PONTIFÍCIA UNIVERSIDADE CATÓLICA
DO RIO DE JANEIRO

**Mateus Mallmann**

# Essays on Banking Segmentation, Credit Access, and Political Persistence

**Tese de Doutorado**

Thesis presented to the Programa de Pós–graduação em Economia of PUC-Rio in partial fulfillment of the requirements for the degree of Doutor em Economia.

Advisor : Prof. Márcio Garcia
Co-advisor: Prof. Fábio Miessi Sanches

Rio de Janeiro
April 2025

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**Prof. Márcio Garcia**
Advisor
Department of Economics – PUC-Rio

**Prof. Fábio Miessi Sanches**
Co-advisor
Department of Economics – FGV-EESP

**Prof João Manoel Pinho de Mello**
Department of Economics – FGV-EESP

**Prof. Leonardo Rezende**
Department of Economics – PUC-Rio

**Prof. Márcio Nakane**
Department of Economics – FEA-USP

**Prof Ricardo Dahis**
Department of Economics – Monash University

Rio de Janeiro, April 29th, 2025

**Mateus Mallmann**

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To my wife, Ludymila, and my children, Murilo and Lívia.

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## Abstract

Mallmann, Mateus; Garcia, Márcio (Advisor); Sanches, Fábio Miessi (Co-Advisor). **Essays on Banking Segmentation, Credit Access, and Political Persistence**. Rio de Janeiro, 2025. 104p. Tese de doutorado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

This dissertation comprises three essays exploring issues in banking and political institutions in Brazil. The first essay examines how strategic differentiation among banks influences competition and profitability in Brazilian credit markets. It develops a measure of bank differentiation, analyzes its relationship with profitability, and estimates a strategic model in which banks allocate credit across market segments. The findings highlight significant segmentation in the Brazilian credit market, shaping banks' profit structures. The second essay investigates the consequences of government-owned bank branch closures since 2015. Following the expansion of bank coverage through the Banco para Todos program, over 30% of these branches were closed. This study investigates the negative effects of these closures on local banking outcomes as well as on real sector indicators. The final essay explores the persistence of political institutions by analyzing legislative size determination in Brazilian municipalities. The legal autonomy to legislate over the size of city councils changed twice, providing cross-sectional variation to test the persistence of political institutions. The findings suggest that legislators have private motives to perpetuate the legislature size but this maintenance depends on the distribution of power within municipalities.

## Keywords

Banking segmentation; Credit Acess Bank branch closure Legislative Size Political Persistence

# Resumo

Mallmann, Mateus; Garcia, Márcio; Sanches, Fábio Miessi. **Ensaios em Segmentação Bancária, Acesso a Crédito e Persistência Política**. Rio de Janeiro, 2025. 104p. Tese de Doutorado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Esta tese é composta por três ensaios que exploram questões relacionadas ao sistema bancário e às instituições políticas no Brasil. O primeiro ensaio examina como a diferenciação de portifolio de crédito entre bancos influencia a concorrência e a lucratividade nos mercados de crédito brasileiros. Nesse ensaio, se desenvolve uma medida de diferenciação bancária, analisando sua relação com a lucratividade e se estima um modelo estratégico no qual os bancos alocam crédito entre diferentes segmentos do mercado. Os resultados revelaram uma segmentação significativa no mercado de crédito brasileiro, que molda a estrutura de lucro dos bancos. O segundo ensaio investiga as consequências do fechamento de agências de bancos públicos desde 2015. Após a expansão da cobertura bancária por meio do programa Banco para Todos, mais de 30% dessas agências foram encerradas. Este estudo analisa os efeitos negativos desses fechamentos sobre os indicadores bancários locais, bem como sobre indicadores da atividade econômica local. O ensaio final explora a persistência das instituições políticas ao analisar a determinação do tamanho das câmaras legislativas nos municípios brasileiros. A autonomia legal para legislar sobre o tamanho das câmaras municipais mudou duas vezes, fornecendo variação transversal para testar a persistência das instituições políticas. Os resultados sugerem que os legisladores têm motivações privadas para perpetuar o tamanho das câmaras, mas essa manutenção depende da distribuição de poder dentro dos municípios.

## Palavras-chave

Segmentação Bancária  Acesso a Crédito  Fechamento de agências bancárias  Tamanho de Legislativo  Persistência Política

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# 1
# Strategic Differentiation of Banks in Credit Markets in Brazil

**Abstract:** The main objective of this paper is to understand how strategic differentiation of banks affects the competition and profits of Brazilian banks. To do this, we investigate the biggest Brazilian banks, which represent more that 70% of the total credit market. We divide our study into three parts. First, we develop a measure of bank differentiation in credit markets. Second, we use these measures of differentiation between banks to study the relationship between differences in the composition of the credit portfolio of different banks and banks' profits. Third, we build and estimate a game of differentiation between banks where they strategically decide the allocation of credit across different segments of the market. Our results indicate that (i) the Brazilian credit market is segmented into three clusters, one occupied by private banks, while two public banks stay in his own cluster; (ii) differentiation on the credit portfolio is associated with bank profits; (iii) counterfactual results indicate that public banks may allocate credit similarly to private banks if they act as profit maximizers.
**Keywords:** Bank segmentation, differentiation, credit market, profit, counterfactual

## 1.1 Introduction

Spreads charged by Brazilian banks are among the highest in the world (Zeidan (2020)). Profits of Brazilian banks are persistently high.[1.1] Various empirical and theoretical papers – Hotelling (1929), Bain (1956), Porter (1980), Dickson & Ginter (1987), Seim (2006), Regan (2008), Mazzeo (2002), Roy (2000) and Bresnahan *et al.* (1997) – have suggested that firms strategically differentiate themselves to soften price competition and preserve high profit margins. Following these insights, the main objective of this paper is to understand how strategic differentiation of banks affects the competition and profits of Brazilian banks.

To do this, we divide our study in three parts. First, we develop a measure of bank differentiation in credit markets. In credit markets, bank differentiation has multiple dimensions. For example, some banks may focus their operations on geographic area "A" while others on region "B", some on the provision of credit to households while others to firms, some on high risk borrowers while others on low risk borrowers, etc. By this reason, measuring bank differentiation in credit markets is a complex task. The main input of our analysis is the composition of credit portfolios of commercial banks operating in Brazil. Bank differentiation is defined from observed differences in the composition of the credit portfolio of each bank. Based on these measures of differentiation we study segmentation in the Brazilian credit market using Clustering Algorithms. We employ clustering algorithms (i) to compute the number of segments in the Brazilian credit market, (ii) to delimit the area of each segment in the space of banks characteristics and (iii) to map banks into segments – see Friedman *et al.* (2001), Kaufman & Rousseeuw (2009) and Sculley (2010) for a detailed discussion on clustering algorithms and Best *et al.* (2017), Hoberg & Phillips (2016) and Wedel & Kamakura (2012) for applications of related methods in economics and marketing. Second, we use these measures of differentiation between banks to study the relationship between differences in the composition of the credit portfolio of different banks and banks' profits. Third, we build and estimate a game of differentiation between Brazilian banks where banks strategically decide the allocation of credit across different segments of the market. We solve the game and use it to produce counterfactuals. A counterfactual question we are interested in is: what happens to profits and to the composition of credit portfolios of Brazilian banks if we remove mandatory restrictions on the operation of public banks?

[1.1] See BCB (2017)

Results indicate that the Brazilian credit market is segmented and it is important for their profits. Of course, this market segmentation is partly explained by mandatory restrictions (or subsidies) on (to) state-owned banks: e.g. CEF (*Caixa Economica Federal*) is very strong in the market for mortgages and BB (*Banco do Brasil*) in credit for agriculture. The differentiation analysis corroborates this point by showing that portfolio difference between public and private banks is much larger than between private banks. Moreover, we find significant heterogeneity even within the group of public banks: BB and CEF pursue markedly different credit strategies, which are closely connected with their funding characteristics. While private banks tend to concentrate within a specific segment, each public bank occupies a distinct and specialized niche in the credit market. From the profit perspective, results show that differentiation in the credit portfolio has a positive correlation with profits for private banks, which are clearly profit maximizers. Moreover, the theoretical model allows us to build counterfactual scenarios to demonstrate that public banks imitate portfolio allocation of private banks if mandatory restrictions on their operation are removed and they act as private banks.

