_{j,t}}} \frac{\mathrm{p_{j,t}}}{\mathrm{d_{j,t}}} = \left\{ \frac{\left[\beta e^{u_j}(1+e^{u_j}) - \beta e^{2u_j}\right]}{(1+e^{u_j})^2} \frac{(1-s_j)}{(1-s_j)^2} + \frac{[\sigma_{j,t}\beta e^{u_j}(1+e^{u_\kappa})]}{(1+e^{u_\kappa})^2} \frac{(1-s_j)}{(1-s_j)^2} \right\} \frac{\mathrm{p_{j,t}}(1-\mathrm{s_{j,t}})}{\mathrm{s_{j,t}}} \tag{A3}$$

From Equation (A3), we show how the price elasticity of demand is equal to the Logit price elasticity of demand. Thus, solving the Equation (A3), considering the credit unions, public and private banks, we have:

$$\frac{\partial \mathrm{d_{j,t}}}{\partial \mathrm{p_{j,t}}} \frac{\mathrm{p_{j,t}}}{\mathrm{d_{j,t}}} = e_t = \beta_t(1 - s_{j,t}) + \beta_t \sum_{j=1}^{3} \sigma_{j,t} \frac{(1+e^{u_j})}{(1+e^{u_\kappa})} \quad \text{(A4)}$$

where $\mathrm{p_{j,t}} = 1$ because we have in logarithmic scale.

In Equation (A4), the $\beta_t \sum_{j=1}^{3} \sigma_{j,t} \frac{(1+e^{u_j})}{(1+e^{u_\kappa})} = 0$ for the three taxonomies analyzed. Remember that in Logit, we have a basket of features and that these features must be mutually exclusive. Thus, be the term $\frac{(1+e^{u_j})}{(1+e^{u_\kappa})}$ the number of taxonomy features event *j* divided by its complementary sample space κ. The probability of consumer finds one feature of *j* in its complementary set κ will result in an empty set { }. Then, in the referred term, we have the 0% of probability. Thus, the demand elasticity in the adapted model is the same as the original Logit. ■

$$\frac{\partial \mathrm{d_{j,t}}}{\partial \mathrm{p_{j,t}}} \frac{\mathrm{p_{j,t}}}{\mathrm{d_{j,t}}} = e_t = \beta_t(1 - s_{j,t}) \quad \text{(A5)}$$

From here follows the table that completes the results of the chapter.

Table A3.1.1. Elasticity Demand Price

quarter	average	Significance	Std. Err	quarter	average	Significance	Std. Err
Mar/08	-2.34	***	0.103	Mar/14	-2.53	***	0.11
Jun/08	-2.41	***	0.097	Jun/14	-2.76	***	0.15
Sep/08	-2.51	***	0.123	Sep/14	-2.58	***	0.12
Dec/08	-2.51	***	0.107	Dec/14	-2.77	***	0.15
Mar/09	-2.62	***	0.079	Mar/15	-2.62	***	0.15
Jun/09	-2.68	***	0.171	Jun/15	-2.85	***	0.37
Sep/9	-2.66	***	0.121	Sep/15	-2.90	***	0.12
Dec/09	-2.87	***	0.082	Dec/15	-2.93	***	0.64
Mar/10	-2.88	***	0.061	Mar/16	-2.70	***	0.15
Jun/10	-2.80	***	0.105	Jun/16	-2.78	***	0.90
Sep/10	-2.62	***	0.096	Sep/16	-2.64	***	0.30
Dec/10	-2.60	***	0.041	Dec/16	-2.69	***	0.14
Mar/11	-2.58	***	0.106	Mar/17	-2.60	***	0.11
Jun/11	-2.46	***	0.115	Jun/17	-2.41	***	0.15
Sep/11	-2.51	***	0.100	Sep/17	-2.25	***	0.23
Dec/11	-2.45	***	0.089	Dec/17	-2.41	***	0.15
Mar/12	-2.53	***	0.100	Mar/18	-2.25	***	0.21
Jun/12	-2.47	***	0.093	Jun/18	-2.11	***	0.17
Sep/12	-2.46	***	0.087	Sep/18	-2.04	***	0.21
Dec/12	-2.54	***	0.108	Dec/18	-2.05	***	0.36
Mar/13	-2.73	***	0.111	Mar/19	-1.88	***	0.15
Jun/13	-2.64	***	0.099	Jun/19	-2.02	***	0.21
Sep/13	-2.67	***	0.102	Sep/19	-1.90	***	0.19
Dec/13	-2.76	***	0.165	Dec/19	-2.17	***	0.12

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1

Table A3.1.2. Private Banks Cannibalization Rate

quarter	average	Significance	Std. Err	quarter	average	Significance	Std. Err
Mar/08	1.33	***	0.11	Mar/14	3.83	***	0.09
Jun/08	4.18	***	0.10	Jun/14	4.23	***	0.14
Sep/08	1.49	***	0.10	Sep/14	3.94	***	0.11
Dec/08	4.25	***	0.09	Dec/14	4.22	***	0.07
Mar/09	0.57	**	0.27	Mar/15	3.99	***	0.17
Jun/09	4.25	***	0.09	Jun/15	4.28	***	0.20
Sep/9	1.12	***	0.09	Sep/15	4.04	***	0.08
Dec/09	4.28	***	0.07	Dec/15	4.28	***	0.40
Mar/10	1.39	***	0.03	Mar/16	4.16	***	0.12
Jun/10	4.30	***	0.10	Jun/16	4.26	***	0.59
Sep/10	1.84	***	0.07	Sep/16	2.62	***	0.25
Dec/10	4.37	***	0.04	Dec/16	4.17	***	0.07
Mar/11	1.62	***	0.07	Mar/17	4.10	***	0.08
Jun/11	4.19	***	0.07	Jun/17	4.04	***	0.22
Sep/11	1.32	***	0.07	Sep/17	3.84	***	0.14
Dec/11	4.13	***	0.07	Dec/17	3.92	***	0.08
Mar/12	3.41	***	0.08	Mar/18	3.85	***	0.20
Jun/12	4.16	***	0.04	Jun/18	3.83	***	0.12
Sep/12	3.27	***	0.05	Sep/18	3.74	***	0.10
Dec/12	4.07	***	0.11	Dec/18	3.75	***	0.21
Mar/13	0.85	***	0.08	Mar/19	3.54	***	0.13
Jun/13	4.17	***	0.08	Jun/19	3.76	***	0.10
Sep/13	3.91	***	0.08	Sep/19	3.69	***	0.16
Dec/13	4.34	***	0.13	Dec/19	3.99	***	0.15

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1

Table A3.1.3. Cannibalization Rate of Credit Cooperatives

quarter	average	Significance	Std. Err	quarter	average	Significance	Std. Err
Mar/08	1.61	***	0.03	Mar/14	1.66	***	0.03
Jun/08	1.54	***	0.03	Jun/14	1.68	***	0.05
Sep/08	1.61	***	0.04	Sep/14	1.66	***	0.04
Dec/08	1.65	***	0.04	Dec/14	1.67	***	0.04
Mar/09	1.69	***	0.04	Mar/15	1.65	***	0.04
Jun/09	1.67	***	0.06	Jun/15	1.71	***	0.10
Sep/9	1.66	***	0.04	Sep/15	1.72	***	0.04
Dec/09	1.68	***	0.03	Dec/15	1.73	***	0.31
Mar/10	1.73	***	0.03	Mar/16	1.73	***	0.04
Jun/10	1.69	***	0.04	Jun/16	1.68	***	0.30
Sep/10	1.64	***	0.03	Sep/16	1.64	***	0.10
Dec/10	1.62	***	0.03	Dec/16	1.66	***	0.05
Mar/11	1.64	***	0.03	Mar/17	1.65	***	0.05
Jun/11	1.56	***	0.04	Jun/17	1.60	***	0.04
Sep/11	1.58	***	0.04	Sep/17	1.53	***	0.06
Dec/11	1.58	***	0.03	Dec/17	1.55	***	0.05
Mar/12	1.60	***	0.04	Mar/18	1.60	***	0.06
Jun/12	1.56	***	0.02	Jun/18	1.50	***	0.05
Sep/12	1.57	***	0.03	Sep/18	1.41	***	0.06
Dec/12	1.58	***	0.04	Dec/18	1.45	***	0.11
Mar/13	1.69	***	0.03	Mar/19	1.43	***	0.05
Jun/13	1.61	***	0.03	Jun/19	1.45	***	0.07
Sep/13	1.65	***	0.03	Sep/19	1.44	***	0.07
Dec/13	1.66	***	0.04	Dec/19	1.47	***	0.03

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1

Table A3.1.4. Public Banks Cannibalization Rate

quarter	average	Significance	Std. Err	quarter	average	Significance	Std. Err
Mar/08	-1.87		1.75	Mar/14	3.94		19.38
Jun/08	-2.30		8.53	Jun/14	3.81		11.08
Sep/08	-2.02		4.00	Sep/14	3.93		60.68
Dec/08	-2.75		16.47	Dec/14	3.83		19.04
Mar/09	-2.66		10.12	Mar/15	4.33		44.69
Jun/09	-3.78		106.09	Jun/15	4.12		311.23
Sep/9	-4.29		50.97	Sep/15	4.93		17.66
Dec/09	-16.48		20.59	Dec/15	4.75		5911.44
Mar/10	-9.25		5.27	Mar/16	5.50		32.18
Jun/10	-14.03	***	2.95	Jun/16	5.73		5698.72
Sep/10	-9.69	***	0.86	Sep/16	8.90		306.88
Dec/10	-15.05	**	6.52	Dec/16	58.92	***	14.46
Mar/11	-6.14		46.70	Mar/17	-18.62		16.03
Jun/11	-12.45		12.49	Jun/17	41.04	***	1.39
Sep/11	-7.49		21.01	Sep/17	49.88		211.87
Dec/11	7.43		6.51	Dec/17	28.28	***	1.32
Mar/12	-8.20		5.14	Mar/18	39.95		140.61
Jun/12	6.68	**	2.63	Jun/18	14.01		33.25
Sep/12	-5.06		6.13	Sep/18	14.32		117.54
Dec/12	5.66		4.08	Dec/18	9.31		323.72
Mar/13	-4.32		2.61	Mar/19	-21.24		20.38
Jun/13	4.21		3.47	Jun/19	11.80		80.50
Sep/13	4.16		3.07	Sep/19	-17.07		40.75
Dec/13	3.77		25.53	Dec/19	17.54	***	4.98

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1

Table A3.1.5. Cannibalization Ratio of Technology Companies (FinTech)

quarter	average	Significance	Std. Err	quarter	average	Significance	Err StD.
Mar/08	0.30	***	0.01	Mar/14	0.06	***	0.02
Jun/08	0.26	***	0.01	Jun/14	0.00		0.02
Sep/08	0.30	***	0.01	Sep/14	0.00		0.02
Dec/08	0.25	***	0.01	Dec/14	0.00		0.03
Mar/09	0.29	***	0.02	Mar/15	0.00		0.02
Jun/09	0.24	***	0.01	Jun/15	0.00		0.03
Sep/9	0.25	***	0.02	Sep/15	0.00		0.02
Dec/09	0.22	***	0.01	Dec/15	0.00		0.14
Mar/10	0.20	***	0.01	Mar/16	-0.05	**	0.02
Jun/10	0.14	***	0.01	Jun/16	0.00		0.13
Sep/10	0.16	***	0.01	Sep/16	0.00		0.05
Dec/10	0.12	***	0.01	Dec/16	-0.13	***	0.03
Mar/11	0.14	***	0.01	Mar/17	-0.08	***	0.03
Jun/11	0.10	***	0.01	Jun/17	-0.15	***	0.03
Sep/11	0.11	***	0.01	Sep/17	0.00		0.04
Dec/11	0.08	***	0.01	Dec/17	-0.11	***	0.04
Mar/12	0.12	***	0.02	Mar/18	-0.07	**	0.04
Jun/12	0.06	***	0.01	Jun/18	-0.11	***	0.04
Sep/12	0.12	***	0.02	Sep/18	0.00		0.04
Dec/12	0.07	***	0.02	Dec/18	0.00		0.05
Mar/13	0.05	***	0.02	Mar/19	0.00		0.03
Jun/13	0.00		0.01	Jun/19	0.00		0.04
Sep/13	0.05	***	0.01	Sep/19	0.00		0.04
Dec/13	0.00		0.02	Dec/19	0.00		0.03

Source: Research Result. *** p<0.01; ** p<0.05; * p<0.1

Table A3.1.6. Ramsey Tests

quarter	F(1.45547)	Prob > F	quarter	F(1.45547)	Prob > F
Mar/08	2.79	0.09	Mar/14	0.58	0.44
Jun/08	0.38	0.54	Jun/14	0.05	0.82
Sep/08	0.02	0.87	Sep/14	0.51	0.47
Dec/08	0.43	0.51	Dec/14	0.07	0.79
Mar/09	0.04	0.85	Mar/15	1.18	0.28
Jun/09	0.10	0.76	Jun/15	0.41	0.52
Sep/9	0.08	0.78	Sep/15	0.12	0.73
Dec/09	0.11	0.74	Dec/15	0.27	0.61
Mar/10	0.49	0.48	Mar/16	0.38	0.54
Jun/10	0.15	0.69	Jun/16	0.84	0.36
Sep/10	0.10	0.76	Sep/16	3.35	0.07
Dec/10	0.07	0.79	Dec/16	0.33	0.56
Mar/11	0.51	0.48	Mar/17	0.49	0.49
Jun/11	0.01	0.93	Jun/17	0.22	0.64
Sep/11	0.06	0.80	Sep/17	0.85	0.36
Dec/11	0.06	0.81	Dec/17	0.00	0.98
Mar/12	0.65	0.42	Mar/18	2.72	0.10
Jun/12	0.10	0.75	Jun/18	0.38	0.54
Sep/12	1.08	0.30	Sep/18	0.58	0.45
Dec/12	0.04	0.84	Dec/18	0.02	0.88
Mar/13	0.00	0.98	Mar/19	3.90	0.05
Jun/13	0.25	0.62	Jun/19	0.52	0.47
Sep/13	0.41	0.52	Sep/19	2.92	0.09
Dec/13	0.98	0.32	Dec/19	0.00	0.96

Source: Research Results.

Table A3.1.7. Co-integration testing

Co-Integration Test - Revenue vs. TVM Expenses						
	ranking	Parameters	Ll	eigenvalue	Dash Statistics	Critical Value
Private bank revenue vs	0	6	-24.70	-	25.93	15.41
public bank expenditure	1	9	-12.33	0.42	1.17*	3.76
Revenue from private banks	0	6	-61.23	-	17.24	15.41
vs. Coopexpense. credit	1	9	-54.91	0.24	4.59	3.76
Revenue from coop. credit vs	0	6	-57.38	-	8.62*	15.41
private bank expenses	1	9	-53.66	0.15	1.17	3.76
Co-Integration Test - Estimated Models						
	0	12	117.33	-	76.22	29.68
Model 1 - Public Banks	1	17	141.93	0.67	27.01	15.41
	2	20	149.85	0.30	11.17	3.76
	0	12	32.03	-	73.57	29.68
Model 1 - Private Banks	1	17	52.80	0.60	32.04	15.41
	2	20	63.22	0.37	11.21	3.76
	0	12	36.91	-	92.62	29.68
Model 1 - Coop. Credit	1	17	59.37	0.63	47.71	15.41
	2	20	75.67	0.52	15.11	3.76
	0	12	104.31	-	85.73	29.68
Model 2 - Public Banks	1	17	134.62	0.75	25.10	15.41
	2	20	143rd.06	0.32	8.22	3.76
	0	12	28.39	-	64.98	29.68
Model 2 - Private Banks	1	17	48.08	0.58	25.61	15.41
	2	20	55.46	0.28	10.84	3.76
	0	12	43.05	-	92.41	29.68
Model 2 - Coop. Credit	1	17	69.07	0.69	40.38	15.41
	2	20	82.88	0.46	12.75	3.76

Source: Research Results. Note: Period 2008 q1 to 2019q4. Two lags on all models.

Table A3.1.8. Selection of lags

	Lags	Ll	Lr	G. Freedom	P-Value	AIC	HQIC	SBIC
	0	-819.51				41.03	41.04	41.07
	1	-725.55	187.91	1	0.00	36.38	36.41	36.46
	2	-725.54	0.02	1	0.892	36.43	36.47	36.55
	3	-722.80	5.49	1	0.019	36.34	36.40	36.51
Public Banks	4	-720.09	5.42	1	0.02	36.25	36.33	36.47
	5	-712.58	15.02*	1	0.00	35.93*	36.02*	36.18*
	6	-712.39	0.38	1	0.537	35.97	36.08	36.26
	7	-711.69	1.39	1	0.239	35.98	36.11	36.32
	8	-711.58	0.24	1	0.627	36.03	36.17	36.41
	0	-799.23				40.01	40.03	40.05
	1	-738.63	121.21	1.00	0.00	37.03	37.06	37.12*
	2	-737.64	1.97	1.00	0.16	37.03	37.08	37.16
	3	-737.64	0.00	1.00	0.98	37.08	37.14	37.25
Private Banks	4	-734.70	5.88	1.00	0.02	36.99	37.06	37.20
	5	-734.31	0.79	1.00	0.37	37.02	37.11	37.27
	6	-734.06	0.49	1.00	0.48	37.05	37.16	37.35
	7	-732.20	3.72	1.00	0.05	37.01	37.13	37.35
	8	-728.04	8.32*	1.00	0.00	36.85*	36.99*	37.23
	0	-727.10				36.41	36.42	36.45
	1	-609.48	235.24	1.00	0.00	30.57	30.60	30.66
	2	-607.03	4.89	1.00	0.03	30.50	30.55	30.63
	3	-605.09	3.88	1.00	0.05	30.45	30.52	30.62
Credit Unions	4	-598.70	12.80	1.00	0.00	30.18	30.26	30.40
	5	-582.31	32.76	1.00	0.00	29.42	29.51	29.67
	6	-574.70	15.23	1.00	0.00	29.08	29.19	29.38
	7	-568.44	12.51	1.00	0.00	28.82	28.94	29.16
	8	-566.18	4.53*	1.00	0.03	28.76*	28.90*	29.14*

Source: Research result. Note: Eight lags represent the 24-month cycle. * Lower significant criterion

Table A3.1.9. Contemporaneous Impact Matrices and their Cholesky Decomposition – Public Banks

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	$0.02\ ***$	0.03	$-0.08\ ***$	$Eq.I$	0.02	-0.00	0.01
	$Eq.R$	0	$0.12\ ***$	-0.06	$Eq.R$	0	0.12	0.01
	$Eq.E$	0	0	$0.10\ ***$	$Eq.E$	0	0	0.10
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	$0.02\ ***$	$-0.05\ ***$	$-0.06\ **$	$Eq.I$	0.02	0.01	0.01
	$Eq.D$	0	$0.19\ ***$	-0.26	$Eq.D$	0	0.19	0.03
	$Eq.E$	0	0	$0.11\ ***$	$Eq.E$	0	0	0.11

Source: Research results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 15 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

Table A3.1.10. Contemporaneous Impact Matrices and their Cholesky Decomposition – Private Banks

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	$0.07\ ***$	-0.03	$-0.30\ **$	$Eq.I$	0.07	−0.01	0.02
	$Eq.R$	0	$0.19\ ***$	−0.18	$Eq.R$	0	0.19	0.14
	$Eq.E$	0	0	$0.08\ ***$	$Eq.E$	0	0	0.08
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	$0.07\ ***$	$0.13\ **$	$-0.34\ **$	$Eq.I$	0.07	−0.02	0.02
	$Eq.D$	0	$0.16\ ***$	$-0.85\ ***$	$Eq.D$	0	0.16	0.07
	$Eq.E$	0	0	$0.09\ ***$	$Eq.E$	0	0	0.09

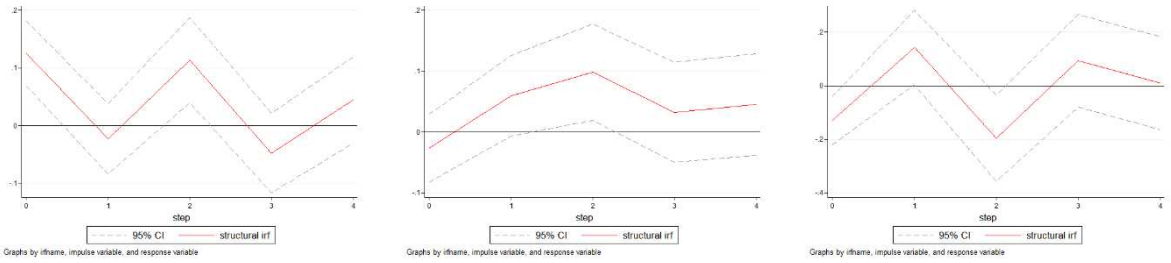
Source: Research Results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 24 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

Table A3.1.11. Contemporaneous Impact Matrices and their Cholesky Decomposition – Credit Union

templates	Contemporary Impact Matrix - RLTVM				Cholesky Decomposition			
Model 1	Eq/Var	I	R	E	Eq/Var	I	R	E
	$Eq.I$	$0.01\ ***$	$-0.02\ **$	−0.01	$Eq.I$	0.01	0.01	−0.00
	$Eq.R$	0	$0.33\ ***$	−0.50	$Eq.R$	0	0.33	−0.04
	$Eq.E$	0	0	$0.09\ ***$	$Eq.E$	0	0	0.09
	Contemporary Impact Matrix - DBTVM				Cholesky Decomposition			
Model 2	Eq/Var	I	D	E	Eq/Var	I	D	E
	$Eq.I$	$0.01\ ***$	$0.02\ ***$	−0.01	$Eq.I$	0.01	−0.01	−0.00
	$Eq.D$	0	$0.29\ ***$	$-0.92\ *$	$Eq.D$	0	0.29	0.09
	$Eq.E$	0	0	$0.09\ ***$	$Eq.E$	0	0	0.09

Source: Research Results. Note: The structural VAR was estimated considering six lags. The criterion for choosing lags considers the average borrowing time of public banks of 24 months, considering the CBI criterion. *I* refer to the provision of doubtful credit as a variable of delinquency. *R* refers to RLTVM. *E* refers to the elasticity of the market. *** p<0.01; ** p<0.05; * p<0.1.