The literature analyzing the Brazilian banking market is voluminous. Early studies, such as Nakane *et al.* (2006), Belaisch (2003) and Sanches *et al.* (2009), examine competition in the Brazilian banking sector by combining aggregate credit market data with market power tests developed by industrial organization economists in the 1980s; see for example Bresnahan (1982) and Panzar & Rosse (1987). These findings are corroborated by Nakane *et al.* (2006), which employ microdata disaggregated at the bank/market level and more recent techniques to estimate structural models of supply and demand (Nevo, 2001; Berry *et al.*, 1995). Criticisms of these early works, which include concerns with assumptions needed to identify firm conduct from aggregate data (Corts, 1999; Genesove & Mullin, 1998; Barbosa *et al.*, 2015) or the lack of data on interest rates charged by banks in local markets, cast doubt on these findings.[1.2] More recently, the work by Joaquim *et al.* (2019) overcomes these limitations by using detailed loan-level data and variation in the structure of local markets due to banking mergers to demonstrate that market concentration has a significant effect on interest rates charged by banks.

Studies analyzing the relationship between differentiation and competition in credit markets are more scarce. The exceptions are Coelho *et al.* (2013) and Sanches *et al.* (2016) that estimate, respectively, a static (Bres-

[1.2] While the methodologies used in Nakane *et al.* (2006) are "free" from some assumptions made, for example, in Nakane *et al.* (2006), Belaisch (2003) and Sanches *et al.* (2009), the lack of interest rate data at the bank/market level lead the authors to impose strong assumptions in their model to estimate the demand for credit.

nahan & Reiss, 1991a,b) and a dynamic (Ericson & Pakes, 1995; Pesendorfer & Schmidt-Dengler, 2008) entry game between public and private banks in isolated markets to infer competition between public and private banks. The findings in these papers indicate entry of a private bank in an isolated municipality reduces the profits of private incumbents but the same is not true when a public bank opens a branch in the same market. As discussed in Sanches *et al.* (2016), a possible explanation to these results is that public and private banks, due to legal restrictions on the mandate of public banks, are focused on different segments of the market. Some of these restrictions, for example, force public banks to concentrate their presence in the markets of credit for agriculture and of mortgages leaving other segments of the market (short term credit for households and firms, for example) exclusively attended by private banks. In a study for the US banking market, Cohen & Mazzeo (2007) also find that competition between financial institutions of the same type ("multi-market" banks, "community" or "single-market" banks and thrifts) is tougher than between institutions of different types.

To the best of our knowledge, this is the first paper that connects the large literature on banking with the marketing literature. By doing this, it is possible to find evidence of market segmentation, even in a very concentrated market such as the credit market in Brazil. The traditional competition analysis on banking (see Tabak *et al.* (2011), for example) uses HHI method to study competition, while this approach can find different bank's actions in the market. This paper also complements results from Coelho *et al.* (2013) and Sanches *et al.* (2016). While these previous works suggest the existence of different operational areas in the credit market for public and price banks, this paper confirms this hypothesis.

The remaining of this paper is organized as follows. Section 1.2 introduces the Brazilian bank and branch level data used in the paper. Section 1.3 presents the institutional background of the banking system. Section 1.4 shows the differentiation and segmentation methodologies used to examine the presence of banking segmentation. Section 1.5 shows evidence on bank differentiation and segmentation. Section 1.6 displays reduced-form evidence on differentiation in the credit market and banking profits. Section 1.7 presents a theoretical Nash Equilibrium model to optimize the allocation of banking credit portfolio and its results. Section 3.6 concludes.

## 1.2
## Data

The Brazilian Central Bank provides detailed information on the composition of banks' credit portfolios. There are two sources of data. One has information at the bank level, with detailed information on credit portfolios but is observed for a shorter period of time. The other has information at the branch level. This dataset is less detailed but it is observed for every bank branch operating in Brazil and for a longer time span. Both will be used for different purposes. Next, we describe these datasets.

### 1.2.1
### Bank Level Data

The first dataset has credit portfolio information at the bank level. Table 1.1 illustrates the information we use to characterize the composition of credit portfolios. These data are available since the second quarter of 2012. There are three aggregation levels for the stock of credits for each bank (first column of Table 1.1): (i) stock of credits to households, (ii) stock of credits to firms and, consequently, (iii) aggregate stock of credit (i.e. the sum of (i) and (ii)). Every aggregation level has one or more dimensions and all dimensions are divided into many subdimensions, which are the final credit type.

The bank level data is organized as follows. The stock of credits to households has one dimension (second column of Table 1.1), "Destination" – i.e. how households use their credits. The stock of credit for firms has three dimensions: "Destination" (how firms use their credits), "Sector" (economic sector in which the firm operates) and "Business Size" (size of the firm). Finally, aggregate stock of credit is also broken into three dimensions "Risk Levels" (borrowers risk levels), "Geography" (i.e. Brazilian administrative region where borrowers are located) and "Consumer Status" (i.e. if the borrower is a household or a firm). Each of these dimensions is broken into subdimensions (third column of Table 1.1). There are in total 45 subdimensions (rows in Table 1.1). We observe the stock of credit allocated to each subdimension.

It is possible to know the total volume of credit designated to all aggregation levels through subdimensions. For the level of aggregation "Households", the sum of the credits in each subdimension gives us the total value of the credit portfolio that each bank allocates to households. For the level of aggregation "Firms", within each dimension, the sum of the credits in each subdimension is equal to the value of the credit porfolio allocated to firms. The same logic holds for the aggregate stock of credit of each bank.

Table 1.1: Composition of Banks Credit Portfolio (Bank Level Data)

| | Dimension | Subdimension |
|---|---|---|
| Households | Destination | Any (Payroll) (*Consignado*) |
| | | Any (Non Payroll) (*Não Consignado*) |
| | | Vehicles (*Veículos*) |
| | | Mortgages (*Habitação*) |
| | | Credit Card (*Cartão de crédito*) |
| | | Agriculture (*Rural e Agroindustrial*) |
| | | Overseas (*Total no Exterior*) |
| | | Other (*Outros Créditos*) |
| Corporate | Destination | Working Capital (*Capital de Giro*) |
| | | Investment (*Investmento*) |
| | | Revolving Working Capital (*Cheque Especial e Conta Garantida*) |
| | | Anticipation of Receivables (*Operações com Recebíveis*) |
| | | Foreign Trade (*Comércio Exterior*) |
| | | Infrastructure (*Financiamento de Infraestrutura*) |
| | | Agriculture (*Rural e Agroindustrial*) |
| | | Real State (*Habitacional*) |
| | | Overseas (*Total no Exterior*) |
| | | Other (*Outros Créditos*) |
| | Sector | Agriculture (*Agricultura, Pecuária, Produção Florestal, Pesca e Aquicultura*) |
| | | Industry (Manufacturing) (*Indústrias de Transformação*) |
| | | Construction (*Construção*) |
| | | Public Utilities (*Serviços Industriais de Utilidade Pública*) |
| | | Extractive Industry (*Industrias Extrativas*) |
| | | Retailing (*Comércio, Reparação de Veículos Automotores e Motocicletas*) |
| | | Public Sector (*Administração Pública, Defesa e Seguridade Social*) |
| | | Transportation (*Transporte, Armazenagem e Correio*) |
| | | Other (*Outros*) |
| | Business Size | Micro |
| | | Small |
| | | Medium |
| | | Large |
| Aggregate | Risk Level | Level AA (lowest) |
| | | Level A |
| | | Level B |
| | | Level C |
| | | Level D |
| | | Level E |
| | | Level F |
| | | Level G |
| | | Level H (highest) |
| | Geography (Regions) | Southeast |
| | | Central West |
| | | Northeast |
| | | North |
| | | Southeast |

**Note:** This table shows how the bank level data is distributed. There are three aggregate levels of credit: “Households", “Corporate", and “Aggregate", combining households and firms. Every aggregation level has one or more dimensions, which are the sum of many subdimensions, that are ways to compute credit destination. All dimensions of “Corporate" and “Aggregate" have the same amount of money, they are just alternative ways of seeing the credit market.