Figure A3.1.1. Impulse analysis of default response on expenditure



Source: Research Results.

3.2 PERFORMANCE IN BRAZILIAN CREDIT UNIONS AFTER MERGER OR ACQUISITION: COMPETITION-STABILITY OR COMPETITION-FRAGILITY?

ABSTRACT

This chapter aims to evaluate whether mergers or acquisitions (M&A) promote variations in the credit union's debt capacity and risk-taking in the loans market. Two theoretical foundations were tested, Competition-Fragility and Competition-Stability. The first one indicates that more liquid firms are beneficial to the financial sector. In contrast, the second proponents encourage competition as this increases the stability of financial intermediation. The research design predicts using the CAMEL and another six accounting indices to test these two hypotheses. The author carried out three stages of estimation. The first considered only firms with one M&A process in the treated group against firms that do not make up for any the M&A process. The second stage analyzed the firms with more than one M&A process in the treated group against the firms that carried out just one M&A treatment. Finally, in the general case, the treated group was analyzed considering the credit unions with at least one M&A process against credit unions without this process. The results indicate that the stability theory induces mergers in the first analyzes since the merged credit unions increased market lending. In the second analysis, the credit unions with at least two M&A processes became more liquid, reducing their risk-taking. Thus, the theory that conduces the second treatment results seems to be Competition-Fragility. In the general case, the M&A process seems to be conducted by Stability theory, where credit unions became most efficient beyond credit expansion promotions.

3.2.1 Introduction

The credit unions operating in Brazil have decreased significantly from 2008 to 2020. In 2009, just over 1,474 financial cooperatives operated in the country. However, at the end of 2020, the credit union active in de Central Bank of Brazil (Bacen) fell to 906 approximately (see Figure A1 in the appendix). This variation is mainly due to 429 merger or acquisition (M&A) processes aiming at good accounting practices (Bacen, 2018). Thereby, the current phase of Brazilian credit unions is conducive to comparing the contribution of M&A in the performance of credit unions.

Two are the banking theory base behind these processes: the Competition-Stability and Competition-Fragility. In the Fragility theory, the competition harms the banking sector because it increases the risk-taking and the leverage of financial firms, putting at risk the entire financial intermediation (see, for example, Keeley, 1990; Besanko and Thankor, 1993; Cetorelli and Peretto, 2000; and Carletti and Vives, 2008). Thus, for the proponents of this theory, the market share is a golden rule that ensures the system's stability.

Otherwise, the Stability theory indicates that more competition, the great is the sector's efficiency, and less is the market failure (see Myers and Rajan, 1998; Allen and Gale, 2004; and Boyd and Nicoló, 2005). Risk-taking also is considered, but according to Martinez-Mieira and Repullo (2010), there is a minimal point between risk and stability that gives some meaningful degree to increase the competition against the market concentration.

Thus, considering these two hypotheses, this chapter aims to analyze the maturity degree of the credit unions in light of mergers or acquisitions under the competition stability and competition fragility hypothesis. Specifically, this chapter seeks to answer three issues: [i] do credit unions that make up M&A processes increase their performance compared with their peers who do not make the process? [ii] what is the orientation that credit unions follow in the M&A process? [iii] do credit unions with one M&A process follow the same orientation as a credit union with more treatments?

The announced reduction in credit unions between 2008-2020 may indicate that the market is concentrating in line with competition for fragility. However, in the Brazilian financial intermediation relevant market, commercial banks, public banks, and technological banks have a meaningful market share. The first empirical chapter of this thesis shows that credit unions compete between third and fourth place by total lendings or total market deposits with a percentage of around 4 to 5% in both markets.

Therefore, in a broader look, the M&A process may be a diversification strategy that will increase the performance and resilience of credit unions in a concentrated market. Moreover, despite some credit unions participating in a system (with central, confederation, and commercial banks), the main activity is local, focusing on the cooperative member and their business (CUTCHER, 2008; SNAC, 2016). In addition, credit unions are non-profit firms that generally maintain the developmental direction in their statutes, being an alternative to commercial banks' credit (KLINEDINST, 2012).

According to Myers and Rajan (1998), auto sustainability comes from a reasonable capacity for responsibility. In financial intermediation firms, the leading share of liability comes from deposits of cooperative members. In order to become attractive to deposit, a firm should find the relative degree of substitutability in their assets. Assets with high replacement bring lower interest rates that can harm the sustainability of the associates. Thus, low-liquid assets may be somewhat useless in times of crisis. Therefore, there is an optimal financial firm size that prevents its solvency (MCFADDEN, 2008).

The trade-off between liquidity and insolvency may reveal the maturity degree of credit unions. According to Ferguson and McKillop (1997), credit union's economic development makes up the following phases: Nascent Credit Unions, Transition Credit Unions, and Mature Credit Unions. There is vital evidence that Brazilian credit unions are in the Transition phase (BACEN, 2003, 2007, 2010; BRAGA *et al.*, 2006; BRESSAN *et al.*, 2012; VELOSO JUNIOR, 2011).

According to Ferguson and McKillop (1997), the Transition phase has the flows characteristics: [i] the flexibility for the association of cooperative members; [ii] the transition from simple prudential to the complete prudential regime; [iii] the professionalization of managements[26]; [iv] greater accountability of central credit unions; and [v] portfolio diversification.

While the free association of cooperative members started in 2003 with the Bacen 3,106 act, the prudential regime came into force twelve years later with Bacen act 4,434 (2015). Between 2003 and 2015, credit unions underwent a consolidation process (see the Bacen, 2007 and 2010). According to Braga et al. (2006), the lack of strategic, tactical, and operational planning, given the insufficient administrative foundation's knowledge of managers, was the primary responsibility of credit unions' inefficiency between 2001 and 2003. In addition, in economies where the credit unions are in the Transition phase, the macroeconomic aspect is an

[26] Issues of efficiency, moral risk, and transparency gain weight and importance.

elementary factor affecting the financial intermediation services' stability and efficient provision (FERGUSON; MCKILLOP, 1997). Thinking about that, Bacen introduced in 2008 some guidelines for good governance and cooperative management practices (VENTURA; FILHO; SOARES, 2009).

The inexistence of a guarantee fund for credit union deposits may increase the moral hazard problem in the entire financial system (KARELS; MCCLATCHEY, 1999). According to Bressan *et al.* (2012), the greater the degree of leverage of Brazilian credit unions, the greater its moral hazard potential. However, because it has a differentiated prudential regime from the other banks[27] (see Bacen, 2017), the issue of collateral (for depositors) is resolved by the creation of the Credit Cooperative Guarantee Fund (FGCOOP, as is their acronym in Portuguese) in 2012. Thus, the FGCOOP began to equate the security standard for depositors of credit unions with the standard adopted by commercial banks[28].

From the above framework, the strategy of this research to analyze the contributions of M&A for the performance of credit unions considers analyzing the following accounts: Capital Adequacy, Assets, Management Capability, Earnings, and Liquidity of mutual firms. The CAMEL indices are an international risk classification system for credit unions. According to Walker and Smith (2019), the standardization of these indexes comes from National Credit Unions Administration (NCUA).

According to Richardson (2009), the CAMEL system was developed as a supervisory tool, being incomplete as a management tool. Thus, the PEARLS (Protection, Effectiveness, Liabilities, Capital, Asset Quality, Rates, Liquidity, and Signs of Growth) is a complete management set. However, the aim of this chapter is on economic analysis, including the supervisory analysis. Thus, the CAMEL system is more appropriate. Nevertheless, the other six economic indices also will be considered: Indebtedness, Performance, Free Technical Reserves, Effectiveness, Margins, and Equilibrium.

Empirically, the strategy considers any degree of the credit unions with M&A between January of 2008 and December 2020 as a treated group. The Propensity Score Matching (PSM) approach and Entropy balance are used in the treatment effect for the treated units (ATT) analysis, being considered only the one that better fits the groups.

Three stages of M&A were analyzed: The first refers to credit unions that make up only in one M&A process, comparing them against those credit unions that did not participate in any process. The second stage analyzes the accounting indexes of credit unions that participated in

[27] For more details, see Bacen, 2013.
[28] For the evolution of the credit union guarantee system see Bressan, 2009.

more than one M&A process against the ones that make up just one process. Finally, the general case relaxes the first stage and includes all credit unions with at least one M&A process in the treated group.

From the results, it is inferable that the M&A process does not interfere in the credit unions' liquidity in the first stage but decreases their Indebtedness represented by time deposits or increases their total assets, reducing their provision for delinquency. In the second stage of M&A, the credit unions presented significant gains in time deposits, accompanied by a significant increase in their liquidity, indicating that credit unions are more capitalized. Thus, it concludes that Competition-Stability is the base for the first stage of the incorporation, while in the second stage, the strategy is Competition-Fragility theory. The general case reinforces the first stage indicating that Competition-Stability is responsible for credit expansion and more efficiency in the market.

In addition to this section, the chapter is divided into four more parts. The second section addresses the theoretical model used, the identification strategy, and the econometric procedures; the third section comes the data presentation; the fourth part presents the results and the discussions. Finally, it concludes.

3.2.2 Methodology

3.2.2.1. The determinants and Identification of the Merger on the Financial Indices

This research strategy analyses the possible variations in the accounting indices of credit unions with a merger or acquisition (M&A). Three steps define with are the treated group:

i. Seeks to compare the credit unions with just one process against credit unions without process;
ii. Seeks to compare the credit unions with at least two processes with credit unions with just one process; and
iii. Seeks to compare the credit unions with at least one process with mutual firms without the M&A process in the general analysis.

The analysis focuses on which theory conducts the M&A process in the credit unions: is Fragility or Stability theory? Thus, the threshold between these two hypotheses is the liquidity degree after the process, considering that untreated groups are similar to a treated group in all other dimensions.

This analysis comes from the banking literature through the CAMEL risk classification system (Table 3.2.1). Empirically, CAMEL has been adopted internationally, and according to

Walker and Smith (2019), since the 1970s, its application follows the standards implemented by the NCUA (National Credit Unions Administration).

Table 3.2.1. CAMEL indexes and their interpretation

Indexes	Calculation	Interpretation
C	Shareholders' Equity / Total Asset	A positive change after the merger indicates that the credit union in question is becoming more capitalized
A	(Credit income – Credit Expenses) / Total Credit	Assesses how much assets generate a net return for the credit union. A positive change after the merger contributes to cash generation
M	Net income / Shareholders' Equity	A positive change after the merger indicates that the administrative sector has improved its risk management capability
E	Net income / Total Assets	A positive variation shows the performance of the cooperative against the total asset
L	Loan Level / Total Assets	This indicator shows the cooperative's ability to diversify

Source: Adapted from Bauer, Miles, and Nishikawa (2009).

However, as the research design seeks to analyze the temporal series in the first difference, ratios coefficient for indices presented in Table 3.2.1 may be not meaningful because the numerator may be increasing in the same relation of the denominator. In addition, with CAMEL, little is concluded about economic issues, such as Competition-Fragility or Competition-Stability. Thus, complementary accounting variables are necessary to meet these research objectives. Next, there are a set of economic variables that complement the CAMEL analysis for the proposes of this research:

- Indebtedness index: the responsibility of credit unions is mainly due to the accumulation of time deposits weighted by total assets. Therefore, the debt ratio reflects the time deposit operations;
- Index of performance in the interbank market: sometimes, an accounting error occurs in credit unions' cash flow balance that forces the administrator to seek emergency resources in the interbank market. On the other hand, credit unions may also act in the interbank market in a lender way. Therefore, the objective of this index is to evaluate the average situation of these mutual banks after incorporation;
- Provision for dubious credits: in some situations, the cooperative member fails to honor their installments. Thus, this index represents the weighted provision of the total assets of the credit union. A positive variation in the provision after the M&A indicates an increase in doubtful credits, evidencing a loss of efficiency of the credit union with the operation;
- Effectiveness: this index complements the provision index and results from dividing lending income and time deposits. It shows the ability to transform the raised input into an asset for the credit unions and highlights the capability of the firm in financial intermediation;
- Contribution Margin: this is another accounting index that complements the analysis of the level of provision. It is the representation of net credit operations income weighted by the credit operations income. In economic terms, this indicator is equivalent to Lerner's index and allows to infer questions about the market power of financial cooperatives; and

- Equilibrium Point: The accounting balance of credit unions occurs from the ratio between credit expenses with the previous index (Contribution Margin). It shows the minimum that credit unions need to sell to cover their expenses. A positive variation indicates that the incorporation process generated a diseconomy of scale or scope for the developer firm.

3.2.2.2. Identification

To identify the contribution of M&A operations in the eleven proposed indices, one must first control for the non-randomness problems. In addition, the observation units (treatment and control) need to be the most similar possible in some dimensions to avoid biased results. Therefore, this chapter considered macroeconomic and microeconomic credit union dimensions to control the treated and control groups. Thus, the effects observed after treatment had more veracity through econometric techniques than control groups with heterogeneous characteristics (RUBIN, 1974).

Credit unions are immersing in the internal and environmental characteristics, and comparing treated, and untreated groups should concern these two points. The external characteristics should include credit unions under the same, or approximate, macroeconomic effects. On the other side, the internal characteristics should reveal the degree of maturity of credit unions, such as loans, deposits, liabilities, or assets.

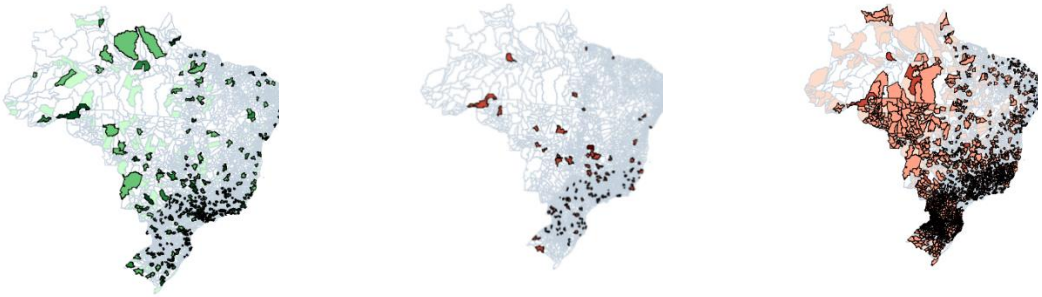
In this chapter, the variables used that represents the external environment were:

- The MHDI (Municipal Human Development Index) is a proxy for the development and characteristics of the cooperative members who demand the services of credit unions. These variables come from *Federação da Indústrias do Rio de Janeiro* (Firjan) that sinces 2005 calculates the IFDM for each year;
- The number of bank branches present in the municipality where the credit union is present; and
- Total population of the municipality where the credit union is present;

While the population and MHDI seek to control the environment of credit unions (Income, Health, and Education), the bank branches are a good proxy to find where the M&A will occur. Figure 3.2.1 shows that the incorporation processes occurred in 131 municipalities distributed throughout Brazil. However, with more presence in the south and southeast regions. Also, the M&A process occurs in a place where there are commercial banks and credit unions. Where this intersection does not occur, coincidently or not, there is no incorporation process.

Figure 3.2.1. Distribution of banking service stations and cooperative service stations in December 2018 and the places of M&A process from January-2008 to December-2020.

Credit unions service stations	Municipalities with M&A	Bank Branches



Source: Own preparation based on the Accounting Report of credit unions made available by Bacen. Observations: The data analyzed here consider only the Bank Service Stations and Cooperative Service Stations. Therefore, the Advanced Banking Service Stations, Electronic Service Stations, Microcredit Service Stations, Collection and Payment Banking Stations, Transitional Service Stations, Gold Purchase Stations, Permanent Exchange Stations, and Transitional Exchange Stations are eliminated.

As the environmental variables are essential to approximate the treated group from the control group in the same macroeconomics effects, the internal variables seek to select the credit unions with similar criteria. Here, there is an independence issue. Including so many variables create a kind of "digital" for credit unions that may eliminate their peer in the control group. Thus, the parsimony criteria are the key to considerate the firms between treated and control groups as comparable. In this sense, the internal variables used in the econometric analysis were:

- The price spent by credit unions in the collection of time deposits (cooperative level price comes from the division between the lending expenses and the total raised for time deposit);
- the price paid to become operational (represented by the operating expenses weighted by the total asset); and
- the price of administrative inputs (personnel expenses weighted by the total asset).

In the literature, two are the main approaches responsible for creating the comparable groups: Entropy Balances (see, e.g., Hainmueller, 2012 and Mcmullin and Schonberger, 2015) and balancing by Propensity Score Match (see Heinrich, Maffioli and Vazquez, 2010). Both methods ensure the weighted groups have the same three specified moments to reduce the non-weighted counterfactual group's bias.

These three moments[29] analysis is an essential step because of the procedure adopted. Since the PSM calculates the propensity interactively through the logit regression technique and depends on a series of diagnoses on the inserted vectors, the Entropy Balance is prone to divergence when there is an error in the data or when the data variables of the model are not valid. In this case, the recommendation is to reduce the restrictions to ensure independence (HAINMUELLER; XU, 2013).

Thus, the challenge to estimate the effects of M&A on the performance of indicators is to build a counterfactual E(Y0 | D = 1) to capture the effect of treatment on treaties (ATT) as defined by Caliendo and Kopeinig (2005)[30]:

$$\mathrm{ATT} = \mathrm{E}(\tau \,|\mathrm{D} = 1) = \mathrm{E}[\mathrm{Y}(1)|\mathrm{D} = 1] - \mathrm{E}[\mathrm{Y}(0)|\mathrm{D} = 1] \qquad (1)$$

where Y_0 represents the performance in the control group and Y_1 represents the performance in the treatment group (fusion)

This research uses both procedures (PSM and Entropy) to estimate this effect. Using both methods provide greater robustness of the results and verifies possible disadvantages of one or the other model's suitability on the data. Thus, while the entropy balancing had adjusted each observation to the three moments in this research, the PSM procedure adjusted the groups at the nearest neighbor.

However, this research's strategy seeks to consider only the model that better fits the treated and untreated groups. This strategy is essential because variance analysis is vital in statistical inference. Thus, the specification test of RESET is a complement to choose which methodology better fits the groups.

2.2.3. Econometric Procedures

The process of estimating and verifying the results is based on each model's weighting methodology (Entropy or PSM). Once the vectors have been selected, they must be adjusted in the regression to find the incorporation probability. In the PSM procedure, the estimation of the functional form of this regression (Equation 2) occurs by Logit. On the other hand, if Entropy

[29] The three moments of PSM is mean, variance and kurtosis. The three moments of Entropy is mean variance and asymmetry.
[30] Caliendo And Kopeining (2005) define the ATT for the PSM, but the idea is the same for the entropy balancing technique.

is the case, the estimation of Equation 2 involves minimizing the entropy distance between the treated and control groups.

$$\text{Treated}_{c,m,t} = \alpha + \beta_1 \text{PIB}_{m,t} + \beta_2 \text{IDHM}_{m,t} + \beta_3 \text{Branches}_{m,t} + \gamma_1 w1_{c,m,t} + \gamma_2 w2_{c,m,t} + \varepsilon_{c,m,t} \quad (2)$$

where γ_s represent the coefficients of the only two variables at the cooperative level (*c* – credit unions, *m* – municipality, and *t* – period). The coefficients of the variables at the municipality level are represented by the β_s. The *Treated* variable receives 1 for treated occurrence and 0 otherwise. Thus, it seeks to estimate the probability of the M&A occurrence.

Entropy balancing (Equation 3) and PSM balancing (Equation 4) have some similarities. In both techniques, after estimating equation (2) by Logit, the covariates of this equation and the *Treated* variable generates a weighting index that makes the treated groups and control as similar as possible.

$$\widehat{\text{E}}\left(\text{Y}^{\text{i}}(0) \,\middle|\, \text{D} = 1\right) = \frac{\sum_{\text{i|D=0}} \text{Y}_{\text{i}} \text{d}_{\text{i}}}{\sum_{\text{i|D=0}} \text{d}_{\text{i}}} \quad (3)$$

$$\widehat{\text{E}}\left(\text{Y}^{\text{i}}(0) \,\middle|\, \text{D} = 1\right) = \frac{\sum_{\text{i|D=0}} \text{Y}_{\text{i}} \text{w}_{\text{i}}}{\sum_{\text{i|D=0}} \text{w}_{\text{i}}} \quad (4)$$

In Entropy balancing, the weights are chosen for each equation's covariates (2). These weights seek to minimize the Entropy given by:

$$\min_{\text{w}_{\text{i}}} \text{H(w)} = \sum_{\text{i|D=0}} \text{w}_{\text{i}} \log\left(\frac{\text{w}_{\text{i}}}{\text{q}_{\text{i}}}\right) \text{ with s.a. } \text{q}_{\text{i}} = \frac{1}{\text{n}_0}$$

$$\sum_{\text{i|D=0}} \text{w}_{\text{i}}\, \text{c}_{\text{ri}}(\text{X}_{\text{i}}) = \text{m}_{\text{r}} \text{Wherer} = (1, \ldots, \text{R})$$

$$\sum_{\text{i|D=0}} \text{w}_{\text{i}} = 1$$

$$\text{w}_{\text{i}} \geq 0, \text{ for all i} \mid \text{D=0} \quad (7)$$

The q_i value is based on the weighting and represents the set of covariates imposed at the control group's weighting (Hainmueller and Xu, 2013). Minimization occurs by reducing the distance between weighting units and q_i. This research minimization was performed for the three moments (mean, variance, and kurtosis) for all independent variables of the equation (2).

In the PSM, the weights are calculated by the following equation:

$$\text{PR}(z_1, \ldots z_n | x_1, \ldots x_n) = \prod_{i=1}^{N} e(x_1)^{z_1} \{1 - e(x_1)\}^{1-z_1} \quad (8)$$

where $e(x_1)$ is the propensity score concerning the treatment, given the covariates x (ROSENBAUM; RUBIN, 1983).

For the PSM case, the propensity score comes from Logit regression and is obtained by most close neighbors.

In the ATT recuperation, since the municipalities and credit unions are not homogeneous, the variance correction occurs by cluster and considers each year a self-correction unit. This analysis is crucial because credit unions and commercial banks interact in the interbank market, and, therefore, the accounting data of one may be correlated with the other accounting data. After the first estimation stage, a Ramsey RESET specification test was performed.

3.2.3 Description of the Data

The data used in this research results from the combination of the report of credit unions, provided by the Central Bank of Brazil (Bacen) with the *Instituto Brasileiro de Geografia e Estatística* (IBGE) data and Firjan data.

The description of these variables is present in Table 3.2.2.

Table 3.2.2. Description of the variables used.

External Vectors	**Observations**	**Average**	**Source**	**Unit/Scale**
Bank Branches	238,368	4.28	Bacen	Log
HDI – M (IFDM from Firjan)	236,840	0.00	IBGE	Level
Population	238,368	12.20	IBGE	Log
Internal Vectors				
W1 – Deposit Cost/ Time Dep.	9,761	-3.68	Bacen	1Δ Log
W2 – Operational expenses/AT	119,091	-3.95	Bacen	1Δ Log
W3 – Adm Expenses/AT	94,803	-5.95	Bacen	1Δ Log
CAMEL indicators				
C	86,035	-0.00	Bacen	1Δ Log
A	19,582	0.02	Bacen	1Δ Log
M	57,309	-0.03	Bacen	1Δ Log
E	57,307	-0.04	Bacen	1Δ Log
L	25,220	0.00	Bacen	1Δ Log
Complementary Indicators				
Effectiveness	66,869	0.02	Bacen	1Δ Log
Debt	66,951	0.02	Bacen	1Δ Log
Interbank	13,991	0.07	Bacen	1Δ Log
Contribution Margin	45,758	-0.00	Bacen	1Δ Log
Equilibrium Point	45,758	0.05	Bacen	1Δ Log
Credit provision	84,805	0.01	Bacen	1ΔLog

Source: Research Results Note: The observations result from the analysis of the various financial cooperatives from January 2008 to December 2020. In the ATT analysis, these observations vary according to observation on treated and control groups. AT is total assets. Dep is deposits. 1Δ mean first difference.

The observations come from the various financial credit unions' analyses from January 2008 to December 2020 (last month with accounting data available in Bacen at this research). There are a total of 1,528 financial IDs of credit unions. The credit unions incorporated, and those with the cancellation dispatched receive zero from the occurrence of M&A point onwards. The observation with zero values turned missing observations when indices go to log scale. Thus, this IDs does not enter in the econometric analyzes after the merger.

The accounting indices are in the logarithm scale. The negative variables as the liabilities are in absolute value. According to the Broad National Consumer Price Index (IPCA, as the acronym in Portuguese), all variables' nominal adjustment was made. The base is the first quarter of 2008. Finally, as the variables are quarterly, the variables are in the first difference to avoid any other structural breakage in the results.

3.2.4 Results and Discussions

The first challenge to evaluate the results was balancing the treatment and control units over the vectors that explain the probability of incorporation. This probability comes from the multilevel estimation given by Equation (2). This part aims to create weights that turn treated and control groups as similar as possible.

Table 3.2.3 brings the statistical between the treated and control groups to PSM and Entropy balances (mean, variance, and skewness), considering the first treatment. In this first step of the analysis, the treated group are credit unions with just one M&A, and the control group is the credit unions that do not make up for the M&A process. The relative bias valid between match and unmatched groups are up to 10%.

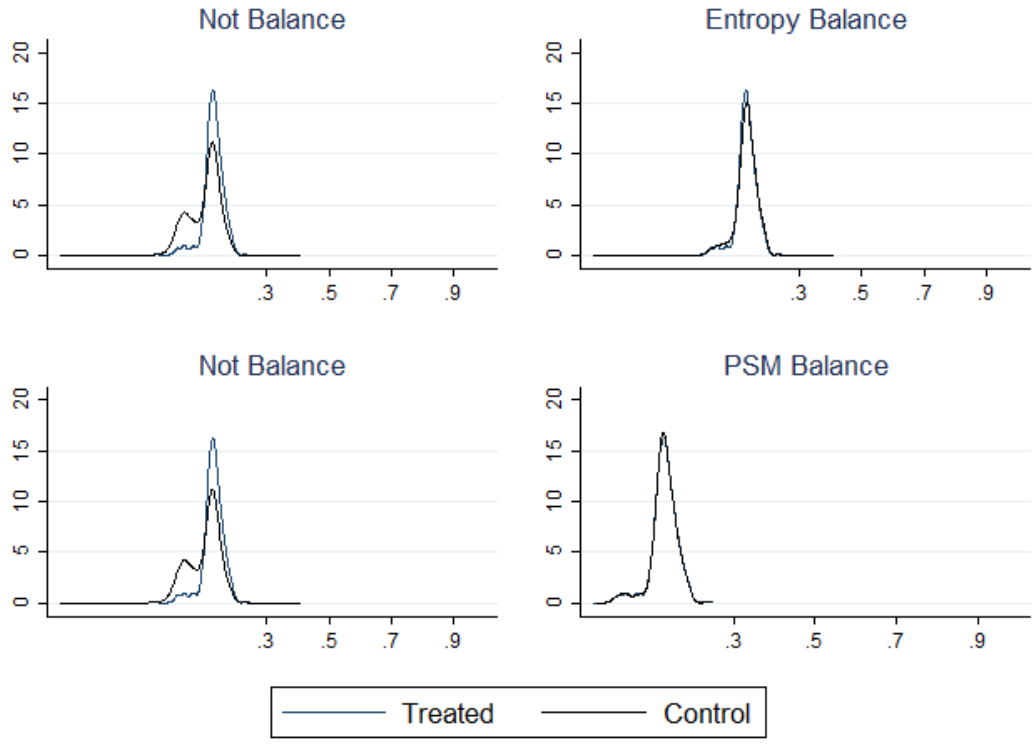
Table 3.2.3. Statistical test between treated and control groups for Entropy and PSM Balances for the first treatment.

Variables	Part A – Entropy Balance						Part B – PSM Balance					
	Treated			Control			Mean			t-test		V(T) / VC
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	% bias	*t*	p > |t|	
IFDM	0.00	0.00	4.91	0.00	0.00	4.91	0.00	0.00	-2.10	-1.39	0.16	0.86*
Branch	4.30	0.00	-1.78	4.30	0.00	-1.78	4.30	4.30	-7.50	-6.67	0.00	1.01
Population	11.78	3.59	0.33	11.78	3.59	0.33	11.78	11.73	2.80	1.88	0.06	0.92*
w1	-3.96	0.58	-0.56	-3.96	0.58	-0.56	-3.96	-3.89	-7.80	-5.71	0.00	1.01
w2	-4.12	0.60	-0.45	-4.12	0.60	-0.45	-4.11	-4.06	-6.40	-4.44	0.00	0.91*
w3	-5.88	0.98	-1.27	-5.88	0.98	-1.27	-5.88	-5.84	-3.90	-2.84	0.01	0.93*

Source: Research Result. Note: Part A shows the three moments between treated and control groups after Entropy Balance. Part B shows the statistical inference between treated and control groups for PSM Balance, relative bias, t-test, and variance ratio. * if variance ratio outside [0.96; 1.04].

The tests presented in Table 3.2.3, indicate that treated and control group is well adjusted for Entropy balance moments (mean, variance, and skewness). However, when it changes skewness to kurtosis (Entropy to PSM), the test indicates that the most percentage bias is to time deposit capture cost (W1) with 7.80%. Figure 3.2.2 presents the visual graph comparison between groups for Entropy and PSM Balance.

Figure 3.2.2. Comparison of adjustments between treated and control groups by Entropy and PSM for the first treatment.



Source: Research Results

In the visual analysis, PSM seems better adjusted than Entropy. However, entropy weighting also generated a sample, in the three moments, reliable for comparison. Also, the Entropy is most sensitive than PSM for convergence analysis. Otherwise, the instruments used in this research would be invalidated, eliminating the need for additional testing for PSM robustness.

In addition to the adjustment analysis, it is necessary to perform the specification test to identify any potential missing variable bias in the ATT recuperation (Table 3.2.4).

Table 3.2.4. Ramsey RESET Test for the first treatment.

Model	Ramsey RESET Test	Prob. > F
Not adjusted	F (2 – 154) – 17.18	0.00***
Adjusted by Entropy	F (2 – 154) – 3.39	0.04**
PSM-adjusted	F (2 – 152) – 1.37	0.26

Source: Research Results. Note: The fitted model is the first stage. *** p<0.01; ** p<0.05; * p<0.1.

The Ramsey RESET test reinforces the visual graph analysis and shows that PSM adjustment is better than the Entropy procedure, reducing the possible existence of specification bias. The meaningful of 5% for entropy specification may explicate the point where the skewness is out of the match. Thus, as the variance is essential to statistical inference, the ATT findings are present under the PSM view.

After the test evaluations, we can now analyze the contribution of M&A to the performance of accounting indices. The analysis of the eleven previous indices should assume the Fragility or Stability theories. As the analysis is in the first difference, the variations findings are temporal. Table 3.2.5 brings the finding for the first treatment analysis.

Table 3.2.5. Effect of the M&A on the performance of credit unions: just one process under credit unions without process (treatment by PSM).

Variables	ATT		GROUPS	
	% Mean	Standard Error	Treated	Untreated
C	-0.30	(0.24)	8,308	58,671
A	1.69	(2.06)	3,665	15,901
M	3.51	(1.90)	5,748	39,031
E	1.64	(1.78)	5,748	39,030
L	-0.49	(0.35)	4,532	20,481
Indebtedness (DP) – (T.Dep/T.Assets)	-0.98***	(0.32)	8,306	58,538
Equilibrium Point – (Expenses/MC)	3.63**	(1.53)	6,625	38,892
M. Contribution (MC) – (R/R-C/R)	0.02	(0.07)	6,625	38,892
Effectiveness – (Receip/T. Dep)	2.55	(1.36)	8,306	58,463
Provision	-0.78**	(0.34)	8,308	58,525
Interbank Market	3.00	(3.53)	1,858	10,136

Source: Research Results. Observations: *** p<0.01; ** p<0.05; * p<0.1.

Table 3.2.5 shows that only three indices are meaningful after the M&A procedure. These are the Indebtedness Capacity (negative variation), the Equilibrium Point of credit unions (positive variation), and the technical reserves for delinquency (negative variation).

As the CAMEL does not present any temporal variations concerning treated and untreated credit unions, the negative quarter variation of around 1% in Indebtedness after the merger is due, mainly to the negative temporal variation in time deposits. Thus, after the M&A

this percentage in relation to total assets falls, indicating that the credit union, on average, stays less liquid.

The asset liquidity decrease may explicate the credit unions' need to sell about 3.8% more to cover their operating costs (Equilibrium Point – EP) after the M&A. In addition, as it does not possible to consider the temporal differences between Contribution Margins of treated and untreated groups, the EP variation is associated with increased credit expenses. On the other hand, the delinquency after M&A seems to fall at around 0.8%, indicating a reduction in risk-taking with credit operation.

These results are in line with the Central Bank of Brazil's recommendations that sought to induce collaborations aligned with international best practices aiming at efficiency gains and risk reduction (BACEN, 2018). In addition, according to Zaia (2019), Bacen expects that credit unions increase the credit by around 20% of its market share. This finding may explicate the negative relationship between total assets and time deposits.

Therefore, among the Competition-Stability and Competition-Fragility hypotheses, these shreds of evidence indicate that credit unions with one M&A process adopt the first path. The increase in the leverage conducts an increase in the credit union risk-taker and reduces delinquency. These findings seem to form the first step of the U-Shaped of Martinez-Miera and Repullo (2010).

3.2.4.1. And the Credit unions with more than one M&A. What happens?

From the sample analyzed and presented in this chapter, 89 credit unions presented more than one incorporation between January-2008 to December-2020. There were 41 credit unions with at least three incorporation processes, 16 credit unions presented at least four processes, eight credit unions presented at least five processes, and four credit unions presented more than five incorporation processes.

The seven credit unions that most carried out the incorporation process in the period are in the following states: Bahia, Minas Gerais, Rio Grande do Sul, São Paulo, and Pará (Table 3.2.6). Of these seven credit unions, the first cooperative (*Cooperativa de Crédito Rural de Teixeira de Freitas LTDA* – initial ID 2447) sought to expand its operations within the Bahia federal state, incorporating firms in the Teixeiras de Freitas, Itabã, Vale do Itanhém, and Brumado and region. The second credit unions (*SicoobCredicom de Belo Horizonte* – initial ID 4289) presented diversification about the Minas Gerais mesoregions, whose integration includes the municipalities of Montes Claros, Ipatinga, Barbacena, and Belo Horizonte.

Table 3.2.6. Seven Credit Unions that Most Carried-out Incorporations Between 2008 and 2020

ID of Firm	State	Number of Incorporations
2447120	Bahia	04 incorporation processes
42898825	Minas Gerais	05 incorporation processes
53923116	Minas Gerais	05 incorporation processes
95594941	Rio Grande do Sul	04 incorporation processes
2663426	Rio Grande do Sul	04 incorporation processes
4833655	Sao Paulo	10 incorporation processes
1042487	Pará	07 incorporation process

Source: Results of the survey based on reports issued by the Central Bank of Brazil and published in the Official Gazette (*Diário Oficial da União* in Portuguese). Reports were issued by the following departments: Deorf, Diorf, Digep, and Sigep of Central Bank of Brazil.

The third credit unions (*Cooperativa de Crédito Rural Coonai* – initial ID 5392) expanded its region of operation from Minas Gerais to the state of São Paulo, and the incorporation allowed the development to expand the regions of operation to the municipalities of Botucatu-SP, Cassia-MG, São Paulo-SP, Jaú-SP, and Passos-MG. The fourth credit unions (*Cooperativa de Crédito de Livre Admissão de Associados da Região Centro do RGS* – initial ID 9559) expanded its region of operation to municipalities of Caçapava-RS, Faxinal do Soturno-RS, São Sepe-RS and Nova Palma-RS.

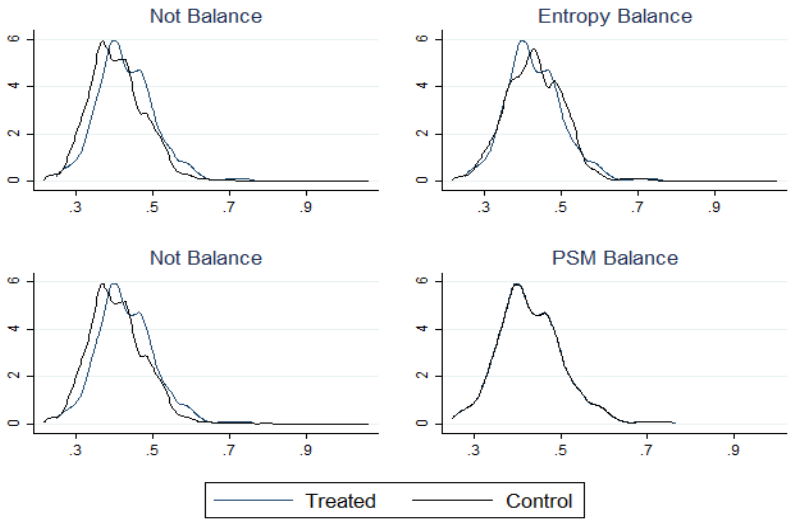
The fifth credit unions (*Cooperativa de Crédito Rural com Interação Solidaria de Constantina Cresol Constantina, do Rio Grande do Sul* – initial ID 2663) presented a greater diversification in terms of regions of activity, incorporating credit unions operating in the city of Petrolina in Pernambuco, central Agreste Alagoano in Alagoas and Araripe in Ceará. The sixth credit union (*Cooperativa de Economia e Crédito Mútuo dos Metalúrgicos da Grande São Paulo Metalcred* – initial ID 4833) concentrate its incorporations in the State of São Paulo, the region of operation began to be expanded to the city of Atibaia, Mogi das Cruzes and Santo André.