This information allows to compute the bank's relative weight of each subdimension in its credit portfolio. More precisely, for households (firms), we calculate the relative weight of each subdimension through division of the volume of credit allocated to each subdimension by the total volume of credit allocated to households (firms).[1.3] For subdimensions where only aggregate

[1.3]For example, for the level aggregation “Corporate”, the sum of credits allocated to each subdimension under the dimension “Destination” is equal to the total value of the credit stock of credit is available, relative weights are computed as the fraction of credits allocated to each subdimension over the aggregate credit stock of each bank. Altogether, we use these relative weights to compute measures of differentiation between banks.

Mathematically, the relative weight of each subdimension is calculated as follow. Let $v_{1j}, \ldots, v_{8j}$ be the total cash volume of resources allocated to each subdimension in Household-Destination for bank $j$. Then, the relative weights of subdimention within Household-Destination of bank $j$ are given by

$$\omega_{ij} = \frac{v_{ij}}{\sum_{k=1}^{8} v_{kj}}, i = 1, \ldots, 8 \tag{1.1}$$

The same process is used to find all other relative weights. In this way, the relative weights ($\omega_{ij}$ is only connected to how a particular bank distributes its own resources.

### 1.2.2 Branch Level Data

The second dataset has information at the branch level, i.e. we observe the composition of the credit portfolio of each bank branch in each municipality at different time periods. This dataset is available at monthly period. However, the information on credit portfolio is not as detailed as the bank level information that was described in subsection 1.2.1.

Table 1.2 summarizes the information about the credit portfolio of each branch. The branch level has only 10 credit accounts. In particular, there is no distinction between credits to households and credit to firms. The dataset contains resources allocated to each credit account. In order to maintain terminology, we aggregate these 10 credit accounts into 4 subdimensions based on similarity.[1.4] As before, it is possible to compute the relative weight of each subdimension in credit portfolio following equation 1.1.

## 1.3 Institutional Background

The analysis focuses on the five largest commercial banks operating in Brazil. Table 1.3 shows these banks, their ownership structure, the total value of their credit portfolios and market shares in March 2019. We also list another seven banks for comparison purposes.

portfolio allocated to firms. The same holds for subdimensions under dimensions "Sector" and "Business Size".

[1.4]Note that the credit accounts related to the "Agriculture" subdimension are closely connected. Further, some of these "Agriculture" accounts were no longer used.

Table 1.2: Credit Portfolio Structure (Branch Level Data)

| **Credit accounts** | **Subdimension** |
|---|---|
| Invoice Financing | invoice&loans |
| General Purpose Loans | |
| Agricultural Production (Investment) | Agriculture |
| Livestock (Investment) | |
| Agricultural Production (Trade) | |
| Livestock (Trade) | |
| Agroindustry | |
| Real State | Real State |
| Leasing | Other |
| Other | |

**Note:** This table displays the branch level data. The Brazilian Central Bank pools credit for households and firms into ten credit accounts. We aggregate these accounts within four subdimensions based on credit similarity.

For the purposes of this paper, we restrict the analysis to commercial banks. Although fintechs and credit unions have become increasingly relevant in the Brazilian credit market, they are excluded from our sample. Fintechs have experienced rapid growth, driven by technological innovation, internet expansion, and faster adoption among younger cohorts. However, the availability of data on fintechs is limited. For instance, XP, one of the leading fintechs, only enters our dataset in 2019. Credit unions, by contrast, have a long-standing presence in Brazil, with some institutions dating back over a century. Their relevance, however, has increased substantially only since the 2010s, particularly in rural areas, as their operations expanded nationwide. Unlike commercial banks, credit unions provide credit exclusively to their members and do not extend credit to third parties, which limits their comparability with commercial banking institutions.

The five largest Brazilian commercial banks are CEF, BB, Itau, Bradesco, and Santander. In March 2019 the total value of the credit portfolio of these banks was approximately US$650 billions and represented 72% of the Brazilian total credit market. BB and CEF are public banks controlled by the Federal Government. The other three are private banks. Bradesco and Itau are Brazilian banks. Santander is a multinational bank with headquarters in Spain. Table 1.3 summarizes these information.

An important aspect of the Brazilian credit market is the coexistence of large public and private commercial banks. Although public and private banks offer the same types of credit, they are different in many aspects. There is an extensive literature documenting these differences – see, for example, Sanches

Table 1.3: Credit Portfolio of the Largest Brazilian Banks – US$ Millions

| Bank | Ownership | Credit Portfolio | Market Share |
|---|---|---|---|
| CEF | Public | 1,628,425.56 | 18.5% |
| BB | Public | 1,485,219.16 | 16.9% |
| Itau | Private | 1,417,620.02 | 16.1% |
| Bradesco | Private | 1,143,399.33 | 13.0% |
| Santander | Private | 746,346.76 | 8.5% |
| Safra | Private | 160,030.80 | 1.8% |
| Votorantim | Private | 122,285.66 | 1.4% |
| Banrisul | Public | 81,201.30 | 0.9% |
| BTG Pactual | Private | 50,950.76 | 0.6% |
| Citibank | Private | 27,520.87 | 0.3% |
| BNB | Public | 24,834.73 | 0.3% |

**Note:** Total value of the credit portfolio of each bank in US$ millions in March/2019. Exchange rate is R$4.15/US$. Market share considers loan, lease, and other credit operations by risk level in the bank level data.

*et al.* (2016) and Coelho *et al.* (2013) for details.

In essence, private banks are profit maximizers. They collect deposits and are free to allocate them to the most profitable credit lines.[1.5] Empirical and anecdotal evidences, on the other hand, suggests that public banks have other objectives besides profit maximization (Sanches *et al.*, 2016). By law, they are used to support family agriculture and to finance housing for low income workers. BB and CEF are frequently used by the government to assist development policies. These banks have, for example, several credit programs to support investments in public infrastructure, specially in smaller municipalities. Their presence is also stronger in less developed regions of the country, where, frequently they are the only providers of bank services. All these activities may not be profitable for private banks. Consequently, a considerable fraction of public banks resources must be allocated to sectors of the economy that would not be served by private banks.

BB and CEF allocate substantial resources to agricultural and housing credit, respectively, due to both their funding structures and institutional mandates. The National Monetary Council (CMN) and the Central Bank establish that 30% of demand deposits must be directed toward rural credit, which includes both interest rate and subsidized loans.[1.6] Given BB's extensive branch network, particularly in rural areas, it receives a large volume of deposits, positioning it as the primary operator of rural credit in Brazil. Similarly, the CMN requires that at least 65% of savings deposits be allocated

[1.5] Of course, all banks must follow prudential regulation rules imposed and monitored by the Central Bank.

[1.6] Law 4.829/1965 establishes the rural credit policy framework. The Brazilian Central Bank consolidates regulations in the *Rural Credit Manual*, which aggregates CMN-issued norms governing rural credit.

to mortgage lending.[1.7] As the largest recipient of savings in the country, CEF channels a substantial share of its funds into housing finance. Additionally, CEF is the sole financial agent for the *Fundo de Garantia do Tempo de Serviço* (FGTS), a federal fund used to finance social housing, sanitation, and urban infrastructure projects.[1.8] Finally, the National Treasury channels additional budgetary resources to these banks for the implementation of federal credit policies—for instance, rural credit subsidies and the *Programa Nacional de Fortalecimento da Agricultura Familiar* (Pronaf) through BB, and the *Minha Casa, Minha Vida* program through CEF.