Finally, the seventh credit union (*Cooperativa de Crédito de Livre Admissão de Associados das Regiões Norte e Nordeste do Pará* – Initial ID 1042) has been reunited all credit unions of Belem/PA.

Diversifying the region of operation saw in the examples of table 3.2.6 through the second incorporation process slightly changes the perception of these financial cooperatives' strategy, under the hypothesis that their starts to present accounting results different from those credit unions that carried out only one incorporation process the period. Thus, this case justifies this second stage of analysis.

This second stage of incorporations analysis is similar to the credit unions' analysis with only one treatment (Table 3.2.3). Nevertheless, again, the PSM was the procedure that better fit to data (Figure 3.2.3).

Figure 3.2.3. Comparison of adjustments between treated and control groups by Entropy and PSM for the second treatment.



Source: Research Results

The Ramsey RESET also was performed in this stage analysis. The test results are present in Table 3.2.7.

Table 3.2.7. Ramsey RESET Test to estimates of credit unions with more than one M&A process for the second treatment.

Model	Ramsey RESET Test	Prob. > F
Not adjusted	F (2 – 154) – 85.11	0.00***
Adjusted by Entropy	F (2 – 154) – 81.74	0.00***
PSM-adjusted	F (2 – 153) – 0.08	0.92

Source: Research Results. Note: The fitted model is the first stage. *** p<0.01; ** p<0.05; * p<0.1.

Table 3.2.7 shows that the PSM is the most indicated balance method to analyze the ATT. In Figure 3.2.3, the PSM also shows a better fit between the groups than Entropy. The statistical analysis of the balance step is present in Table 3.2.8:

Table 3.2.8 shows that PSM for credit unions with more than one M&A process (Treated) against credit unions with just one M&A process have a better fit than PSM in the first stage of analysis. For all variables, the relative bias is less than 2%, and does is not possible to reject that the treated group is different from the untreated group in the analyzed dimensions. Thus, again the PSM is chosen to analyze the results.

Table 3.2.8. Statistical test between treated and control groups for Entropy and PSM Balances – Credit Unions with more than one process.

Variables	Part A – Entropy Balance						Part B – PSM Balance					
	Treated			Control			Mean			t-test		V(T) /
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	% bias	*t*	p > |t|	VC
IFDM	0.00	0.00	3.79	0.00	0.00	3.79	0.00	0.00	1.50	0.87	0.38	1.21*
Branch	4.30	0.00	-1.73	4.30	0.00	-1.73	4.30	4.30	1.30	0.71	0.48	1.06*
Population	12.23	3.39	-0.18	12.23	3.39	-0.18	12.23	12.28	-2.70	-1.58	0.11	0.93*
w1	-3.95	0.58	-0.51	-3.95	0.58	-0.51	-3.95	-3.95	0.20	0.12	0.91	0.97
w2	-4.14	0.61	-0.47	-4.14	0.61	-0.47	-4.14	-4.16	1.80	1.01	0.31	0.99
w3	-6.00	0.92	-0.34	-6.00	0.92	-0.34	-6.00	-5.97	-2.20	-1.29	0.20	0.94*

Source: Research Result. Note: Part A shows the three moments between treated and control groups after Entropy Balance. Part B shows the statistical inference between treated and control groups for PSM Balance, relative bias, t-test, and variance ratio. * if variance ratio outside [0.96; 1.04].

Table 3.2.9 presents the contribution of two or more M&A processes against just one M&A process.

Table 3.2.9. Effect of incorporating accounting and economic indices about credit unions with at least two M&A processes on cooperatives that performed just one incorporation (treatment by PSM).

Variables	ATT		GROUPS	
	% Mean	Standard Error	Treated	Untreated
C	1.81***	(0.38)	6,124	8,308
A	1.84	(2.82)	2,991	3,665
M	-4.13	(2.44)	4,322	5,748
E	-1.79	(2.40)	4,321	5,748
L	4.48	(0.56)	3,795	4,535
Indebtedness (DP) – (T.Dep/T.Assets)	1.35***	(0.46)	6,123	8,306
Equilibrium Point – (Expenses/MC)	0.28***	(2.12)	4,792	6,625
M. Contribution – (R/R-C/R)	0.09	(0.05)	4,792	6,625
Effectiveness – (Receip/T. Dep)	-2.58	(1.84)	6,124	8,306
Provision	2.02***	(0.45)	6,124	8,308
Interbank Market	1.51	(5.28)	1,705	1,858

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1.

The contribution of two or more M&A processes for the performance of credit unions has a different contribution sense. For example, in Table 3.2.9, the credit unions with two or more treatments are becoming more capitalized, as the average in Capital Adequacy increases around 1.8% after two or more treatments.

Furthermore, the ratio of time deposit per total assets has a positive effect. As the temporal analysis, this finding indicates that time deposit increases at a greater level than total assets in credit unions with more than one treatment. This result indicates that these credit unions are turning more liquidity.

Finally, the credit unions with two or more processes make up to an increase in delinquency, increasing the technical reserves by around 2%. This finding may be associated with the equilibrium point, which again shows an increase in the expenses with credit.

The first treatment results show that the incorporation process, initially recommended by Bacen, is associated with the sector's efficiency and an increase in the total assets, validating the Competition-Stability theory. However, the credit unions that decided to carry out more than one M&A process seem mainly motivated by the more significant variation of the liabilities via time deposits than total assets, seeking more liquid investments and a more capitalized portfolio. These results are in a sense with Competition-Fragility theory.

3.2.4.2. What is the general contribution of the M&A process?

The first analysis focuses on the credit unions that make up just one M&A process in the treated group against credit unions without incorporation (untreated group). The second analysis focus is on credit unions with at least two M&A processes against credit unions with just one M&A process.

Now, the analysis is general, where the treated group will consider all credit unions that make up the M&A process, and the untreated group is the credit unions without any process in the period.

Table 3.2.10 brings the Ramsey RESET to this general analysis. In general, the Ramsey test has the same behavior as the tests of other steps, indicating that PSM has a better fit than Entropy.

Table 3.2.10. Ramsey RESET Test to estimates the general analysis.

Model	Ramsey RESET Test	Prob. > F
Not adjusted	F (2 – 154) – 24.21	0.00***
Adjusted by Entropy	F (2 – 154) – 3.48	0.03**
PSM-adjusted	F (2 – 154) – 0.91	0.40

Source: Research Results. Note: The fitted model is the first stage. *** p<0.01; ** p<0.05; * p<0.1.

Table 3.2.11 and Figure 3.2.4 complements the Table 3.2.10 analysis with the statistical test between groups and visual analysis. The statistics for the general case are worse than in Table 3.2.8 and Table 3.2.3. However, the maximal bias is less than 10% in PSM and brings an acceptable fit for the analysis (see the empirical strategies). These statistics are expected, as the behavior in the first treatment has different conduct of second treatment. Thus, convergence tends to be harder in the general case. However, this case is primordial because it brings us the framework of credit union competition around 2008 to 2020.

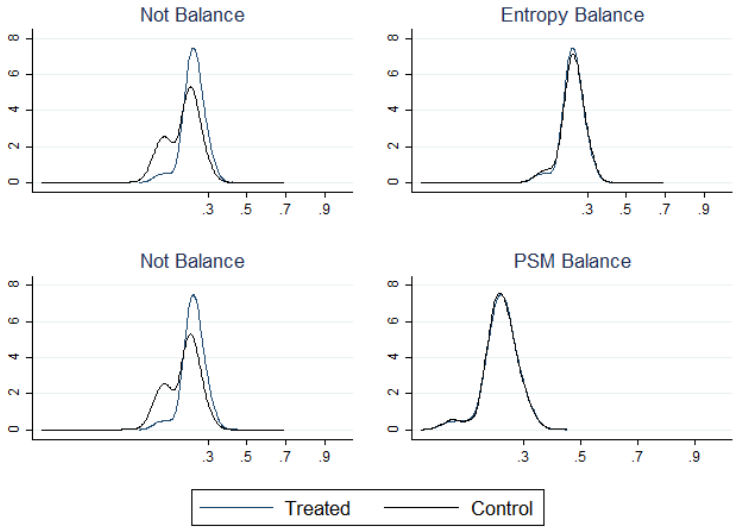
Table 3.2.11. Statistical test between treated and control groups for Entropy and PSM Balances – Credit Unions with more than one process.

Variables	Part A – Entropy Balance						Part B – PSM Balance					
	Treated			Control			Mean			t-test		V(T) /
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	% bias	*t*	p > |t|	VC
IFDM	0.00	0.00	4.37	0.00	0.00	4.37	0.00	0.00	-5.40	-4.28	0.00	0.75*
Branch	4.30	0.00	-1.77	4.30	0.00	-1.77	4.30	4.30	-6.30	-7.27	0.00	1.02
Population	11.97	3.55	0.12	11.97	3.55	0.12	11.97	11.84	6.80	6.09	0.00	0.89*
w1	-3.95	0.58	-0.54	-3.95	0.58	-0.53	-3.95	-3.93	-3.10	-2.91	0.00	0.95*
w2	-4.13	0.60	-0.46	-4.13	0.60	-0.46	-4.13	-4.10	-3.90	-3.51	0.00	0.90*
w3	-5.93	0.96	-0.89	-5.93	0.96	-0.90	-5.93	-5.90	-2.50	-2.29	0.02	0.81*

Source: Research Result. Note: Part A shows the three moments between treated and control groups after Entropy Balance. Part B shows the statistical inference between treated and control groups for PSM Balance, relative bias, t-test, and variance ratio. * if variance ratio outside [0.96; 1.04].

Figure 3.2.4 shows the visual convergence between the groups in balanced and unbalanced PSM and Entropy:

Figure 3.2.4. Comparison of adjustments between treated and control groups by Entropy and PSM in the general case.



Source: Research Results

Both Entropy and PSM bring good visual fits, but just in the PSM does is not possible to reject the null assumptions that the specification is correct. Thus, the analysis in Table 3.2.12 comes, again, from PSM.

The general findings complement the effects of the other tables (Tables 3.2.5 and 3.2.9). As Indebtedness falls in the first analysis (Table 3.2.5) and increases in the second analysis (Table 3.2.9), this general analysis variable converges to effects presented in the first treatment. Here, the credit unions turn less liquid with a negative relationship between time deposits and total assets (Indebtedness). The Effectiveness now has some meaningful and, in the general

case, the net incomes of credit unions increase are greater than a time deposit, relatively. However, the credit expenses increased almost 10% above the contribution margins, indicating that credit unions are more leverage after M&A.

Table 3.2.12. Effect of incorporating accounting and economic indices about credit unions with at least one M&A process on credit unions without process (treatment by PSM).

Variables	ATT		GROUPS	
	% Mean	Standard Error	Treated	Untreated
C	0.03	(0.22)	14,432	52,547
A	7.50***	(1.79)	6,656	12,910
M	1.42	(1.54)	10,070	34,709
E	1.07	(1.55)	10,069	34,709
L	-0.02	(0.27)	8,330	16,686
Indebtedness (DP) – (T.Dep/T.Assets)	-0.98***	(0.26)	14,429	52,415
Equilibrium Point – (Expenses/MC)	9.35***	(1.28)	11,417	34,100
M. Contribution – (R/R-C/R)	-0.08	(0.06)	11,417	34,100
Effectiveness – (Receip/T. Dep)	4.32***	(1.10)	14,430	52,339
Provision	-0.74**	(0.30)	14,432	52,401
Interbank Market	2.63	(2.71)	3,563	8,431

Source: Research Results. *** p<0.01; ** p<0.05; * p<0.1.

General analysis indicates that credit unions are more effective after the M&A process. Thus, the Competition-Stability hypothesis is straightforward. The credit unions are increasing their risk-taking and earning more revenue with credit. Finally, these results indicate a fiercer competition between Brazilian credit unions.

3.2.5 Conclusion

This chapter evaluated the Merger and Acquisitions (M&A) process between credit unions from January 2008 to December 2020. Specifically, the analysis seeks to answer what theory conducts these processes. Thus, three was the empirical analysis: [i] compared the credit unions with just one process, with credit unions without process in the first analysis. [ii] compared the credit unions with at least two treatments with just one treatment in the second analysis. [iii] compared the credit unions with at least one process with credit unions without treatment in general analysis.

The research design proposal uses the Entropy, or Propensity Score Matching (PSM) balances to adjust the credit unions in comparable groups. Thus, after comparing treated and untreated credit unions, the difference comes just one from the M&A process. The method used in the three empirical analyses was only the PSM, as this adjusted the treated and control groups without presents inadequate specification in the three analyses.

The research design considered eleven indices to determine if the theory of Fragility or Stability drives the M&A process. The threshold between these two theories is the increase or decrease of the credit in the market. The proponents of Fragility theory indicate that more liquid financial firms bring more stability to the financial intermediation. On the other hand, the Stability theory indicates that competition increases the financial system's stability.

The results were meaningful and pointed out that the main reason for incorporations in the first analysis is in line with the Stability theory, as the increase in the total assets is greater than increases of time deposits (essential input to credit).

Once some credit unions gain market share with the first M&A process, a small portion of these credit unions begin to expand their areas outside of their headquarters municipalities. In this process, the credit unions increase their time deposits and turn more capitalized. The greater liquidy in the findings of this second analysis indicates that the theory that conducts the present results are Competition-Fragility.

Finally, the general analysis, confirms that Competition-Stability is behind of most of M&A process occurred between January-2008 to December-2020. The leverage of credit unions increases around 10% after the merger process. In addition, the efficiency of credit unions also increases meaningfully. This case also indicates that the M&A process between credit unions has made competition between credit unions fiercer. Thus, the Brazilian Central Bank recommendation seems to be a good policy to increase the efficiency of credit unions.

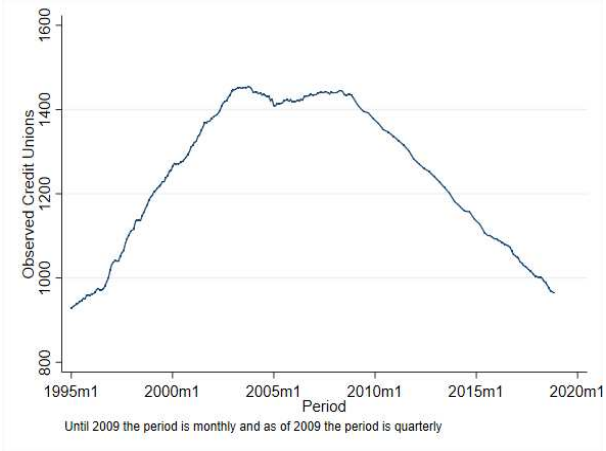
As the Competition-Stability predicts a U-shaped, between risk-taking and bank failure, the minimal point seems to be in the second treatment. Analyzing by Dual, the minimal point of Competition-Stability is the maximal point of the production function. Thus, deductively hypothetical, we can say that credit unions with at least two processes are leaving the transition towards the more mature phase of cooperativism.

As continued research suggests analyzing how this gain in market share interfered with the variation of commercial banks' market power and the variation of interest charged by them by loans. Also, since the incorporations take place where commercial banks and credit unions coexist, it would be interesting to analyze whether, in these municipalities, there is any competition for inputs between these two types of financial firms.

3.2.6 Appendix for "Mergers and Acquisitions in Credit Unions and Development of the Brazilian Financial System: Competition-Stability or Competition-Fragility."

Figure A3.2.1. The number of Credit Unions and M&As occurred between 2009-2020.

Panel A - Evolution of coop quantity.



Panel B - Coop M&A. Credit

Period	Difference	M&A
2008	-	13
2009	47	26
2010	48	29
2011	49	29
2012	54	31
2013	43	38
2014	59	35
2015	41	41
2016	36	34
2017	44	48
2018	50	37
2019	45	44
2020-20	52	24

Source: Research results based on the Accounting Report of the Bacen Cooperatives.

3.3 COMPETITION FOR DEPOSITS MINING IN A BRAZILIAN FINANCIAL INTERMEDIATION NETWORK: CREDIT UNIONS STATIONS X COMMERCIAL BANK BRANCHES?

ABSTRACT

This chapter analyzes whether credit union service stations compete with commercial bank branches in the deposit mining market, referred to as hot markets (or hotspots). The research design uses the systematic transfers of deposits between financial institutions from 2008-2019 to estimate financial institutions' networks. The data that make up this research is at the municipal level and is available on the Central Bank of Brazil website. Thus, five macro-networks were estimated for each Brazilian macro-region (South, North, Northeast, Midwest, and South-east). From then on, this chapter used the QAP (Quadratic Assignments Procedure) and the weightings based on Propensity Score Matching and Balance Entropy to analyze the dynamics between these two classes of banks. The results indicate that credit unions and bank branches compete in a deposit mining sub-market. However, credit unions are not yet in the hotspots. The entry of credit unions in these markets is associated with reducing the total final product, signaling a possible barrier to entry by bank branches, and lacking possible public policies for the sustainable entry of credit unions. At this point, it appears that the business model of credit unions is independent of the business models of commercial banks, which allows the formulation of different policies for each taxonomy of financial institutions.

3.3.1 Introduction

Credit unions and commercial banks[31] play an essential role in the brokerage of financial certificates to eliminate possible market failures, promote economic development, and fulfill their indirect role as producers of goods in the capitalist world (SCHUMPETER, 1985). However, the institutions' actions are decisive and have more relative weight than their market share in financial intermediation (see the proponents of Competition-Stability Theory. E.g., Allen and Gale, 2004; Boyd and Nicoló, 2005; and Myers and Rajan, 1998).

According to the first empirical chapter of this thesis, comparing the various taxonomies (public and private commercial banks and credit unions) in the downstream market of Brazilian financial intermediation, only the credit unions are associated with a positive financial inclusion behavior at adverse times. Commercial banks (exceptionally private banks) also may promote greater access to credit, but there is no evidence that this occurs so far (2019) comparing with the 2008 level. In this context, the sums of credit unions' shares operating in Brazil rose from the 19th position in 2008 to the sixth position in 2019.

This result is associated with credit unions' guidance in promoting local and economic development, especially to develop the activities carried out by their members (SNAC, 2016). Furthermore, the non-orientation to profit, aligned with the efficiency gain in allocating resources and the scale of action, has been another merit of credit unions that favor financial inclusion in the environment in which it operates (KLINEDINST, 2012). Thus, the second chapter of this thesis shows that Brazilian credit unions are becoming more competitive utilizing mergers or acquisition processes.

Even with efficiency gain, a handful of credit unions have some lags in terms of market share because these financial institutions do not have a joint administration. Their performance has been mainly local and, most often, with an administration focused on a small group of cooperative members (SNAC, 2016). Notwithstanding, since 2003, credit unions have increased their participation in municipalities with more and more populations, where from 2010 onward, credit unions were allowed, under certain conditions, to operate in large Brazilian cities (BACEN, 2010).

[31] commercial in the sense of acting in the retail market. In Brazil, public banks, private banks, and technology companies operate in this space (FinTech). In this article, the term "commercial banks" will always be used to demonstrate the performance of these types of banks. When it is of interest to segregate the performance of each type of bank, the reader will be warned.

This movement of credit unions put two classes of financial intermediation firms in the same municipality: credit union service stations and banking branches. Analyzing the Central Bank of Brazil (Bacen) data between 2008 and 2019, it is possible to confer that, rarely, single credit unions have more than one service station, while the bigger commercial banks have two or three banking branches in the same municipality. Thus, municipally, credit unions act as individual banks against some municipal networks of commercial banks brands. A similar case occurred in the United States of America (US) between the 1920s and 1930s. Carlson and Mitchener (2006) compared the states with just one bank band, without branching, against states with more than one bank class (allowing bank branching). They concluded that monopoly status is likely to be eliminated in states with more than one banking class.

Despite commonly Brazilian credit unions acting individually inside the municipality, many of these firms act within a vertical system, creating their own network. This network goes beyond the municipal border and gives support for the credit unions against the competitive commercial bank branches network. However, according to Allen and Galle (2004), there is the "lock-in" effect that emerges with "Lemmon" degree cases when the borrower switches from one bank brand to other or banking class to other. As the new bank does not have temporal information about the new client, it may put a learning cost at the change starts. Open Banking seeks to solve this problem, but, in Brazil, it will become partially active only from mid-2021(BACEN, 2021).

A point draws attention when it is compared the cases between classes of banks. Bordo, Rockoff, and Redish (1994) compared the financial intermediation of Canada against the US financial intermediation system. Many states have individual banks in the US, while the Canadian system has a few branch banks. Their results indicate that the rates paid for Canadian depositors were higher than rates paid in states of the US with just individual banks. This result is an essential point because deposits are the primary means of survival for firms. In addition, according to the second empirical chapter of this thesis, the mergers or acquisitions of credit unions have been induced by more competition, risk-taking, and credit in the market. Thus, depending on the type of bank, the more deposits it can attract, the more it can lend, increasing its returns to scale (BORDO; ROCKOFF; REDISH, 1994).

Given this framework, this research aims to analyze whether there is any competition between credit union stations and commercial bank branches in places where these two types of institutions coexist. Specifically, the analysis focuses on the bank deposit product (Cosif account 41000007 and their equivalent in the ESTBAN) observed in financial institutions at

each Brazilian municipality, considering its location within the five macro-regions defined by the Brazilian Institute of Geography and Statistics (IBGE).

Two keywords are essential in this chapter: *key points* and *hotspots*. The key points refer to all financial firms that make systematic deposit transfers to other financial firms. The hotspots are the financial firms that most make systematic deposit transfers, considering a threshold of 20%. The present analysis focuses on inputs because it is crucial for effective financial intermediation, as the Canadian case demonstrated in the Bordo, Rockoff, and Redish (1994) research. Then, intermediation begins with the transfer of inputs in the interbank market, mainly on a regional basis. Thus, two are our hypotheses:

i. The concentrations of bank deposits occur in places and firms where commercial banks branch and credit union stations coexist.

ii. Commercial bank branches and credit union stations compete for bank deposits in these locations.

This chapter adopts the network approach to evaluates these hypotheses. The idea is to estimate an array of deposit flows that identify the transfers of resources from one financial intermediary to another. I.e., the target is to estimate the flow and sense of systematic interbank transfers, considering that a bank branch or a credit union station captures deposits in one municipality and sends it to another financial firm (in the same or another municipality) that may lend on the downstream market. Thus, the author will identify one dynamic transfer, at least dyadic, of resources from financial intermediaries (bank branches and credit union stations) and analyze the systematic transfer relationships that these financial firms spatially make between them. Also, from network analysis, the author will identify the deposit hotspots among the key points for both institutions, assessing whether bank deposits are determinant for the occurrence of flows, and then answer:

- What is the dynamic between commercial bank branches and credit union stations at key points?

The author's starting point focuses on estimating the *Deposit Flow Matrix* (called *Array F*). These estimates come from complementarity and substitutability between financial intermediation firm liabilities[32]. Based on Fukao (1983), the authors analyze whether the

[32] Bank deposits

institutions compete from these microeconomics foundations. This Array F forms the banking network, as the studies of Fernandez (2011) and Ding and Sickles (2019). Therefore, following Fukao (1983), the construction of the flow matrix will be based on the Pearson Correlation between the quarterly observations of financial institutions' deposits from 2008 to 2019. Here, one problem emerges because the Pearson Correlations only draw the directions. Thus, the author proposes a method to find the sense of deposit flows between financial firms. This contribution to literature is present in the Methodology section.

From Array F, it is possible to evaluate both hypotheses econometrically. The first analysis is on Quadratic Assignments Procedure (QAP), developed from the 1960s and which has been reissued its popularity in the last 20 years with the development of network economy and the expansion of the model for the Multiple Regression Quadratic Assignments Procedure (MRQAP), developed to estimate multiple equations (DEKKER; KRACKHARDT; SNIJDERS, 2007; KRACKARDT, 1987; KRACKHARDT, 1988; MANTEL, 1967; SIMPSON, 2001). Altogether, from the network economy, the research design also predicts other network analyses (as the degree of clustering, the outdegree, and indegree of each financial institution) that contribute to achieving each specific objective.

Subsequently, the Average Treatment Effects on the Treated (ATT) is the base to compare the hotspots to other financial firms, indicating how much more deposits transfer, on average, these financial firms do than financial firms that are only at key points. Thus, the research designs predict a simulation to evaluate whether entering the credit union in the hotspot market increases the probability of obtaining more inputs. The difference between ATTs (proved by natural market stage and simulation market stage) give us the answers for the second question of this chapter:

- Is there a competition between credit union stations and commercial bank branches in municipalities with hotspot inputs?

The identification strategy comes from Game Theory, whose empirical approach is typically the static entry game where one firm has its decision space and chooses whether to enter a determined market according to the rewards and costs (e.g., Bajari *et al.*, 2010; Berry, 1992; Bresnahan and Reiss, 1991; Ciliberto and Tamer, 2009). However, the theoric base of the present analysis is Product Life Cycles Theory and Production Theory, considering the maturity degree of credit unions in the sense of Fergunson and Mckillop (1997). Thus, the double-difference from ATT's analysis does not seek to find the rewards after possible entry of

the credit unions but sought to identify the reaction of incumbents (commercial bank branches) if the credit unions enter the hotspot market.

The results confirm the two hypotheses, showing competition between the credit union stations and commercial bank branches in the key points, as these two firms are considered substitutes. However, it stands out that, although credit unions act as "exporters" of deposits to other credit unions, they have not yet entered the hotspot market. This result comes from the simulations showing a possible deterrence from commercial bank branches in places where these two firms act. These results are essential for financial inclusion policy formulation, and their content brings relevant information about the current situation of the deposit mining market in Brazil.

In addition to this introduction, this research is divided into six more parts. The following section splits into three subparts that will present each stage of identification. The fourth section is devoted to the descriptive statistics of the variables used. Section five, also divided into three subparts, presents the results. Finally, it ends.

3.3.2 The definition and Conceptual Mechanism Behind the Competition

As presented in the introduction of this chapter, we have two classes of financial intermediation firms inside of municipalities (single credit union stations and a network of banking branches). The process of identifying competition between these classes requires some cautions about the objectives of this research because many studies have sought network methodologies to analyze the banking market, however, with different purposes. E.g., Craig and Von Petter (2014) used the network theory under data from 1999-2012 and found evidence that German banks do not lend to others directly, as the firms of that market use the central bank as intermediation. Cerutti and Zhou (2017) also have used the network theory to analyzes bank globalization, comparing the network with the pre-crisis of 2008 against the post-crisis. Their findings indicate that financial firms are become interlinked regionally, reducing their global dependence. Ding and Sickles (2019) estimated panel data for US banks between 2001-2016. This estimate's residuals allowed them to construct their network to control the spatial error framework and analyze the effect of capital restriction under-investment and assets risks. The last recent example of network utility in the banking literature presented here comes from Zhang, Zhuang, and Lu (2020), employing the econometric model and network theory to

evaluate the spatial spillovers of volatility among G20 stocks. They indicate that indirect effects are more significant than direct spillover effects on global markets.

The cases presented above are several, and the network analyses combined with econometric analysis have so many more cases that enable the evaluation of other empirical research. The present case's main objective is to analyze the competition between commercial bank branches and credit union stations in the municipal deposit market. Thus, this research sought to classify the financial firms in the hotspot or key point markets from network theory. Then the research design simulated the credit union entry in the hotspot, verifying the incumbents' behaviors. This section seeks to bring the meaning of *competition* to the reader to understand, without doubt, the procedure adopted in the identification strategy of this research.

The competition concept in this research derives from the five forces described by Porter (1979): rivalry between competitors, monopsony power of buyers, the monopoly power of suppliers, barriers to entry, and the existence of substitute products in the market. This research does not intend to dismember the concept analyzed over the years or expand it, but to analyze whether two-fifths of forces analyzed by Porter are present. These are the existence of substitute products through credit unions stations and commercial bank branches in the same municipalities and the rivalry for inputs between these two institutions in these locations. The other three points are considered as consequences of this research.

In the sense of rivalry, the widely known economic ecology concept brings a base of competition for this research, indicating that rivalry is the interaction between the companies that need the same limited resource to survive (PERMAN *et al.*, 2006, Cap 5). In this sense, the bank deposits held by bank branches and credit unions stations are private liabilities for these firms[33] and are economically rivals and excluding.

Deposits raised by these firms are also substitutes if the costs of change are low and financial portability is applicable. Therefore, the expansion of the service network of credit unions to new neighborhoods of the municipality assumes the Hotelling (1929) behaviors and can facilitate the raising of resources. The same type of analysis can occur for bank branches.

However, credit unions only make these moves if their cooperative members desire, while profitable bank branches expand their operation regions within the municipality if this strategy is viable for shareholders (DELLER; SUNDARAM-STUKEL, 2012). Thus, there be competition between commercial banks and credit union stations in each municipality if, and

[33] Deposit is then considered to financial institutions as an inventory variable. This relationship is because of the cost of imprisonment imposed by these firms (for entrapment analysis see: SILVA, U.S.; LUCINDA, 2017).

only if there is an intersection between these two desires. This intersection may start from credit unions' desire, commercial banks' desire, or both.

Once this intersection exists, the author can analyze the competition and dynamics between these two classes of financial firms, defining a convex set in the sense of the theoretical chapter of this thesis. As the commercial bank branches are the incumbents and service stations of credit unions are the entrants in the municipalities, the leading share of deposits belongs to the incumbents. Thus, credit unions are the competitive fringe at the time of entry. Therefore, the competition occurs through the variation of the opportunity costs when credit unions enter the municipality (see the theoretical chapter of this thesis).

3.3.3 Methodology

3.3.3.1. The Flow Matrix

Four parts compound the research design. The first one is critical because it estimates the bank deposit flow matrix (*Array F*). This matrix should represent the systematic (statistically significant) transfers from a bank branch or credit union to another financial firm. The author used Pearson's correlation to capture these systematic transfer coefficients from a linear relationship between the deposits of the various financial institutions. Thus, be the firm i that keeps the deposit D in the municipality m in period t, forming the vector $D_{i,m}(d_{i,m,t}, \ldots, d_{i,m,T})$ for $i=(1,., n)$.

Suppose the bank deposit is coming out of firm i with systematic destination for firm j. Then, considering everything else constant, the deposit account of these two firms has a negative correlation in time because the firm i account decreases and the firm j increase in the period of the transfer. In the corner solution, this variation brings a correlation equal to -1. Thus, for these institutions, the elements of the flow matrix assume 1. If there is a meaningful positive correlation, then the flow matrix element is equal to zero—the statistical significance comes from the t-test.

After estimating all the correlation matrix elements and the constraints imposed, the author finds the *Matrix X*. However, because the correlation $\hat{\rho}$, between firms i and j, is equal to the correlation between firms j and i, the flow matrix still does not allow us to identify where the resources are coming from and where the resources are going, but only whether there had a negative linear relationship between both accounts. In other words, the *Matrix X* has only two dimensions. However, the deposit transfers are vectors with orientations and directions, but

symmetric *Matrix X* assumes no orientation. Thus, to increase one more dimension in the *Matrix X*, the author created a new matrix called Z_{nx1}, where Q_{nxn} is the diag (Z_{nx1}). Finally, the author created the J_{nxn} = 1 matrix. From here, to identify the sense of the direction, the following procedure was adopted:

$$\begin{array}{ll} 1 & YU = \mathrm{JQ}' \\ 2 & YL = YU' \\ 3 & F = YU - YL \end{array} \qquad (1)$$

From operation number 3 of the array[34] in Equation 1, the author identifies the resources' orientation. Because the analysis occurs on the mean, the corresponding values of the variables in the diagonals (upper and lower) have different signals. Thus, the positive values represent the financial institutions that receive the deposit transfers, and the negative values represent the financial institutions that send the deposit transfers. Then, there is a transform for the symmetric matrix into a non-symmetric array. The values equal to one are the elements considered as key in this research.

$$\mathrm{F} = \begin{bmatrix} 0 & \mathbf{0} & \cdots & 0 & \mathbf{1} \\ 1 & 0 & & 0 & 0 \\ \vdots & & \ddots & & \vdots \\ 0 & 0 & & 0 & 0 \\ \mathbf{0} & 0 & \cdots & 0 & 0 \end{bmatrix} \qquad (2)$$

where bold values are examples of possible filters that occurred in the matrix.

From *Array F,* the author performed several descriptive statistics, such as identifying the pattern of systematic transfers in which bank branches and cooperative service stations are subject. Also, this procedure allowed to identify the social distance in which a given credit unions stations is from a given bank branch, assessing which path the deposit goes from credit unions to the bank branch (and vice versa). In this sense, following Freeman (1978), the hotspots analysis (hot marketplaces) considered centralized institutions' existence in systematic transfer patterns.

The procedure for identifying hotspots considered how many connections (ties) a particular financial institution (bank branch or cooperative service stations) sends (outdegree) or receives (indegree). Therefore, the following procedure was necessary to calculate these connections:

[34] Arrays have three or more dimensions, while matrix have only two. The Array F has firm *i* firm *j* and sense of transfers as dimensions.

$$C_o(i) = \sum_{j=1}^{\infty} f_{ij} \;\; ou \; C_i(i) = \sum_{j=1}^{\infty} f_{ji} \quad (3)$$

C_o is the outdegree, and C_i is indegree; i is the row, and j is the columns; f is the *Array F's* element.

For this research, hotspots are the outdegrees with the highest degree of centrality, considering a threshold above 20%. The centrality comes from Equation 4:

$$C_x = \frac{\sum_{j=1}^{\infty}[C_x(i^*) - C_x(i)]}{max \sum_{j=1}^{\infty}[C_x(i^*) - C_x(i)]} \quad (4)$$

where $C_x(i^*)$ is the point with the highest centrality value of the network. $C_x(i)$ is one of the central points defined according to the index (outdegree or indegree). The denominator represents the most considerable sum between the central point difference for the other analyzed array points.

If all firms have the same centrality degree, then the region's centrality index equals zero. Otherwise, the centrality varies from 0 to 1, to the highest degree of heterogeneity among firms. Moreover, following Watts and Strogatz (1998), the procedure also identified the cluster of financial institutions.

$$\mathrm{Cavg}(\mathrm{f_{ij}}) = \frac{1}{\mathrm{N}-1} \sum_{\mathrm{j}=1}^{\infty} \mathrm{w_{ij}} \quad (5)$$

where Cavg is the average cluster percentage, $\mathrm{w_{ij}} = \left(\mathrm{f} + \sum_{\mathrm{j}=1}^{\infty} \mathrm{f_{ij}}\right)$ N is the number of existing nodes.

The w_{ij} represents the maximum existing *node paths* that interconnect financial institutions *f.* Thus, for a given financial institution *f*, the cluster's degree is given by the total of firms that this financial institution sends resources, divided by the possible total that the same firm could send. Identifying the degree of the cluster of financial institutions in each macro-region is essential. Equation 6 allowed to control the probability of a key point in the competition analysis, as the cluster had been an estimated characteristic of the firm, as demonstrated in equation 6:

$$Cover(N) = \frac{Closed}{Connected} \quad (6)$$

where *Closed* means the total of three firms that are connected (without connecting edges). Connected indicates the total of three firms connected through two edges (indirectly).

Thus, Equation 5 represents each firm a degree of centrality. On the other hand, Equation 6 indicates how strong the network is. These equations had allowed us to identify and

evaluate the firms' patterns with greater connection and development entry strategies in the respective cluster. To this relationship, one can apply the analysis of game theory.

Finally, an econometric model was estimated to determine the flow's probability, considering the characteristics inherent to bank branches or credit union service stations. This analysis is in the following subsection.

3.3.3.2. The Econometric Analysis of the Probability of the Network Existence

Network models that follow *Array F*'s presentation suffer from structural problems because the dyadic observations were constructed based on bank deposit correlations. The relationship between two firms creates a series of statistical inference barriers, as there may be a correlation between error term observations (SIMPSON, 2001).

According to Dekker, Krackhardt, and Snikders (2007), the error at the second moment can exceed 50%. Thus, two different approaches in the literature are evaluable to correct this bias. The first is the Quadratic Assignment Procedure, or QAP, as it is better known. The second methodology is composed of the Exponential Random Graphic Models (ERGM). The focus of ERGM is on modeling the dependency found in the analyzed network (DEKKER; KRACKHARDT; SNIJDERS, 2007).

On the other hand, the QAP has been used to analyze the probability that a given event occurs. Thus, QAP has been estimated by Ordinary Least Squares (OLS) or Logit in the didactic binary matrix (SIMPSON, 2001). In this research, the procedure used the Logit because the *F matrix* is binary dyadic. Empirically, the model takes the following functional form:

$$F_r = \beta_a Y_r + \mu \qquad (7)$$

F is the estimated square *n x n x d* array. For a given region composed of municipalities containing bank branches or credit unions stations. The β_a is a scalar to be estimated based on their respective variable *a,* including the constant. With dimension *n x a*, Matrix *Y* is a group of independent variables that explain the *F* dyadic moments. Finally, the μ is the error term. Table 3.3.1 resumes the variables contained in *Y*:

Aggregate deposits at the municipal level are essential to determine whether their presence in each municipality contributes to the probability of having a financial institution that transfers resources to the rest. Thus, the variable *Deposits* at the municipal level are crucial to identifying the probability of key points' existence in *Array F*. Deposits in monetary values was

transformed to the logarithmic scale, considering the value of the Napierian number as the basis. Then, the derivative about institutions *i* concerning *j*, being *i = j=0*.

Table 3.3.1. Variables contained in Matrix Y and their descriptions.

ID	Variables	Description
1	Deposits	Aggregate deposits at the municipal level (ESTBAN)
2	Transfer between the same FI type	Coop. Single Credit, Central or Bank Branch (BACEN)
3	Transfer between Differ FI type	Coop. Single Credit, Central or Bank Branch (BACEN)
4	Quantity of Agency	Number of stations or agencies in the municipality (BACEN)
5	Municipal Population	The population of municipalities in 2018 (IBGE)
6	HDI – Municipal (IFDM)	Development index 2018 for municipalities (FIRJAN)
7	State of the Federation (UF)	State of the federation in which IF is located (BACEN)

Source: Research Result. FI is Financial Institutions. The Deposits variable is the COSIF account 4.1.0.00.00-7 for credit unions and the sum between accounts 420, 432, 430, and 431 of ESTBAN for Bank Branches. More details about the accounts in BACEN (1964).

There is one variable with two types of analysis between the transfer of financial institutions (ID = 1 and ID =2). In the gross form, this variable assumes a value equal to 1 for the bank branches of commercial banks, 2 for the singular credit unions' service stations, and 3 for the central credit unions. The Midwest region is the only one without a central credit union, so this variable in that macro-region only goes until category 2.

The first analysis, "same," or ID=1, aimed to identify the probability of occurrence node from the same firm types because it is a categorical variable. I.e., from singular credit unions to singular credit unions. The "Differ," or ID = 2, refers to the distance between one class and another in the second analysis. Therefore, this second type of reading sought to analyze nodes' probability for the different financial institutions, being zero when the types are equal.