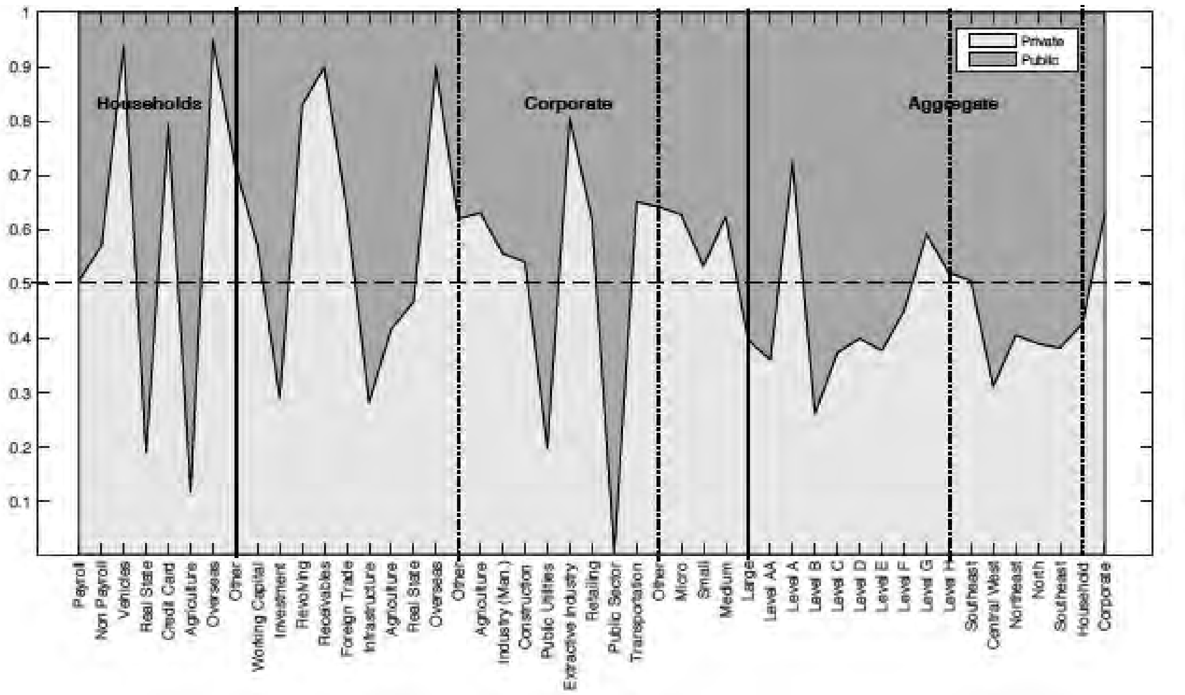
Likewise, institutional attributions of public banks seem to work as a natural source of differentiation between the largest Brazilian banks. Figure 1.1 illustrates this point. The figure plots the share of public (BB and CEF) and private banks (Itau, Bradesco, and Santander) for each subdimension of banks' credit portfolios (see Table 1.1) in March 2019. The first thing to note is that the presence of several (upward and downward) spikes in the figure suggests that public and private banks focus on credit products with different characteristics. For example, looking at the first bit of the picture (credit for households), public banks dominate the subdimensions "Real State" and "Agriculture". As mentioned, this is expected as, by mandate, they have to provide credit to family agriculture and housing. Private banks, on the other hand, are particularly strong in the subdimensions "Vehicles" and "Credit Card". These are credits that have to be used to buy vehicles and to repay credit card debts. The second bit of the picture has information on corporate credit. Once again, there is a large number of spikes. Public banks are relatively stronger in some subdimensions and private banks in others. Differences in terms of risk levels of credit operations, geography (the geographic region where the borrower is located), and type of borrower (households or firms) are less pronounced but still present.

Overall, the institutional details of the credit market in Brazil suggest that public and private banks offer credit products with different characteristics. Differentiation between these types of banks are associated with mandatory restrictions and funding characteristics, and a lower degree of price competition in the credit market. The next section presents the methodologies used to better illustrate this point.

[1.7] Law 4.380/1964 created the *Sistema Financeiro da Habitação* (SFH), and CMN resolutions define the operational rules—see, for example, CMN Resolution 4.676/2018.

[1.8] Law 8.036/1990 regulates FGTS and its use in financing public policy. Law 11.977/2009 created the *Minha Casa, Minha Vida* housing program, which is operated exclusively through CEF.

Figure 1.1: Shares of Public and Private Banks for Credit Portfolio Dimensions – March/2019




**Note:** This figure plots the share of public (BB and CEF) and private banks (Itau, Bradesco, and Santander) for each subdimension of banks' credit portfolios (see Table 1.1) in March of 2019. The horizontal axis has the subdimensions. The darker area represents the share of public banks in each subdimension. The continuous vertical lines divide the subdimensions according to data aggregation levels (first column of Table 1.1). The dashed vertical lines divide each aggregation level in different dimensions (second column of Table 1.1).

## 1.4 Differentiation and Segmentation: Methodology

This section describes the methodology used to measure banks' different actions in the credit market. Starting by proposing a strategy to measure the degree of bank differentiation in the Brazilian credit market, which has multiple dimensions. For example, some banks may focus their operations on geographic area “A" while others on region “B", some on the provision of credit to households while others to firms, some on high risk borrowers while others on low risk borrowers, etc. By this reason, measuring bank differentiation in credit markets is a complex task.

The main input of the analysis is the composition of credit portfolios of the five biggestes commercial banks operating in Brazil. Bank differentiation is defined from observed differences in the composition of the credit portfolio of each bank. Based on these measures of differentiation we study segmentation in the Brazilian credit market.

### 1.4.1 Differentiation

Using the bank level data, a bank is characterized by the relative weight of each subdimension within its credit portfolio. The assumption is that each subdimension is a bank characteristic. Banks differentiate themselves (strategically) by setting different relative weights to each subdimension[1.9] - see equation 1.1 for a mathematical definition on the relative weights.

The mathematical representation of differentiation is given as follows. Each bank is represented by a vector of relative weights, $\Omega_j = \{\omega_{ij}\}_{i=1}^{I} \in [0,1]^I$, where $\omega_{ij} \in [0,1]$ is the relative weight of subdimension $i$ in bank $j$'s credit portfolio, and $I$ is the number of subdimensions observed. The baseline measure of the degree of differentiation between banks $j$ and $j'$ is the Euclidean distance between them in the space of banks characteristics:

$$D_{jj'} = \sum_{i=1}^{I} \left(\omega_{ij} - \omega_{ij'}\right)^2 \tag{1.2}$$

From equation (1.7), differentiation between banks in credit markets can be fully represented by a symmetric matrix $D$ with dimension $J \times J$, where $J$ is the number of banks operating in the market. The cell $(j, j')$ in $D$, for any $j, j' \in \{1, 2, ..., J\}$, contains the Euclidean distance between banks $j$ and $j'$, $D_{jj'}$, in the space of banks characteristics. The distance $D_{jj'}$ will be smaller if $j$'s credit portfolio is "akin" to $j'$'s or, in other words, if relative weights of the same subdimensions in $j$ and $j'$'s credit portfolios are "close". This measure summarizes similarities between banks taking into account a large set of banks' characteristics. Because banks' portfolios can be observed at different points in time it is possible to study how differentiation has changed over time.

The Euclidean distance is a popular measure of dissimilarities between objects. In the context of this paper this measure is particularly convenient because it simplifies considerably the formulation, the estimation and the solution of the structural model of strategic differentiation that will be presented later. We refer the reader to Friedman *et al.* (2001) and Hoberg & Phillips (2016) for a discussion of alternative similarities measures.

### 1.4.2 Segmentation

Another way of measuring the degree of differentiation between banks is through segmentation analyses. In this paper, a segment is defined as a set

[1.9] Alternatively, another possible interpretation of this concept is that each bank offers a different credit product in the market and each row in Table 1.1 represents a characteristic of this product. The "value" of each characteristic is then given by the relative weight of each subdimension on banks credit portfolio.

of credit portfolios with approximately the same characteristics. Portfolios in different segments will have different characteristics. Likewise, the number of segments in the market is related to the degree of product differentiation in this market. Analysis of segmentation is extremely popular in the marketing literature – Kamakura & Russell (1989) and Wedel & Kamakura (2012).

In the context of this paper, clustering algorithms are used to delimit the space of portfolio characteristics, into segments. "Similar" objects are assigned to the same cluster. Frequently, the degree of similarity is measured by the distance between them in the space of observed attributes. At each point in time, banks will appear in a given segment. Clustering algorithms group or segment objects into disjoint subsets (clusters). In this way, it is possible (i) to compute the number of segments in the Brazilian credit market, (ii) to delimit the area of each segment in the space of bank's characteristics, and (iii) to map banks into segments – see Friedman *et al.* (2001), Kaufman & Rousseeuw (2009) and Sculley (2010) for a detailed discussion on clustering algorithms and Best *et al.* (2017), Hoberg & Phillips (2016) and Wedel & Kamakura (2012) for applications of related methods in economics and marketing.

As in Best *et al.* (2017) we use the popular Silhouette coefficient (Rousseeuw, 1987) and K-Means/K-Medoids algorithms to choose the optimal number of segments in the Brazilian credit market, to delimit the area of each segment, and to assign banks to different segments.

First, it is necessary to define the number os clusters $k$. To do this, we employ the Silhouette coefficient. Let $\Omega_{jt}$ be the vector of relative weight of bank $j$ at time $t$. Then, for each $\Omega_{jt}$, its Silhouette coefficient is given by

$$s(jt) = \frac{b(jt) - a(jt)}{\max\{b(jt), a(jt)\}}, \quad \forall j \in J \text{ and } \forall t \in T \tag{1.3}$$

where $a(jt)$ is the average distance between $\Omega_{jt}$ and the other vector of relative weights in the same cluster, and $b(jt)$ is the average distance between $\Omega_{jt}$ and the vector of relative weights in the nearest cluster. A high value of the Silhouette coefficient indicates that the vector of relative weights is well clustered: it is close to the vector of relative weights in its cluster and far from the vector of relative weights in the nearest cluster.

Second, the K-means method groups the relative weight vector into de $k$ clusters defined by the Silhouette coefficient. The K-means gather all $\Omega_{jt}$ into $k$ clusters by finding a centroid $c_k$ for each cluster to minimize the sum of squared distances between the vector of relative weight and their group's centroid. That is, it solves

$$\min_{c} \sum_{j=1}^{J} \sum_{t=1}^{T} \| g(c, \Omega_{jt}) - \Omega_{jt} \|^2 \tag{1.4}$$

where , and $g(c, \Omega_{jt})$ returns the closer centroid to $\Omega_{jt}$

In the Appendix 1.8 we an intuition of the clustering algorithms and procedures. Next section demonstrates the application of these methods in the context of the Brazilian credit market.

## 1.5 Evidence of Bank Differentiation

This section shows descriptive evidence of differentiation between Brazilian banks. The section is structured in two subsections. Subsection 1.5.1 brings estimates of the degree of differentiation between banks, while Subsection 1.5.2 has the results of market segmentation. These exercises are performed using the sample of bank level data, which has very detailed information about the credit portfolio of each bank - see Subsection 1.2.1 and Table 1.1 for more details. The main focus is the investigation of the biggest players: BB, CEF, Bradesco, Itau, and Santander.

We compute the degree of differentiation between the five Brazilian banks using the methodology proposed in Section 1.4.1. Following the discussion in Section 1.3, it is important to show differentiation between public and private banks. In particular, we illustrate how these differences evolve over time.

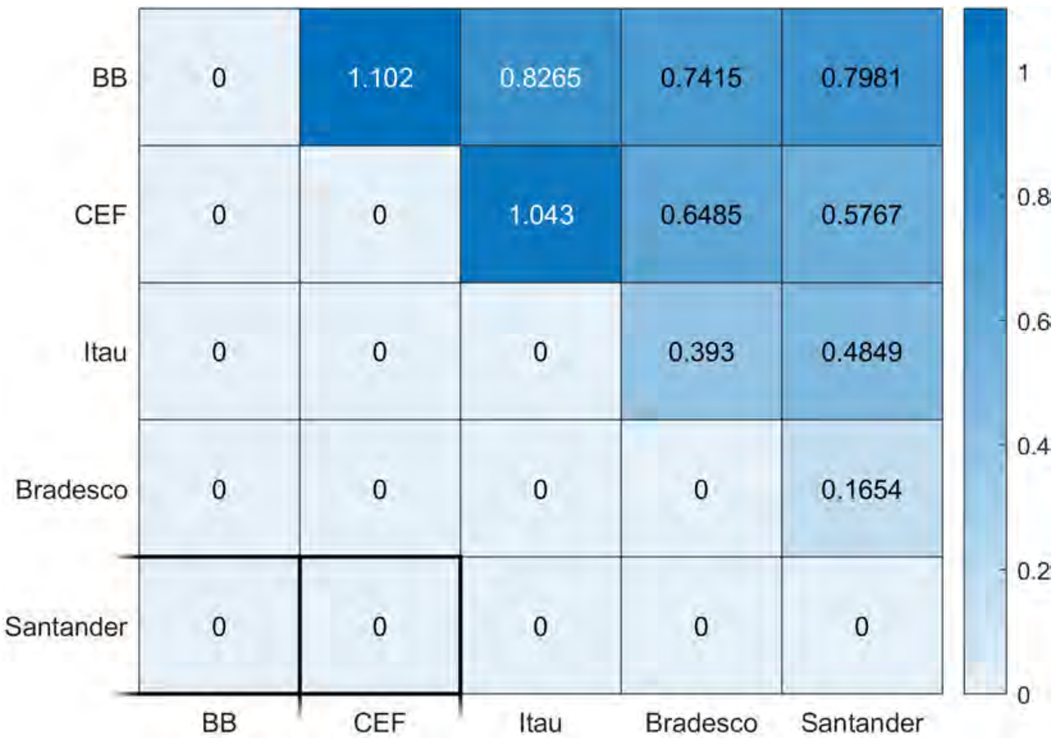
The descriptive study of differentiation is complemented with segmentation analysis. Clustering algorithms are used to estimate the number of segments in the credit market and after it maps banks into segments. By construction, banks with the same characteristics are clustered into the same segment; banks with different characteristics are clustered into different segments. Likewise, the number of segments may be seen as an alternative measure of differentiation between banks.

### 1.5.1 Product Differentiation

To compute the measures of bank differentiation - see subsection 1.4.1 - first, it needs to calculate the relative weight of each subdimension from each bank's credit portfolio - see equation 1.1. These relative weights are the characteristics of banks. Intuitively, they reflect the importance that banks give to different aspects of the credit market. Having computed these relative weights it needs to calculate the Euclidean distance between all pairs of banks - see equation (1.7). This procedure measures product differentiation between banks.

Figure 1.2 is the distance matrix $D$ between the largest Brazilian banks. This is the distance matrix given by equation (1.7) that is calculated for each quarter using bank level data and averaging. In the figure, darker colors indicate larger distances. Not surprisingly, the figure shows a clear pattern: (i) distances between public and private banks are much larger than differences between private banks, and (ii) there is a great distance between BB and CEF. This suggests that differentiation is much less pronounced between public-public and public-private than between private-private banks.

Figure 1.2: Euclidean Distance Between Banks




**Note:** This figure represents the distance matrix given by equation (1.7). The distances between each pair of banks are calculated for all periods and averaged. Darker colors indicate larger distances, which means banks with less similar credit portfolios.