The variable "*Quantity of Agencies"* quantifies how many credit union services stations have within the municipality and how many bank branches of a specific bank *i* also have. Its analysis refers to the difference between the variables that firm *i* have*,* about firm *j,* being equal to zero when *i = j*. Thus, this variable's analysis indicates whether having one more face-to-face service in the municipality increases the key point occurrence probability.

The variable "*Municipal Population*" had the control character of the environment firms' size, thus considering the probability through the municipalities' size. The analysis focuses on the difference between the population in which firm *i* is subject and the population in which firm *j* is subject (being zero when firms *i* and *j* are in the same municipality).

Similarly, the "*Municipal Human Development Index*" was used to identify whether a bank branch or service station's probability be a key point depends on human development. Thus, this variable sought to capture any difference in the development index or the population's size, making it more likely to be a transfer firm.

Finally, the last variable involves the state of the federation to which the financial firms are. The *UF* variable contains values within the set [1,27], where each set number represents a federation state. However, the macroregional values vary according to the number of states within each region, being [1,3] for the South region, [1,4] for the Midwest region, [1,7] for the North region, [1,9] for the Northeast region, and [1,4] for the Southeast region. This variable's analysis sought to control the probability of the transfer between financial institutions belonging to the same state of the federation.

The main problem that has been pointed out in the literature for the estimated QAP model by OLS or Logit, without any treatment of variance, is in the correlation existing in *Array F*. In the present case, this problem is the dynamics of bank deposits that come from the Pearson's correlation in the construction of this array. I.e., the deposits can be in multiple places simultaneously, generating a "false" transaction feel.[35] For example, the same deposit certificate may exit bank A, pass through credit union A, go back to bank A, and then bank B. The correlation between these accounts does not affect the estimated OLS or Logit coefficient. However, the variance and covariance matrix is impaired because it enters as an inflationary factor, generating a high bias and the model's inefficiency.

The literature has suggested permuting the rows and columns simultaneously of the *F* matrix (dependent variable) to simulate various situations (SIMPSON, 2001). This permutation generates a random *R(F)* array that allows formulating the null hypothesis of non-association between matrices *F* and *Y*. This new random association generates a reference distribution of values that allows statistical inference.

According to Jackson and Somers (1989) and Mantel (1967), a sample between one thousand and ten thousand observations is relatively sufficient to approach the reference distribution applying about *a!* random permutations in *R(F),* where *a* is the smallest dimension of unrepeated variables of the *Y* matrix.

3.3.2.3. The Competition Identification Procedure

The competition identification procedure is an analysis that occurred after the estimation of the QAP coefficients. However, the steps adopted in that procedure are insufficient to identify competition in the hotspot markets. Although the variables control as much as possible the characteristics inherent to the financial institutions analyzed, they do not also make the institutions in the hot market compared with the other institutions.

[35] False on account of the bank multiplier.

Two main models with the ability to make the treated groups (elements equal to 1 in *Array F*) and control (elements equal to zero in *Array F*) as close as possible have been used in the economic literature: the Propensity Score Match (PSM) and Entropy Balancing (EB). As a measure of robustness, this research uses both models. For specific details of the procedure used in each case, see Hainmueller (2012) and Mcmullin and Schonberger (2015) for EB analyses and Heinrich, Mafioli, and Vazques (2010) for PSM case.

From the weightings, it is possible to assess the hotspot market's effect against other financial institutions. According to Caliedo and Kopeining (2005), this procedure is known as the Average Treatment Effect on Treated (ATT) in the econometric literature. A brief presentation of this procedure is given by:

$$ATT_d = E(\tau \,|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1] \quad (8)$$

where Y(0) represents the effect in the control group, and Y(1) represents the effect in the group represented by firms in treatment, and *d* is formed by three periods of estimates.

Equation 8 was estimated three times, each time (step *d*) with one different objective. The first refers to the network in its natural state, sense, and dimensions. In the second step, *d* was performed as a simulation, where the credit unions enter with their respective deposits in the hotspots market. The simulation criterion for assessing whether a credit union was considered a hotspot firm was its participation in the same municipality of a financial hotspot firm. Note that a credit union service station does not need to be, necessarily, a key point firm. The hypothetical idea is that the managers change their orientation and enter the same market as the hotspot firm in that municipality. Empirically it is known as banking of credit unions.

For example, suppose the hypothetical hotspot firm *j*, located in municipality *m*, sends inputs to any financial firm *s* in the simulation. In that case, the credit union will enter this market and send their inputs to the same firms *s*. This research design performed this simulation for all municipalities where hotspots coexist with credit unions.

In the third step, the original ATT was then pared separately with its simulations to identify variations in bank deposits at hotspots. In this step, The standard deviation from the difference between the original ATT and the simulated ATT comes through Delta Method (see Oehlert, 1992).

The ATT in two first¸ *d*, steps were considered the first difference step. The second period in this step indicates how different deposit-taking is if the credit union services stations enter hotspot markets. The comparison was performed with another financial firm that does not enter the hotspots market. The first period indicates the current state of the deposit market.

The difference between ATTs is a production function (deposit vs. quantity of firms) analysis that indicates the following cases:

i. If the differences between ATTs is positive and statistically significative, and the first stage is also positive and significative, then it is rational for the service station to enter in hotspot market, as the analysis of the maturity degree of financial firms (Nascent);
ii. If the difference between ATTs is statistically insignificant, and the first stage was positive and statistically significative, then the maturity of credit unions is at its optimal, and again the enters the hotspot market is rational (Transition);
iii. Suppose the ATT differences are negative and statistically significant, and the first stage is positive and significant, then credit unions found a market saturation, where the entry of a new competitor reduces the results of deposit mining. In this case, it is irrational the credit unions ingress (Mature); and
iv. If credit unions enter hotspots markets and the first stage is negative, this action irrational moves (Decline).

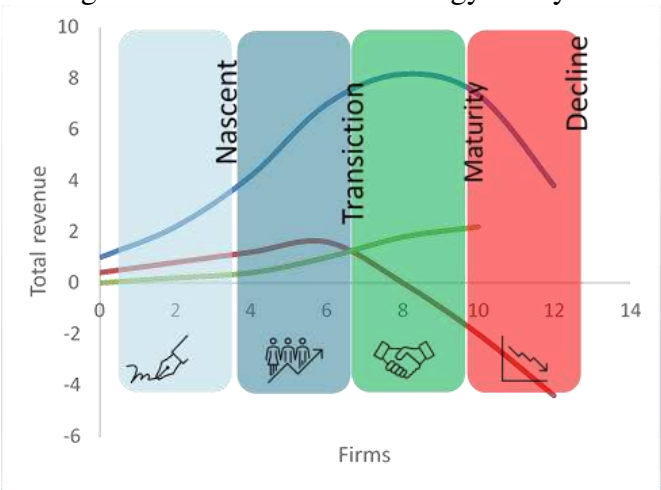
The identification occurred according to BE and PSM balance. Both models include the same variables. The validation of results considers the logical analysis. The model is accurate if all BE or PSM models adjust the variables without disturbances in their mean, variance, and kurtosis (to PSM) or skewness (to BE).

The criteria to consider the points [i, iv] is BE or PSM (or BE ∨ PSM). If the sentence BE ∨ PSM is true for some hypothesis of the above items, the respective item is valid. If just one model presents adjustments in all variables without disturbances and another model presents disturbances at any moment, then the item is weakly identified. If all BE or PSM model variables adjust without disturbances in their moments, and each model identifies a different set of items (e.g., i and ii or iii and ii), the analysis indicates no competition.

Following the maturity of credit unions, proposed by Fergunson and Mckillop (1997), and according to Production Function theory (Figure 3.3.1), the item *i* and *ii* indicates, in general, there is not a competition between commercial banks branches and service stations, because there is space to each firm type increase the mining production. Items *iii* and *iv* indicate

that commercial bank branches and credit union stations compete by a market deposit because the market is saturated.

Figure 3.3. 1.The Visual Strategy Analysis.



Source: Own elaboration.

Always that (iv) occurs, the competition between commercial bank branches and credit union service stations will be present.

3.3.4 The Data Descriptive Statistics

Five matrices were estimated, one for each Brazilian macro-region, following IBGE's previously established division. Thus, the strategy considers only flows that occur within each of these five macro-regions[36]. One crucial point that we highlight is the number of financial firms. Unfortunately, this research only considers the financial firms with at least 32 quarters of information from 2008 to 2019. This limitation is due to Pearson's correlation and the freedom degree that the model lost when performing the statistical inference on *Array F'*s construction.

Table 3.3.2 contains the total of bank branches (BB) and their standard deviations. The same is for Credit Union Service Stations (CUSS), Total population of each region in 2019

[36] For example, people consume energy, water, light, internet, cable TV among others. Every month a wage earner receives his resources. These resources come out of a financial institution and go to another financial institution (we have a transfer). People pay their consumption bills (we have another transfer). The point is that the dealerships presented in this example are regional and receive payments in a single account in a given region. Thus, it is possible to consider that most retail market flows are regionalized and that national flows may not reflect well the retail structure, as they are subject to different interferences, such as Investments, Purchasing and Sales, Monetary Allocations, among others.

(Pop), FIRJAM Municipal Development Index (FIRJAN, 2008) – considering the average of the municipalities of each region –, and for deposits maintained between 2008 and 2019 by the financial institutions of each region.

Table 3.3.2. Description of data by region.

Region	BB	CUSS	Pop 2019 (1,000)	IFDM	Deposits (R$ 1,000,000)
Midwest	1,901.00	94.00	312,894.00	0.74	503,975.00
	(5.68)	(0.30)	(676.00)	(0.07)	(10,300.00)
Northeast	3,922.00	96.00	560,180.00	0.62	235,795.00
	(3.26)	(0.19)	(511.78)	(0.09)	(605.00)
North	1,220.00	50.00	169,364.00	0.60	52,581.00
	(2.26)	(0.23)	(419.58)	(0.10)	(298.00)
Southeast	13,521.00	365.00	3,198,186.00	0.76	34,279,821
	(12.13)	(0.25)	(2,067.59)	(0.07)	(11,300.00)
South	4,865.00	353.00	417,472.00	0,77	423,239.00
	(3.61)	(0.31)	(312.89)	(0,06)	(1,250.00)

Source: Research data. Data in parentheses reflect the standard deviation. Inside the parentheses are the standard deviations (SD). Above SD, we have the total for BB, CUSS, Pop, and Deposits. The IFDM is the macro-region average.

The variables presented in Table 3.3.2 will enter only as an explanatory variable. This Table shows that the region with the highest number of bank branches and CUSS is in the Southeast region, followed by the South, Northeast, Midwest, and North. However, estimating matrices with these dimensions is computationally unfeasible[37] and analytically with little additional information.

Thus, bank branches and credit union service stations were aggregated into Banking Representatives Branches (ABR) and Credit Unions Representative Service Stations (CURSS), both by each municipality. Thus, for example, if credit union *j* has two services stations in the municipality *m*, the result is under representative of these two credit unions (CURSS) in this same municipality. The same is the case for commercial banks. In this way, municipality A may have several financial institutions of the same CNPJ but represented by only one branch or CURSS in *Array F*.

When aggregating in representative firms, we do not lose information. The number of branches in each municipality will be included as an exogenous variable, and its coefficient will indicate how important the municipal network, on average, is for the nodes. Table 3.3.3 contains the number of representative bank branches and representative services stations analyzed in *Array F*.

[37] In terms of time.

Table 3.3.3. The number of Cooperative Service Stations and Bank Branches Contained in Array F

Region	Representative Banking Agencies	Representative Cooperative Service Stations	Total
Midwest	995	90	1.085
Northeast	2.621	95	2.716
North	836	50	886
Southeast	5.417	351	5.768
South	3.072	347	3.419

Source: Research data. Data were obtained from the following agencies: ABR and CURS from the Central Bank of Brazil (Report 4010, EstBan, and Financial Relations).

Tables 3.3.2 and 3.3.3 shows that commercial banks' ballast overcomes credit unions in all macro-regions. On average, commercial banks have about two bank branches throughout Brazilian municipalities, with the southeast region with the highest average number of branches, 2.5 per ABRs. On the other hand, credit unions are represented uniquely, with an average of only one cooperative service station by CNPJ (This is the acronym for identification number of firms in Brazil – in Portuguese, this means *Cadastro Nacional de Pessoa Jurídica*) in all macro-regions, and in some municipalities can reach a maximum of 2 service stations.

The last column in Table 3.3.3 represents the dimension of *Array F*. In the case of the Midwest region, 1,085 financial firms have, between representative credit unions and representative bank branches, the flows analyzed among themselves. Therefore, the gain of analysis in reducing the dimension (sum between ABR and CURSS) for the total presented in Table 3.3.3 is meaningful.

Computationally, the estimated time to perform the analysis considers the matrix dimension exponentially. For example, if computational analysis takes an average of 8 seconds to estimate the QAP in a 100x100 dimension matrix, and if the matrix size doubles to 200x200, then eight square seconds[38] to take around 64 seconds to achieve a result. Finally, the permutation considers the number of variables in the model and influences the estimated time.

3.3.5 Results

The results presented in this section seek to evaluate the two hypotheses presented in the first section of this chapter and their specific objectives. Briefly, the assumptions are that some financial institutions systematically transfer resources to another and that, once identified, it would be possible to assess the following questions: is there competition for a bank deposit

[38] This is just one example, whereas for the largest matrix the QAP estimate in the software *r* took about 4 hours for 5 variables and 120 permutations. However, the whole process, after the entire programming was done, it took 2 weeks, between construction of the *F* printing of the maps and obtaining the results.

in the municipalities that these institutions are? Moreover, what is the dynamic between commercial bank branches and credit union stations at key points? In this way, this section has three subsections. The first evaluate the estimation of *Array F,* its characteristics, patterns, and systematic relationships. The second subsection presents the econometric estimates of the key point probability. The third subsection is devoted to the analysis of the hypothesis of competition between financial institutions.

3.3.5.1. Flow Matrix Analyses

One of the first points of interest in the Flows matrix is how many connections financial institutions have, either systematically receiving deposit flows (indegree) or sending these flows (outdegree). For this analysis, the key points are all those institutions that send flows to the others, while hotspots are the institutions that send the most flows, considering the 20% threshold.

In Table 3.3.4, the reader can access financial institutions' information with the highest standard of sending resources. The analysis occurs for each macro-region. Table 3.3.4 also contains the degree of centrality for each of the two operations performed.

Each region's centrality index is interpreted equally to zero for homogeneity of connections between firms and equal to 1 for firms with high centrality degrees. In this sense, the South and Northeast macro-regions have a lower homogeneity of connections between firms. That is, many firms receive funds, while a small number of financial institutions sends resources. The region with the highest degree of homogeneity is the Northern macro-region, with an index of approximately 52%.

In all regions, credit unions are far from the top placements in terms of centrality degree. However, considering the total number of firms in each Region (Table 3.3.3), they are relatively centralized.

For example, the credit union classified as Central in the Northeast region, with CNPJ 34148882 (CC SICOOB/BA), presented a systematic pattern of sending resources to 565 other financial institutions while systematically receiving resources 178 financial institutions. The number of nods to which this financial cooperative is interconnected stands out with ¼ of the degree of centrality of the northeast region's banks, configuring as the municipality's fourteenth financial institution with more deposits. The same is the case for Teixeira de Freitas with SICOOB Extremo Sul (CNPJ 2447120), where, in deposited values, contain more inputs than many other municipal bank branches.

Table 3.3.4. Degree of Centrality of Sending Resources and Number of Connections to the Key points of Each Region.

Region	Ranking	Municipality, CNPJ, and Type of Financial Firm	*Out Degree*	*In Degree*
North	1	Manacapuru (AM) - 0 - Bank Branch	483	1
52% degree of centralization	2	Manaus (AM) - 1701201 - Bank Branch	399	2
27% general grouping	164	Macapá (AP) - 13517050 – Singular CURSS	38	44
7% direct grouping	234	Ji-Paraná (RO) - 4632856 - Central	24	1
MIDWEST	1	Brasília (DF) - 3347902 - Bank Branch	758	0
62% degree of centralization	2	Dourados (MS) - 0 - Bank Branch	684	15
26% general grouping	109	Smile (MT) - 26555235 - Singular	48	6
9% direct grouping	110	Rio Verde (GO) - 24795049 - Singular	48	57
South	1	Curitiba (PR) - 1701201 - Bank Branch	2665	15
74% degree of centrality	2	Paranaguá (PR) - 0 - Bank Branch	2559	94
31% general grouping	148	Blumenau (SC) - 5463212 - Central	601	26
8% direct grouping	225	Ibirama (SC) - 16779741 - Singular	438	32
Southeast	1	São Paulo (SP) - 5958811 - Bank Branch	3984	80
65% degree of centrality	2	São Paulo (SP) - 6242198 - Bank Branch	3961	113
25% general grouping	183	São Paulo (SP) - 4306351 - Singular	752	86
6% direct grouping	198	Vitória (ES) - 32428294 - Central	703	28
Northeast	1	Fortaleza (CE) - 7450604 - Bank Branch	2088	75
74% degree of centrality	2	Maceió (AL) - 1701201 - Bank Branch	2065	3
35% general grouping	60	Salvador (BA) - 34148882 - Central	565	178
4% direct grouping	263	Teixeira de Freitas (BA) - 2447120 - Singular	111	139

Source: Research Results. Outdegree represents the number of firms that send resources to the other. Indegree represents the number of firms that receive only resources and do not send systematic resources to the other.

The analysis of the degrees of centrality standards indicates that none of the financial institutions is outside the respective system of the region presented. I.e., all financial institutions analyzed connect to at least one institution with a higher or lesser degree of systematic transfer patterns.

In this sense, the total hotspot firms in each macro-region, according to the threshold of 20% about the first financial institution, the North region contains about 60 hotspots, the Midwest region has 26 hotspots, the South 170 hotspots, the Southeast region approaches the South region with 171 hotspots. The northern region has 107 financial institutions in the first top deposits.

However, although a path connects all financial institutions, the average grouping of financial institutions within each macro-region is 27% for the Midwest macro-region, where only 7% of financial institutions directly connect with other institutions. Instead, the other institutions benefit from indirect connections. The exact relationship applies in the South region, with 26% grouping, but only 9% is direct. The southeast region has 31% indirect or direct, with only 8% direct. For the North macro-region, the values are 25% to 6% of natural grouping (6% is direct). Finally, the Northeast region has fewer direct groupings, with 36% indirect or direct groupings and only 4% direct groupings.

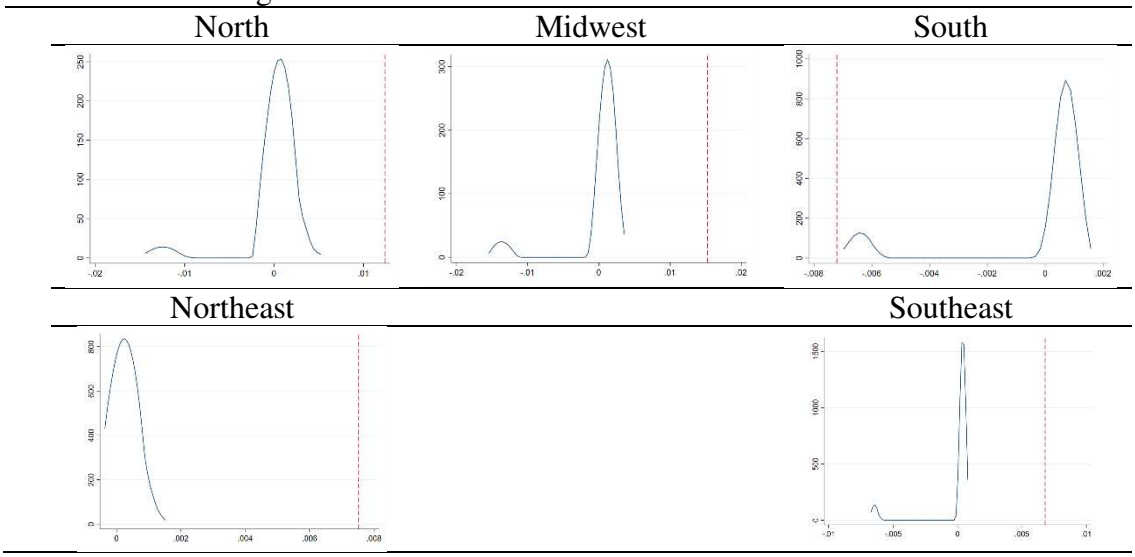
The low values of natural (direct) groupings are related to the individual grouping of financial institutions. Those institutions with the most significant number of nods send

systematically to many institutions but receive fewer financial institutions. Thus, the number of existing nodes about each region's possible total generates a low proportion. As the German banks, from Craig and Von Petter's (2014) findings between 1999-2012, the low degree of direct transfer promoted by Brazilian financial intermediates indicates that these firms also use the central bank (in the present case, the Central Bank of Brasil) as the main intermediation. Thus, the Brazilian financial intermediation seems to be tired and congested instead of flat and fluid.