Figure 1.3 shows how the degree of differentiation between both types of banks changes over time. The figure shows the average distance across banks for each type of bank. Differentiation between public and private banks and between public banks was falling until the end of 2016. These trends suddenly changed from that point on. This break happens after Dilma Roussef's impeachment[1.10] and a drastic change in the orientation of economic policy. This evidence seems to suggest that Brazilian public banks are subject to political influence – see Carvalho (2014), Coelho *et al.* (2013) and Sanches *et al.* (2016). The figure also suggests that differentiation between private banks seems to be reducing over time – except for a temporary increase right after the

[1.10] Her impeachment was approved by the Brazilian Senate on August/31/2016.

third quarter of 2016, which may indicate that competition may have gotten tougher between private banks.

We are also able to analyze the behavior of each credit line over time and say which of them has more influence on the general shape of the curves presented in Figure 1.3. Starting from the public-public relationship, the differences in their portfolios are basically explained by real state credit (households) and credit for infrastructure (corporate). During 2016 and 2020, CEF increased both credit lines while BB decreased the relative weight in both credit lines, so the difference in their portfolios became higher. In the public-private relationship, movements can be explained by differences in credit for vehicles and real state (households) and infrastructure (firms). In general, credit for real state and infrastructure is negatively correlated with the interest rate. Therefore, when the interest rate started its descendent cycle, during 2016-2020, reaching its minimum value, the relative weight between CEF and BB and between public and private banks in these two lines of credits increased as a consequence and it produced a boost in public-public and public-private portfolio distance in the same period. [1.11] The convergence in the private-private credit portfolio can be explicaded by a reduction in credit cards, working capital, agriculture, and infrastructure until 2017. After this point, credit overseas differences lowered for both households and firms.

### 1.5.2 Market Segmentation

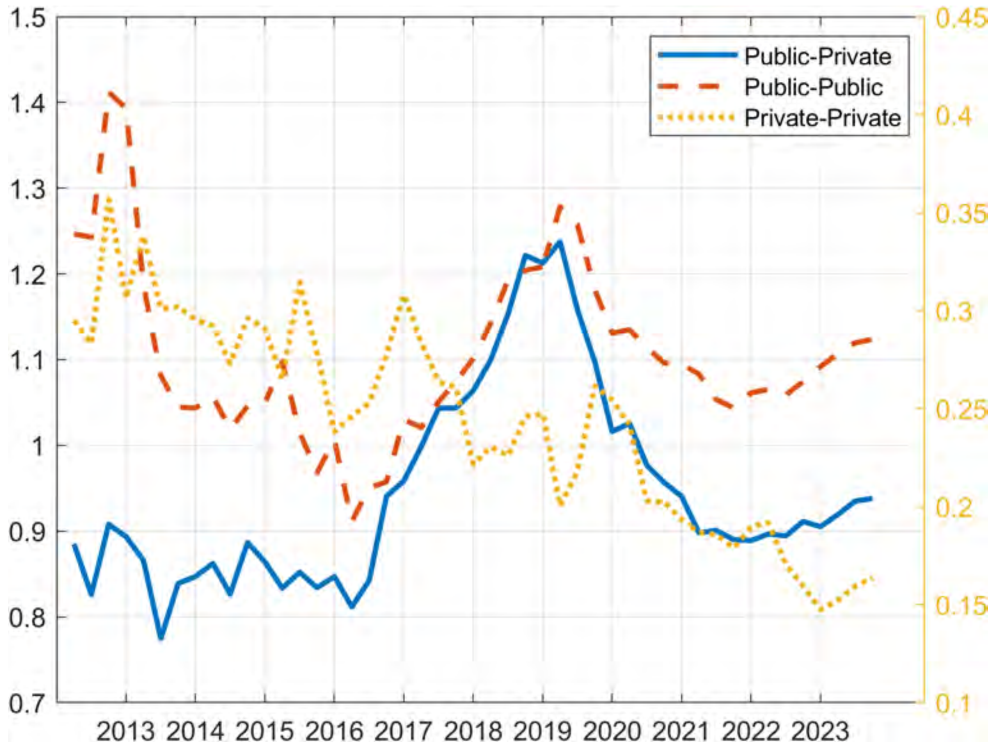
The segmentation analysis in the Brazilian credit market uses clustering algorithms. If banks are closer in the space of characteristics they will populate the same segment. Likewise, the number of segments may be seen as another measure of bank differentiation. We use the sample of bank level data of the five largest Brazilian banks from 03/2013 until 09/2024.

First, it is necessary to compute the optimal number of clusters using a Silhouette coefficient – see subsection 1.4.2. We clustered the data using the K-Means algorithm for $k \in \{1, 2, ..., 20\}$ number of clusters. For each value of $k$ the average Silhouette coefficient, $S_k$, is calculated. The optimal number of clusters, $k$, is such that $k = \underset{k=1,...,10}{argmax}\,\{S_k\}$.

Figure 1.6 in the Appendix 1.8 plots the average Silhouette coefficient, $S_k$, for different values of $k$. It shows that the optimal number of clusters is 3. With three clusters the K-Means algorithm assigns all private banks in a cluster,

[1.11] Besides the relative differences between banks in all credit lines, the total amount of money destined to this lines, could variate over time. For instance, credit for real state increased 27% between 2016Q1 and 2020Q1, while credit for infrastructure reduced 31%.

Figure 1.3: Euclidean Distance Between Banks over Time




**Note:** This figure shows the average Euclidean distance between banks for each bank type over time. Vertical lines indicate the last quarter of each year. Overall, the distance between public and private banks increased during President Temer's mandate, peaking just before the COVID-19 pandemic, and has declined since then. Public banks reduced their portfolio distance until Temer's presidency, increased it until the pandemic, and then began to shorten it again. Private banks exhibited a general trend of decreasing portfolio distance throughout the entire period.

while each public bank are allocated to the other two clusters, i.e. each type of bank is assigned to a different segment in the space of bank characteristics. Figure 1.4 provides a visual representation of the position occupied by each bank in a $\mathbb{R}^2$ representation of the space of bank characteristics.

We use principal components[1.12] to approximate the 45 dimensional space to a 2 dimensional space.[1.13] Each shaded area represents a segment in the space of characteristics[1.14] or, alternatively, a set of portfolios with relatively homogeneous characteristics. It is interesting to note that private and public banks have very different characteristics, such as BB and CEF, as documented in Section 3.2. Figure 1.7 in Appendix 1.8 shows a representation of the space of characteristics in $\mathbb{R}^3$ and results are quite the same. As mentioned before, the argument that public and private banks have different objectives has already

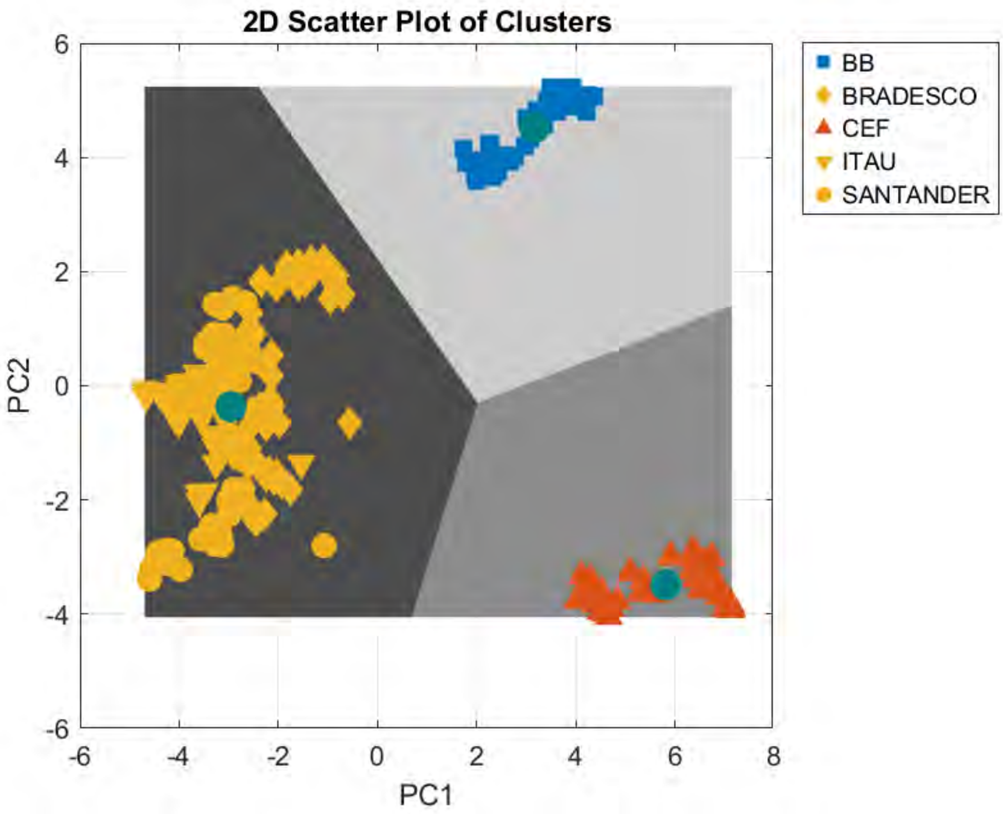
[1.12] See Friedman *et al.* (2001) for a description of this method.

[1.13] These two principal components explain approximately 60% of the variation of the data. Unfortunately, we can not give an economic interpretation for these two principal components.

[1.14] See Appendix 1.8 for a description on the proceduresused to delimit these segments.

appeared in early works[1.15] but they were not so specific as we do. Here we provide a characterization of this difference.

Figure 1.4: Two Dimensional Representation of the Space of Characteristics




**Note:** This figure provides a visual representation of the position occupied by each bank in a $\mathbb{R}^2$ representation of the space of bank characteristics. To do this, the first two principal components are used. All observations from the same bank are close. Every shaded area is a cluster. Each point (represented by a different geometric format) is a bank in a given period of time. The markers represented by green circles are the centroids of each segment. In this representation, private banks stay in one segment, while BB occupies another segment, and CEF a third segment.

In summary, this section documented interesting facts about differentiation between banks in the Brazilian credit market. First, as discussed in Section 1.3, differentiation between the two public banks and between public and private banks is much larger than between private banks. Second, the degree of differentiation between public-public and public-private banks increased after 2016 and reduced after the pandemic, while the degree of differentiation between private banks reduced steadily since 2013. Third, we find strong evidence of segmentation, with each public bank in a cluster, which can be interpreted by agriculture and housing, and a different segment for private banks, where they compete. Together, these empirical evidences show that

[1.15] See Coelho *et al.* (2013) and Sanches *et al.* (2016).

competition between Brazilian private banks is tougher than between public-public and public-private banks – see Sanches *et al.* (2016) and Coelho *et al.* (2013).

## 1.6 Reduced-Form Evidence

This section gives evidence that differentiation matters for profits. To do this, we estimate reduced form regression using our measure of differentiation as a regressor. In order to provide individual responses to differentiation on profits, we estimate regression separately for Bradesco, Itau, and Santander. To increase performance estimation, we add two modifications compared to the earlier analysis: (i) we replace the bank level data with the national aggregation of the branch level data, a (ii) we incorporate an addition of seven banks.

In fact, when the differences in the portfolio of banks increase banks profits also increase. The basic hypothesis is that private banks maximize profit. The same is not necessarily true for public banks, given that they can perform in market segments that are not profitable for private' ones. For example, Banco do Brasil delivers credit for the agriculture market, while CEF distributes resources from social programs, such as Bolsa Familia, and provides better conditions to housing/mortgage for families. Coelho *et al.* (2013) and Sanches *et al.* (2016) made similar argument.

In order to verify the relationship between credit portfolio and profits, we estimate a reduced-form aggregation regression. To do so, we use the Euclidean distance of bank $j$'s credit portfolio to the others $J-1$ banks, which is the differentiation method described in Subsection 1.4.1, as a measure of bank differentiation in credit lines to maximize profits. Therefore, the main explanatory variable is the mean of bank $j$'s Euclidean distance of the relative weights between banks. In this regression, we only use private banks observations and measure their portfolio differences to private and public banks. The functional form is given by

$$Profit_{jt} = \alpha DistPublic_{jt} + \beta DistPrivate_{jt} + \Omega_{jt} + \delta_t + \varepsilon_{jt} \tag{1.5}$$

where the dependent variable is the twelve months profit sum of all branches from the same bank divided by its equity. This metric does not include revenues from treasury operations. $DistPublic_{jt}$ is the mean of the distances for bank $j$ to all public banks at time $t$, $DistPrivate_{jt}$ is the mean of distances for bank $j$ to all private banks at time $t$, $\Omega_{jt}$ are the relative weights of subdimensions invoice&loans, agriculture, real state, and others, $\lambda_j$ and $\delta_t$ are fixed effects variables. We interpret positive values of $\alpha$ and $\beta$ as evidence that portfolio differentiation matters for bank profits.

We run this regression individually for Bradesco, Itau, and Santander. For this purpose, we measure their portfolio distance to other banks. Following the Brazilian Central Bank, we consider all banks with total exposure equal to or bigger than 1% of the Brazilian GDP.[1.16] In September 2024, there were seven private banks (Bradesco, BTG Pactual, Citibank, Itau, Safra, Santander, and Votorantim) and four public banks (Banco do Nordeste, Banrisul, BB, and CEF) classified according to this criterion. The sample comprises monthly observations from 2000 to September 2024. In order to incorporate more observations, we aggregate monthly branch level data at the national level.

The individual banks' regressions are presented in Table 1.4, with distinct coefficients for all banks. Parameters for $DistPrivate_{jt}$ are not significant for Bradesco and Santander and positive and significant for Itau. At the same time, coefficients for $DistPublic_{jt}$ are positive and significant for Bradesco and Santander and not significant for Itau. In all cases, parameter $\omega_{other,jt}$ is the ommited variable and it is set as zero in the theoretical model.

This section investigated the relationship between differentiation in the credit portfolio and bank profits. Overall, results presented in Table 1.4 display that differentiation has positive correlation with profit. All significant coefficients of $DistPrivate_{jt}$ and $DistPublic_{jt}$ are positive, which is an indication that the differentiation in the credit market correlates with profit for Bradesco, Itau, and Santander.

## 1.7 Strategic Model

This section presents the theoretical model used to replicate the allocation of credit for Brazil's three biggest private banks. The game is a simple Nash Equilibrium model where competitors decide simultaneously their credit portfolio through the relative credit weights. The optimal results coming from the model are close to the allocation observed in the data, especially for Itau and Santander. Here, we use the aggregation of branch level data, which correspond to its four subdimentions, and include all banks greater than 1% of the Brazilian GDP, either used in the last section.

[1.16] The Brazilian Central Bank classifies financial institutions into five categories, S1 through S5, according to their risk profile and the relevance of their international activity to apply prudential regulation proportionally. In this approach, institutions more exposed to risks or with relevant international activity (S1) have to comply with a wider and more complex regulation, while institutions with less risk exposure (S5) must observe simpler rules. For more details see https://www.bcb.gov.br/en/financialstability/regulation.