When one observes the grouping of degrees, the reader can note that financial firms have a high degree. They probably need to seek inputs (deposits) from various hotspots because they are lender agencies. These results make the issue of the correlation between financial institutions of different classes questionable. Positive and statistically significant correlations indicate that financial institutions are substitutes, while negative correlations indicate that financial institutions are complementary.

Thus, the focus is on analyzing the correlation within the same types of financial institutions and correlations between them. In table 3.3.5, the reader finds five figures with a degree of correlation between the nodes of different financial institutions (Banking Branches, Central Credit Unions, and Singular Credit Unions). The results presented in Table 3.3.5 confirm some connections between the different types of financial institutions. Thus, a disturbance affects both classes of institutions in the same sense.

Table 3.3.5. Degree of Correlation between the Different Financial Institutions



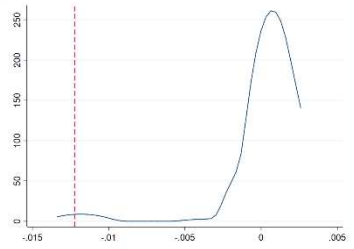
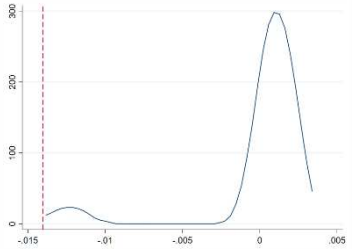
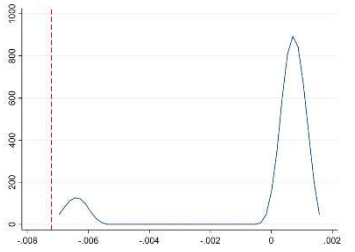
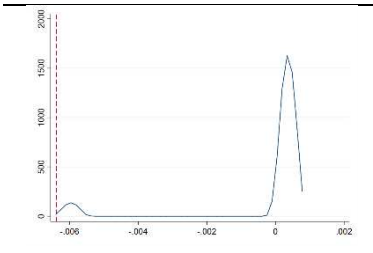
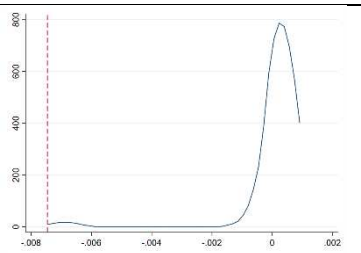
Source: Research Results. The X-Axis represents correlations. The Y-axis represents density. The Dotted Trait indicates the degree of correlation. The analysis considers 100 permutations in the Flow matrix.

However, the low correlation evaluated indicates that the degree of independence of these financial institutions is greater than the degree of dependence. From this result, we can

say that the policymaker may formulate different public policies for the different financial institutions. What draws attention is that the correlations are positive, indicating some degree of substitution between the different financial institutions.

On the other hand, the correlations between the same financial institutions are statistically significant and low (figures in Table 3.3.6). However, in the sense of Fukao (1983), the negative sign indicates that these financial institutions are complementary to each other. For example, similar financial firms smooth the disturbance when there is a disturbance in their respective classes.

Table 3.3.6. Degree of Correlation between Financial Institutions with the Same Type Classification.

North	Midwest	South
		
Southeast		**Northeast**
		

Source: Research Results. The X-Axis represents correlations. The Y-axis represents density. The Dotted Trait indicates the degree of correlation. The analysis considers 100 permutations in the Flow matrix.

Again, this relationship can infer the issue of financial intermediation, indicating that institutions capture deposits in some places to lend in others, considering their respective types of institutions. For example, a credit union looks for deposits to send to another credit union to lend elsewhere. This relationship applies to both credit unions stations and commercial bank branches.

Table 3.3.6 allied with Table 3.3.5 indicates that the credit union's business model is different from commercial bank branches. We already see some shreds of evidence of this difference in the first empirical chapter of this thesis. Here we add further evidence, where bank branches and credit unions stations probably have few connections between them. What involves both businesses are the substitutive case, indicating these firms have some customers

in common. These verifications turn on the signal that these two classes compete with each other.

Finally, since all the firms are connected but with a low degree of strong grouping, it remains to present the dynamics of the prominent financial institutions (hotspots) between 2008-2019. The minor map analysis in Table 3.3.7 is limited by only containing the network of the hotspots. The red curves indicate the dynamics of these financial institutions about the transfer of resources. On the larger map, it is possible to identify all financial institutions considered key points, where those represented by larger circles are financial institutions considered hotspots.

Table 3.3.7. Dynamics among Financial Institutions Classified as Hotspots in Study Macro regions

North	Midwest	South
		

Table 3.3.7. Continuation…

Southeast	Northeast
	

Source: Research Results. The most prominent red points represent the hotspots on the larger map, and the more minor points are the institutions that only receive resources. In the Smaller Map, in blue, are the target flows of resources sent between hotspots. The rows represent the transitions sent.

Analyzing the minor map density, we see that the North and Midwest regions have fewer transactions than other macro-regions, beyond the representative financial intermediation to be

more spaced. In this sense, the Midwest macro-region contains 17 municipalities with hotspot institutions (all bank branches), and these municipalities also contain about 56 credit unions (all singles). In the Southeast, 94 municipalities with hotspot institutions (all bank branches) share space with 159 credit unions (five central). There are 86 municipalities with only bank branches as hotspots in the Northeast. These municipalities have 48 credit unions (two central). One hundred thirty-two municipalities with hotspot institutions (all bank branches) in the South share spaces with approximately 128 credit unions (4 are central). Finally, 50 municipalities with hotspot institutions (all bank branches) in the North, where 24 credit unions also operate.

3.3.5.2. Analysis of the Key Point Probability

The econometric analysis contains two parts. The first one refers to estimating the Quadratic Assignments Procedure (QAP) model to analyze the probability of a financial institution's existence considered a key point. This financial institution can be a bank branch of some commercial banks as a credit union service station. Thus, for each of the analyzed macro-regions, the QAP analysis was made considering 120 permutations of the dependent variable.

The permutations criteria are adopting $a!$, where $a=5$ refers to four unrepeated variables. In Table 3.3.8, the reader finds the results found for the probability analysis of the key points' existence for each macro-region of interest.

One of the main points that validate the results is that deposits at the municipal level are meaningful at 1% in all macro-regions analyzed. These results demonstrate some stability of the flow matrix's estimation, which was constructed based on the negative correlation between the financial institutions' deposits. Note that the more significant the percentage change of the municipal deposit is for all regions, the more likely this will have a key point. This relationship corroborates this article's partial thesis that the key institutions are into municipalities with abundant deposits.

Table 3.3.8. Probability Analysis of Occurrence of a Key point

Regions	Midwest	Northeast	North	Southeast	South
Person Service Points	-0.054	-0.116	0.13	-0,172***	0,017
Being Bank Branch	0.032	-0.137*	-0.128	-0.175***	-0.018
Being Service Stations	-0.622***	-0.767***	-0.562**	-0.347***	-0.420***
Municipal Population	0.045	0.163***	0.053	0,114***	-0,011
HDI - Municipal	0.572	1.552***	-0.499	2.160***	-0,376
Deposits	0.202***	0.163***	0.121***	0,116***	0,195***
Same Federation State	-0.181***	0.259***	-0.058	-0,389***	0,075***
Same type of FI	0.181	-2.598**	0.200	0,076	0,017
Differ type of FI	0.000	-1.509**	-0.201	-0,016	-0,110

Source: Research Results. Note: * up to 10% of statistical significance; ** up to 5% of statistical significance; and *** up to 1% of statistical significance. FI is Financial Institutions.

Another point that stands out is the region of activity when the control is the macro-regions states. Acting in the same federal state (UF) or make a systematic transfer only for the same UF in the Southeast and Midwest reduces the likelihood of finding the key point. I.e., the credit unions station and bank branch whose network is limited into one (same) state probably are not a key point in these macro-regions. Stand out the federal government transfers in the Midwest and Southeast states' owner characteristics. On the other hand, the Northeast and South make systematic transfers from and for the same state, indicating that these regions' wealth is used mainly in local financing.

Different financial institutions, or similar financial institutions, have a significant likelihood only in the Northeast macro-region. This result indicates that the Northeast states' distribution of the key points concentrates in few places. Thus, the comparison between the same or different types of financial institutions is unfavorable. Thus, the Northeast macro-region also seems to be a dependent region. However, we have here a limitation because the research design does not analyze the systematic transfers from other macro-region to the Northeast.

Having more in-person service points is not statistically significant in four of the five macro-regions analyzed. This result is explained mainly by commercial banks. On the other hand, in all macro-regions, the probability of having one more credit union service station has a negative relationship with the occurrence of a key point. In the Southeast macro-region, the negative likelihood to Person Service Point represents a saturation of face-to-face service, being irrational increase news service points.

The deposit is the primary variable to be analyzed in key point probability. The positive and statistically significant values for all macro-regions represent that the strategy is to position a face-to-face service where more municipal deposits exist, however, in a way that does not saturate the place (financial sustainability).

Since the deposits at the municipal level were statistically significant, and the relationship between the firms analyzed appears to be strategic, the simulations proposed in the methodology section seek to analyze whether there is any competition between bank branches and service stations credit unions in hotspots.

3.3.5.3. Analysis of The Competition for Deposits between Credit unions and Commercial Banks

Following the steps presented in subsection 3.3.2.3 and previous results, we can now identify whether credit unions compete with bank branches in hotspot markets. Remember that

QAP analysis indicates that credit union does not compete against bank branches increasing its service stations. However, this is not sufficient to eliminate our hypothesis about competition, as we have a shred of evidence showing services station and bank branches deposits are substitutes goods. Thus, this section presents the difference between deposits on hotspots, key points, and other firms.

First, to guarantee the results' efficiency and consistency, it must be ensured that the treated and control groups are as similar as possible. Therefore, the authors consider a weighting index that made both groups comparable during the ATT procedure for all macro-regions. The estimations of these weighting indices are by Propensity Score Matching (PSM) and Entropy Balance (BE) procedures. According to the degree of adjustment between the treated and control groups, Entropy Balance was the one that left both groups as close as possible because it has been to control the variables for groups in its three moments (Table 3.3.9).

Table 3.3.9. Degree of adjustment of Balance Entropy Models and Propensity Score Match.

MIDWEST												
MODELS	BALANCE ENTROPY						PROPENSITY SCORE MATCH					
VARIABLES	Treat			Control			Mean			t-test		V(T)/V(C)
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	%bias	t	p>t	
Population	11.21	3.08	0.73	11.21	3.07	0.73	11.21	11.21	0.00	0.00	1.00	1.00
Clustering Degree	0.19	0.02	0.34	0.19	0.02	0.34	0.19	0.19	0.00	0.00	1.00	1.00
IFDM	0.74	0.00	-0.60	0.74	0.00	-0.60	0.74	0.74	0.00	0.00	1.00	1.00
UF	2.61	0.79	0.23	2.61	0.79	0.23	2.61	2.61	0.00	0.00	1.00	1.00
Type	1.07	0.06	3.42	1.07	0.06	3.42	1.07	1.07	0.00	0.00	1.00	1.00
UF#Type	2.78	1.39	1.71	2.78	1.39	1.71	2.78	2.78	0.00	0.00	1.00	1.00
NORTH												
MODELS	BALANCE ENTROPY						PROPENSITY SCORE MATCH					
VARIABLES	Treat			Control			Mean			t-test		V(T)/V(C)
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	%bias	t	p>t	
Population	11.22	1.73	0.95	11.22	1.73	0.94	11.22	11.22	0.00	0.00	1.00	1.00
IFDM	0.61	0.01	-0.12	0.61	0.01	-0.12	0.61	0.61	0.00	0.00	1.00	1.00
InDegree	2.37	2.15	-0.04	2.37	2.15	-0.04	2.37	2.37	0.00	0.00	1.00	1.00
NORTHEAST												
MODELS	BALANCE ENTROPY						PROPENSITY SCORE MATCH					
VARIABLES	Treat			Control			Mean			t-test		V(T)/V(C)
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	%bias	t	p>t	
Population	11.51	2.40	0.75	11.51	2.40	0.75	11.51	11.51	0.00	0.00	1.00	1.00
UF	4.27	5.56	0.50	4.27	5.56	0.50	4.27	4.27	0.00	0.00	1.00	1.00
Type	1.04	0.07	7.28	1.04	0.07	7.27	1.04	1.04	0.00	0.00	1.00	1.00
SOUTH												
MODELS	BALANCE ENTROPY						PROPENSITY SCORE MATCH					
VARIABLES	Treat			Control			Mean			t-test		V(T)/V(C)
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	%bias	t	p>t	
Population	10.78	2.19	0.44	10.78	2.19	0.44	10.78	10.78	0.00	0.00	1.00	1.00
UF	1.86	0.60	0.24	1.86	0.60	0.24	1.86	1.86	0.00	0.00	1.00	1.00
Type	1.14	0.26	3.33	1.14	0.26	3.33	1.14	1.14	0.00	0.00	1.00	1.00
SOUTHEAST												
MODELS	BALANCE ENTROPY						PROPENSITY SCORE MATCH					
VARIABLES	Treat			Control			Mean			t-test		V(T)/V(C)
	Mean	Variance	Skewness	Mean	Variance	Skewness	Treated	Control	%bias	t	p>t	
Population	11.99	4.43	0.75	11.99	4.43	0.75	11.99	11.99	0.00	0.00	1.00	1.00
Clustering Degree	0.21	0.02	0.20	0.21	0.02	0.20	0.21	0.21	0.00	0.00	1.00	1.00
IFDM	0.78	0.00	-0.80	0.78	0.00	-0.80	0.78	0.78	0.00	0.00	1.00	1.00
UF	3.19	0.97	-0.67	3.19	0.97	-0.67	3.19	3.19	0.00	0.00	1.00	1.00
Type	1.11	0.20	3.99	1.11	0.20	3.99	1.11	1.11	0.00	0.00	1.00	1.00
UF#Type	3.48	2.60	2.67	3.48	2.60	2.67	3.48	3.48	0.00	0.00	1.00	1.00

Source: Research Result. Note V(T)/V(C) represents the disturbance on variance, considering the respective interval: Midwest [0.96;1.04]; north [0.95; 1.05]; northeast [0.98; 1.02]; south [0.98;1.02] and southeast [0.97;1.03].

The models for the macro-regions contain different variables to control the groups. According to Hainmueller, Jens, and Xu (2013), the adjustment procedure should be carried with parsimony. Thus, some variables were also unnecessary in the model adjustment tests for some macro-regions, while others were necessary.

Although the PSM also showed a slight mean disturbance, the degree of adjustment is satisfactory because the mean and variance were equal between treated and control (right side of Table 3.3.9). These occurrences are for all macro-region models analyzed. The BE also presents a satisfactory adjustment in its three moments.

The dependent variable is a matrix *nxn*, as was made in the QAP procedure. However, the BE and PSM procedure takes a long time to calculate the results in *nxn* dimensions. Thus, the estimation for all macro-regions was based on a random sample, considering a *nxn* dimension percentage. The assumptions are that the Central Limit Theorem applies. The sample size was 30% to Midwest, 30% to North, 15% to Northeast, 10% to South, and 10% to Southeast.

In Table 3.3.10, the reader finds the results for the first stage of estimations (natural and simulated market states) for the five macro-regions. The upper part of Table 3.3.10 is for Entropy Balance weights, and the results in the bottom part of the Table are for PSM. The first line bellows the model's name presents the macro-regions occupying two-column each. In the lines of the first column, the Table has the ATT for natural market followed by treated and control value groups. Then, the Table presents the sequence for simulated ATT.

Table 3.3.10. First Step of Differences – The ATT Results for Natural and Simulated Market (BE and PSM)

ENTROPY BALANCE										
Macro-region	Midwest		North		Northeast		South		Southeast	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
ATT	0.46***	(0.01)	0.52***	(0.01)	0.53***	(0.01)	0.69***	(0.00)	0.56***	(0.01)
Treated	17.01***	(0.07)	16.25***	(0.05)	16.84***	(0.03)	17.11***	(0.03)	17.81***	(0.06)
Control	17.47***	(0.07)	16.77***	(0.07)	17.37***	(0.07)	17.80***	(0.04)	18.37***	(0.04)
Simulated ATT	0.41***	(0.01)	0.51***	(0.01)	0.52***	(0.01)	0.69***	(0.00)	0.56***	(0.01)
Treated	17.03***	(0.07)	16.25***	(0.05)	16.85***	(0.03)	17.11***	(0.03)	17.82***	(0.06)
Control	17.44***	(0.07)	16.76***	(0.07)	17.36***	(0.07)	17.80***	(0.04)	18.37***	(0.04)
PROPENSITY SCORE MATCH										
Macro-region	Midwest		North		Northeast		South		Southeast	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
ATT	0.73***	(0.01)	0.66***	(0.02)	1.06***	(0.01)	1.01***	(0.01)	1.14***	(0.04)
Treated	17.53***	(0.07)	16.77***	(0.08)	17.47***	(0.15)	17.83***	(0.08)	18.42***	(0.03)
Control	16.80***	(0.07)	16.12***	(0.07)	16.40***	(0.06)	16.82***	(0.04)	17.28***	(0.03)
Simulated ATT	0.43***	(0.01)	0.59***	(0.09)	1.04***	(0.00)	1.02***	(0.01)	1.13***	(0.01)
Treated	17.22***	(0.07)	16.72***	(0.08)	17.45***	(0.15)	17.83***	(0.08)	18.41***	(0.03)
Control	16.79***	(0.07)	16.12***	(0.07)	16.41***	(0.07)	16.82***	(0.04)	17.28***	(0.03)

Research Result. Note: * up to 10% of statistical significance; ** up to 5% of statistical significance; and *** up to 1% of statistical significance. The standard error in brackets comes from the Delta Method.

The Table shows that both models (BE and PSM) present statistically positive treaty and control values for all macro-regions. However, each macro-region coefficient is analyzed carefully because the BE and PSM weights converged in absolute value but diverged in the magnitude of the ATT. In this research, the ATT magnitude analysis divergences between BE and PSM will be considered "confidence interval," as both results are statistically significant.

All ATT values were calculated based on the antilog coefficients. The calculation is part of the following equation $(e^{Att}-1)100$. Thus, considering the BE and PSM results as the minimum and maximum intervals, the financial firms that act in key points have between 58% to 108% more deposits than financial firms that do not operate in the deposit mining market in Midwest. Other macro-regions are 68-93% in the North, 70-189% in the Northeast, 99-175% in the South, and 75-213% in the Southeast. From these results, the macro-regions Northeast and Southeast have more interval margins, presenting more heterogeneous firms acting in the deposit mining market.

When the reader looks at simulations (Simulated ATT in Table 3.3.10), the interval margins decrease because more firms act as key points, mainly in hotspots. The macro-region simulated interval becomes 51-54% in the Midwest, 67-80% for North, 68-183% in the Northeast, 99-177% for South, and 75-210% in the Southeast. Although smaller, the most extensive interval remains between Northeast and Southeast, showing that the entering of credit unions in the hotspot market promotes a heterogeneous decrease in financial firms.

The second step of differences (Simulated ATT minus Actual market ATT) for all macro-regions is in Table 3.3.11. The values are statistically significant at 1% but negative in the two models for all macro-regions, except the South macro-region that presented divergent values. Thus, the interval for financial firms in the southern states goes from rational enter until irrational.

Table 3.3.11. Second Step of Differences – Difference between Actual Market and Simulated Market

Regions / Models	Midwest		North		Northeast		South		Southeast	
Balance Entropy	-0.05***	(0.00)	-0.01***	(0.00)	-0.01***	(0.00)	-0.00***	(0.00)	-0.00***	(0.00)
PSM	-0.30***	(0.02)	-0.06***	(0.00)	-0.02***	(0.00)	0.00***	(0.00)	-0.01***	(0.00)

Research Result. Note 1: The Actual Market is the market estimated, considering the mean between 2008 to 2019. The Simulated Market considers the entering of credit unions in the hotspot market, considering the criterion that this financial cooperative was already operating in the same municipality in which a firm classified as a hotspot operates. Note 2: * up to 10% of statistical significance; ** up to 5% of statistical significance; and *** up to 1% of statistical significance. The standard error is in brackets.

The computations of percentages are the same adopted in Table 3.3.10 (from the antilog procedure). Thus, when the credit unions enter the hotspots market, the total product reduces

between -5% to -26% in the Midwest. For other macro-regions, the variations are between -1% up to -6% in the North, -1% up to -2% in the Northeast, -0.04% up to 0.05% in the South, -0.07% up to -0.52% in the Southeast.

The result indicates that markets in the Midwest, North, Northeast and more minor degree Southeast are saturated or a possible entry barrier by banks under the entrance of credit unions. Considering the current market conjuncture in these regions, the credit union stations, and commercial bank branches compete for municipal deposits. Some municipalities have some margins for credit unions to enter a hotspot market in the South macro-region. However, the gain with the enters is smaller (< 0.05%), and then the cost of enters may not be compensatory.

3.3.6 The Discussion

The relationship between credit unions and their members and between commercial banks and their shareholders promotes different utility maximization functions. While the former's restriction is involved in productive activity, the financial market, and the Central Bank of Brazil's resolutions, the latter is restricted only to the financial market and the Central Bank of Brazil's resolutions.

This difference in the restriction can generate a conflict when both financial firms compete since the cooperative members' view may or may not be different from the commercial banks' shareholders' view. However, to become operational, both company's types need inputs to perform financial intermediation. In The second chapter of this thesis, credit unions' merger or incorporation processes between 2008-2019 are motivated by increasing risk-taking or market share. In both cases, the inputs (deposit) are crucial, and adopting the deposit mining strategy may sound like the next step to staying sustainable.

In 2010, credit union activity was delimited for municipalities up to two million populations, being more under specific conditions (BACEN, 2010). Even in this situation, credit unions are not yet increasing their service stations within the municipalities. Nevertheless, they are probably linked to the cost because expanding service stations reduces the probability of becoming a key point in the deposit market. In addition, it must consider the significant heterogeneity among financial institutions, with many operating in crowded markets and others operating in less crowded markets. Thus, the question of becoming a deposit exporter is a strategic action that must consider the quickest path between loans and deposit mining. However, the loans market does not analyze in the present research.

Although all institutions are indirectly linked with systematic transfers, direct links are concentrated in a few financial institutions. This result shows a hot market (hotspots), where mining is more abundant than other markers, and that no credit unions have been classified as active in this market. Operating in this market requires knowledge of the financial market, the wisdom of which branches need interbank resources, know the shortest path to get to these agencies, and having a network capable of mining and offering them more efficiently. On the other hand, credit unions seem to be creating their market with some financial inclusion success (vide the first empirical chapter of this thesis). However, to credit unions reach levels (shares) such as in Germany or France (see SNAC, 2016), it is impossible to avert competition with traditional banks. Thus, the conclusion is that in all Brazilian macro-regions, credit unions stations and commercial banks branches are in fierce competition.

So, one wonders what should be done to increase the participation of credit unions in the market? The answer to this specific question would be nothing. This process is already in full swing, and the financial companies themselves are taking strategic actions. What can be done is speed up the process so that those most interested in participating in the credit union activities can eliminate this market failure.

Many recommendations have been made for the Central Bank, mainly in financial security and soundness. However, this relationship still restricts the credit unions because the analysis does not consider a possible technological shift. In the simulation case, these would enter the hot market with their current resources, management forms, thoughts, doctrines, among others. Thus, the side that exerts the fiercest competition comes from commercial bank branches who feel the growth in credit unions' market share.

The importance of the independence degree of credit unions in the market may promote the Yardistck theory (from Shleifer, 1985). As credit unions have a greater degree of independence from commercial bank branches, public policies aimed at the process of financial inclusion may, in the short term, act in favor of credit unions without affecting the behavior of commercial banks but changing the direction of the market.

Thus, since competition comes from commercial banks, the Yardstick Theory would come into action, promoting, in addition to financial inclusion, the reduction of the bank spread in whole Brazilian financial intermediation. Thus, the results of this chapter, associated with the results of the second empirical chapter and the theoretical chapter of this thesis, are helpful

throughout the financial inclusion policy process, bringing relevant information[39] to expand the intermediation market.

3.3.7 Conclusion

The purpose of this paper was to analyze whether credit unions and commercial banks compete for deposit mining in municipalities where both types coexist. Two hypotheses were assumed. The first one is that there are locations where financial institutions can mine deposits more quickly than in other locations. The second is that commercial bank branches and credit union service stations compete by the deposit mining market in these places. The Network Methodology is the identification base, complemented by Average Treatment Effect on Treated.

First, from the network analysis, it was found that commercial banks and credit unions are considered substitute institutions for each other. However, the degree of substitution shows that there is still a great degree of independence in the policies and macroeconomic relations that affect the two financial institutions due to a low degree of direct interconnection in the transfers of the two classes. This result shows that systematic deposits occur separately between each type and atypically between the analyzed classes of financial institutions. In addition, the low degree of interconnection between the credit union and bank branch demonstrates that credit unions' business models may differ from commercial banks' business models.

Based on these results, it was possible to confirm the first two hypotheses raised, indicating that key points for deposits are statistically different from other points. The second hypothesis is that there is evidence for competition between the credit union service stations and commercial bank branches, but this occurs only in the key points because there is no credit union in hotspots. However, if credit unions enter hotspots, the final input will be reduced. This result shows a possible barrier entrance promoted by bank branches under credit union service stations. There is a lack of public policy to a sustainable entrance of credit unions in the hotspot market.

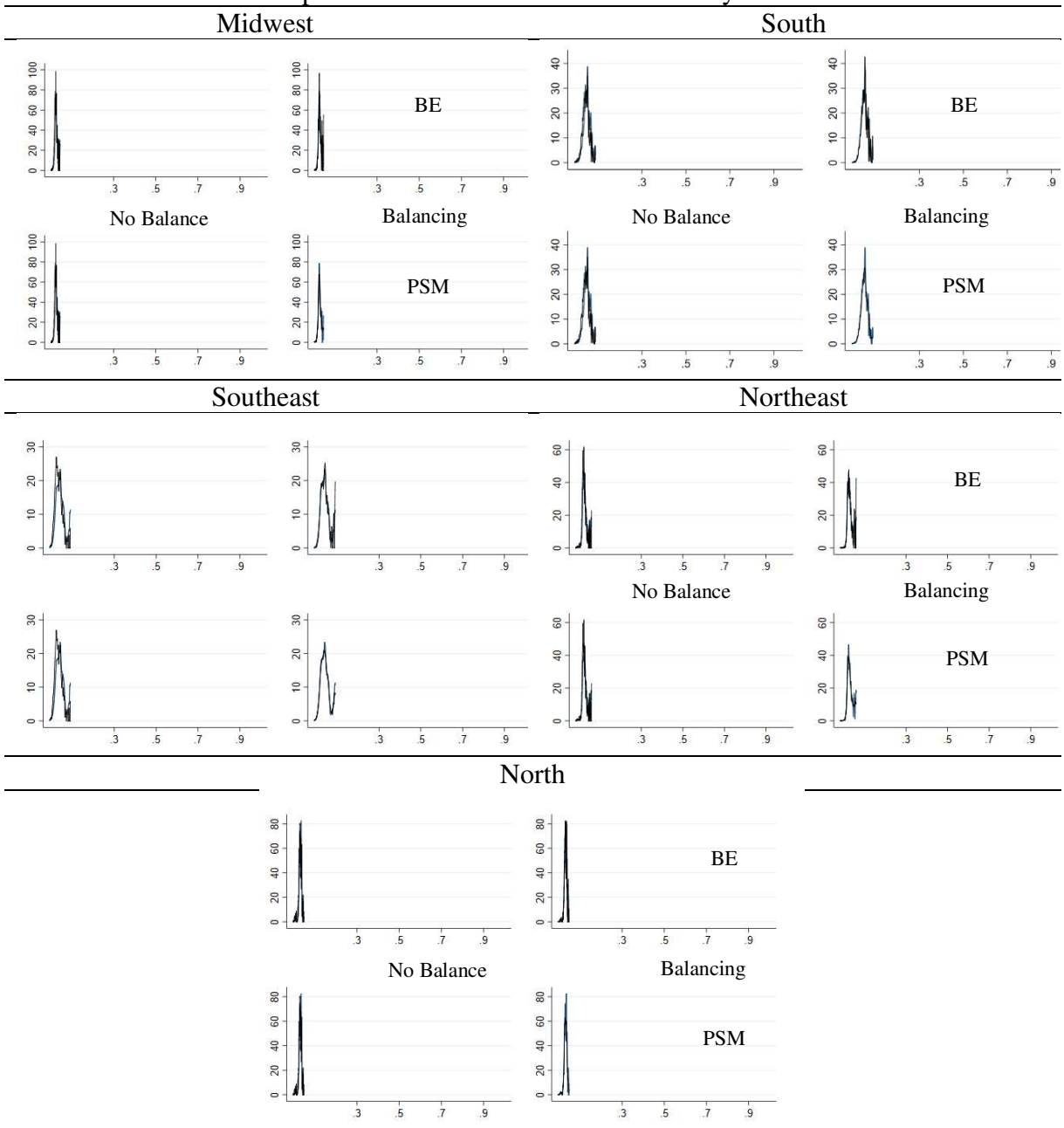
This article offers essential information for public agents interested in promoting sustainable financial inclusion. In addition, it brings relevant information about the competition at the local and macro-regional levels. As a continuation of this paper, we recommend analyzing

[39] Which can be private or collective action strategies.

the loan market, considering the recent virtual expansion as the primary means of institutions' financial inclusion action and disintermediation.

3.3.8 Appendix

Table A3.3.1. Comparison between treated and control by PSM and BE



Source: Research result. Note: For each macro-region, on the left side of the figures, the upper and bottom graphs are the same, representing the data without balance. In the right size, the upper graph represents the Entropy Balance (BE), and the bottom graph represents the Propensity Score Matching (PSM)

4 FINAL CONCLUSION

4.1 CONCLUDES

One of the central points that drive financial intermediation is sustainable financial inclusion. In the Brazilian case, the retail market's leading firms are commercial banks, credit unions, and, more recently, technology companies (FinTech). Because it is still a very new market, FinTech is still confusing with the commercial banking market under mobile dimensions. Thus, this thesis's central objective was to evaluate the relationship between credit unions and commercial banks in Brazil from 2008-2020.

Over this period, several changes in the Brazilian financial intermediation took place, mainly for credit unions. Among these changes, stand out: the creation of a guarantee fund for credit unions, the guidance of the Central Bank of Brazil, the expansion of credit unions areas of operation, the guidance of the Central Bank of Brazil in favor of mergers between credit unions, the incentive to increase the percentage of the competitive credit share from 9 to 20% by 2022, and the implementation of Basel 3 with new policies aimed at technical reserves (mainly affecting commercial banks)

However, analyzing the relationship between these two types of financial institutions is not easy. While commercial banks reform occurred in 1994, with generous support from the Central Bank of Brazil (Bacen), the credit unions had their areas of activity limited by several resolutions of the Bacen. The banking reform was oriented to Competition Fragility things, where the proponents defended the concentration of shares in few financial firms aiming for more stability in the financial system. In addition, the concentration bank process occurred in few years.

Almost one decade later, the credit unions began to gain their "freedom" in 2003 (with free association measures – Resolution 3.106/2003). Until then, the credit unions were limited in municipalities with small populations and with rural predominance. In 2010, the Bacen expanded the actuation areas of credit unions for municipalities up to two million inhabitants. Before (since 2003), they were limited to the municipality of up to 750 thousand inhabitants. Furthermore, the Single credit unions have a bank dependence on acting in the Brazilian financial system. Since 2000 the Central credit unions may be a shareholder of a cooperative bank. However, in Brazil, only two cooperative banks interconnect the credit unions into the financial system.

Despite these relationships, many credit unions already feel the transformations and seek to improve their technical and allocative efficiencies. This relationship is felt by expanding

the mutual credit' market, both in deposit mining and lending. Considering the aggregated share, the credit unions jumped from the nineteenth position in 2008 to 6th in 2019 and, between 2013-2014, reached the third position in terms of market share. Nevertheless, it should not be forgotten that credit unions' performance, although guided, sometimes by a Central or Confederations, is still individual, and each singular credit union defines, with their cooperative members, the actions to be taken.

In this context, three was the broad objectives of this thesis:

i. To evaluate the dynamics of financial firms in the financial inclusion process;
ii. To compare the maturity degree of the credit union considering mergers in competition stability and competition fragility hypothesis; and
iii. To verify if any competition dynamics for deposits occur between credit unions and commercial banks at the municipal level, considering the observed network.

Faced with these difficulties and to achieve the broad objective of this thesis, it was first necessary to seek the economic theories that explicate the mechanism between traditional banks and mutual firms. Thus, the second section of this thesis is concentrated on presenting the basic theory of this research where the central relationship comes from Yardstick Theory.

Initially developed by Shleifer (1985), this theory is widely used to evaluate policy implementation relationships by parallel governments but is also applied in market regulation through a shadow firm. In Brazil, this theory is applied in the markets of essential goods, such as the mobile market and water and light supplies.

Considering the shadow firm, the identification in financial relationship occurs because, in common sense, credit unions' interest rates are lower than commercial banks. However, this relationship does not occur in the mean lending rates (face value) at first glance. Thus, comparing the utility gained by the cooperative members with the utility of commercial banks' customers, under the same lending rate, it is known that the credit unions' members have the leftovers. Thus, due to the baskets of these two institutions' characteristics, the hypothesis arises that the utility presented by credit unions is greater than the utility of commercial banks.

Once this hypothesis occurs, commercial banks would then promote sustainable financial inclusion by reducing their margins. This inclusion would be motivated by the opportunity costs generated by the pressure of the favorable utility of credit unions. However, credit unions' performance limitations would take commercial banks' margins because they would be acting on a competitive fringe.

In this sense, the second theory base of this thesis is on the Upward Pricing Pressure (UPP) theory of Farrell and Shapiro (2010). The analysis presented expands the UPP theory to

a market (oligopoly) with a competitive fringe. Since an opportunity cost generated by the competitive fringe exists, commercial banks would feel regulated with the expansion of credit unions' operation area, promoting the effect provided by Yardstick theory.

Thus, the first empirical article analyzes sustainable financial inclusion, considering the adapted UPP theory as a base. This article's specific objective was to evaluate financial institutions' dynamics in the financial inclusion process between 2008-2019. Four types of financial institutions were analyzed: public banks, private banks, credit unions, and in a complementary way to FinTechs. It is understood that in adverse moments public banks can act in a way to soften the credit restriction generated by private banks, promoting increased government indebtedness and upward pressure on interest rates (known as the crowding-out effect). In this sense, two specific hypotheses were assumed: [i] the crowding-out effect exists in the national retail lending system, and [ii] that consumer delinquency is one of the main factors that promote the reduction of the supply of loans for all financial institutions.

To the author evaluate these hypotheses, the market demand was estimated by adapting the Berry procedure (1994) to assess the price-elasticity of demand in addition to diversion ratios according to Upward Pricing Pressure Theory. From the results, it was possible to verify that the crowding-out effect is partially present between public and private banks because credit unions, such as public banks, expand bank loans in adverse times. As far as FinTech companies are concerned, these firms' participation in the national market is still incipient.

Once the financial inclusion was evaluated and confirmed that it is positively associated with credit unions, this thesis's second empirical article sought to analyze the degree of maturity of these financial institutions evaluating the mergers and incorporation process, taking as hypothesis two banking theories (Competition-Stability and Competition-Fragility).

The second empirical article analysis comes from the Average Treatment Effect on Treated (ATT). Three stages of estimation were carried out. The first considered only firms with an incorporation process and compared that with other firms that did not incorporate it. The second stage analyzed the firms with more than one incorporation process compared with firms that carried out one process. Finally, the third case considered treating all mutual firms with at least one M&A. The results indicate that the mergers between January 2008 and December 2020 were induced by fragility theory in the second stage since the main variations observed were associated with more market share and less risk-taking. In the first stage and general case, Competition-Stability is the theory associated with the results as expanding places promotes more efficiency in mining deposits.

The second empirical article identifies that some credit unions used mergers and acquisitions to increase their market share. However, to this, the financial firms need inputs. Thus, the last empirical article sought to answer whether the relationship between credit unions and commercial banks was, between 2008-2019, conducted by competition in the deposit mining markets.

Financial institutions with plenty of deposits were classified as hotspots, and the municipality in which they operate was considered a hot market. The analysis was based on the network methodology, estimated from systematic deposit transfers between financial institutions. Thus, five networks were estimated for each Brazilian macro-region (South, North, Northeast, Midwest, and Southeast). Theoretical analysis is based on the Product Life Cycle Theory combined with the Product Maximization Theory, and Game Theory inspires the analysis.

Among the various analyses, credit unions and bank branches compete in the deposit mining market, where the commercial bank branch conducts this competition mainly. Furthermore, it was identified that there is a possible deterrence for credit unions in the deposit mining market.

In summary, on the financial intermediation firms, only credit unions promoted sustainable financial inclusion between 2008-2019. The public banks (*Banco do Brasil e Caixa Econômica Federal*) only complement the private market adverse times, and the lending demand of private banks is most sensitive to crises. Thus, the private bank customers that demand to lend have more market frictions. This result is empirical evidence that Brazilian credit unions begin in the maturity phase, oriented to stability theory for general cases. Finally, the existence of deposits in greater volume for commercial banks explicates the evidence of a barrier to entry into the deposit mining market, explaining the inexistence of credit unions classified as hotspots.

This research has some limitations. The fact that the estimates are made based on the book values of each company makes the dead weight-loss assessed in the first empirical chapter based on monetary units M4, which makes it unfeasible in translating this relationship to the reality of Brazilian consumers and entrepreneurs. However, the results are consistent with those found in published field research, such as SEBRAE (2018). Another point that cannot be neglected as a limitation is that this study is based on information from the firms themselves, which may contain data collection errors. As much as the Central Bank of Brazil supervises and considers correct information only after six months of information on the data utilized in this thesis, the central bank's data are constantly changing, also modifying information that is more

than six months old. Finally, for computational reasons, it was not possible to develop a complete banking network for all of Brazil in the analysis of the third empirical chapter, which made it impossible to analyze which Brazilian states feed the loan flow in the Brazilian northeast. However, this did not make it impossible to answer the questions in this thesis.

As a continuation of this thesis, it proposes evaluating if the barrier to the entrance in the deposit market promotes the increases in the face value of the interest rates and the Brazilian banking spread. Another agenda is how the larger spread of commercial banks affects the leftovers of mutual firms.

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