Table 1.4: Individual regressions

| | Bradesco | Itau | Santander |
|---|---|---|---|
| | (1) | (2) | (3) |
| $DistPrivate_{jt}$ | 0.0404 | 0.1603* | -1.5040 |
| | [0.0714] | [0.0929] | [0.9676] |
| $DistPublic_{jt}$ | 0.3107*** | -0.2047 | 6.3410*** |
| | [0.1088] | [0.1665] | [1.1042] |
| $\omega_{invoice,jt}$ | 0.1962*** | -0.1505 | 2.1495*** |
| | [0.0722] | [0.1021] | [0.7810] |
| $\omega_{agri,jt}$ | 0.0297 | -1.9545** | 1.4227 |
| | [0.3308] | [0.7586] | [3.3615] |
| $\omega_{real,jt}$ | -1.5613*** | 0.4244 | 1.5577 |
| | [0.3430] | [0.3849] | [4.3630] |
| Year FE | Yes | Yes | Yes |
| Month FE | Yes | Yes | Yes |
| Observations | 297 | 297 | 297 |
| R-squared | 0.776 | 0.776 | 0.526 |

*** p<0.01, ** p<0.05, * p<0.1

**Note:** This table displays regression results for the relationship of profits, measured by the twelve months profit sum of all branches from the same bank divided by its equity, and portfolio differentiation, measured through the Euclidean distance in the relative credit weight for each of the S1 private banks. $DistPublic_{jt}$ is the mean of the distances for bank $j$ to S1 and S2 public banks at time $t$, $DistPrivate_{jt}$ is the mean of distances for bank $j$ to all S1-S2 private banks at time $t$, $\omega_{k,jt} \in \Omega_{jt}$ is the relative weights of subdimensions invoice&loans ($\omega_{invoice,jt}$), agriculture ($\omega_{agri,jt}$), real state ($\omega_{real,jt}$), and others ($\omega_{other,jt}$), which is ommited. Standard errors are reported in brackets.

### 1.7.1 Baseline model

The model comprehends the credit allocation decision of Bradesco, Itau, and Santander, the biggest private banks in Brazil. These banks are profit maximizers and they interact with smaller private banks and public banks. The other private banks are considered exogenous because of their tiny relative market share. Further, as public banks do not have a clear objective function, their credit allocation is also assumed to be exogenous. The model uses the four relative weights observed (invoice&loans, agriculture, real state, and others, presented in Table 1.2) in all periods for each bank. The model gives the optimal relative weights of credit decision and we compare them to the data observed.

The game goes as follows. Each of the $j$ biggest private banks ($Pri1 \in$ {Bradesco, Itau, Santander} ) decide simultaneously over the relative weight of all subdimensions of credits $i \in I$, represented by $\omega_{ij} \in [0, 1]$. The decision set is determined by $\Omega_j = \{\omega_{ij}\}_{i=1}^{I} \in [0, 1]^I$. Each $Pri1$ banks chose $\omega_j$ according to the relative weights of the other $j' \in Pri1$ banks, denoted by $\omega_{j'}$, with

$j' \neq j$. The relative weight of the smaller private banks and public banks are denoted by $\bar{\omega}_{-Pri1}$ and $\bar{\omega}_{Pub}$, respectively. Bank $j$ measures the difference between bank's portfolio through the Euclidean distance of the relative weights – see more details in section 1.4.1. Therefore, the profit maximization problem is given by

$$\begin{aligned} &\max_{\omega_j} \Pi_j \left(\omega_j, \omega_{j'}, \bar{\omega}_{-Pri1}, \bar{\omega}_{Pub}\right) = \alpha_j \frac{\sum_{j=1}^{N_{Pub}} D_{j,Pub}}{N_{Pub}} + \beta_j \frac{\sum_{j=1}^{N_{Pri}} D_{j,Pri}}{N_{Pri}} + \gamma_j \omega_j \\ &s.t \quad \sum_{i=1}^{I} \omega_{ij} = 1, \quad \forall j \in J \\ &\qquad 0 \leq \omega_{ij} \leq 1, \forall \omega_{ij}, \quad i \in I \text{ and } j \in J \end{aligned} \tag{1.6}$$

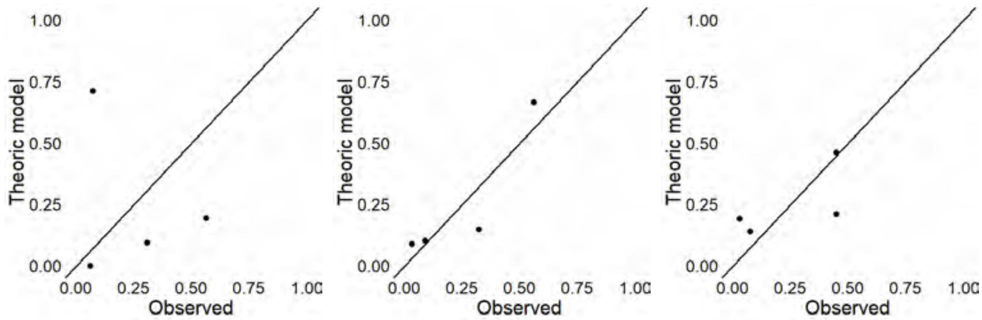
where $N_{Pub}$ denotes the total number of public banks, $N_{Pri} = N_{Pri1} + N_{-Pri}$ represents the total number of private banks, $D_{j,Pub}$ is the Euclidean distance between portfolios of bank $j$ and public banks, and $D_{j,Pri}$ is the Euclidean distance between credit allocation of bank $j$ and another private bank, including the other $j'$ banks from $Pri1$ and the smaller ones $(-Pri1)$. Bank $j$'s optimal value is denoted by $\omega_j^* = \left(\omega_j, \omega_{j'}, \bar{\omega}_{-Pri1}, \bar{\omega}_{Pub}, \alpha_j, \beta_j, \gamma_j\right)$. Variable $\omega_j$ and $\omega_{j'}$ are simultaneously calculated, while $\bar{\omega}_{-Pri1}$ and $\bar{\omega}_{Pub}$ are exogenous.

Parameters $\alpha_j, \beta_j$, and $\gamma_j$ for each of the three $Pri1$ banks come from the estimation presented in Table 1.4. Banks have their own values for parameters $\alpha$, $\beta$, and $\gamma$ and it is possible to know how they relate to other banks and the relative importance of all credit subdimensions. In all cases, parameter $\omega_{other,jt}$ is the ommited variable and it is set as zero in the theoretical model.

Figure 1.5 shows the fit of the Nash Equilibrium model. We ran 3000 simulations and present the convergent results from the baseline model. The figure compares the optimal result given by computational optimization of the four subdimensions of each $Pri1$ bank with the mean of the relative weight observed. As can be seen, the model predicts Itau and Santander's allocation well and is not a good approximation for Bradesco. The model predicts 71% of resources in *real state* for Bradesco's allocation, while the observed mean is 7%. This is emblematic because $\omega_{real,jt} < 0$, while the objective function maximizes $\omega_{ij}$.

The possible explanation for this result is that the model is an untargeted approach. In order to imitate real relative weights of $Pri1$ banks, the model focus on the portfolio distance between banks. It is not build to replicate the relative weights as its main purpose, then there could be important features not incorporated in our approach. The traditional economic view considers a profit function composed by costs and revenues to derive the optimal credit allocation for each subdimention, while our approach tries to optimize profit based on differenciation in product characteristics.

Figure 1.5: Fit of the Nash Equilibrium model




(a) Bradesco (b) Itaú (c) Santander

**Note:** This figure compares the relative weights calculated by the optimization of the Nash Equilibrium model (y-axis) with the average relative weights observed in the data (x-axis). The closer the dots are to the 45-degree line, the more similar the calculated and observed relative weights.

### 1.7.2 Counterfactuals

Even with theses results, we build a counterfactual scenario to investigate what will happen with the biggest public banks without mandatory restriction over their credit allocation decisions. We choose to investigate what happens with BB and CEF if they assume private behavior and not all public banks for three main reasons. First, to maintain consistency with the entire paper because we are interested in the biggest players. Second, we focus on BB and CEF to preserve the same basic optimization equation consisting in the portfolio difference for public and private banks. Third, BB and CEF are the only banks widespread in the Country, the other two public banks act regional: Banrisul is the bank of the Rio Grande do Sul state, and BNB promotes economic development in the Brazilian's northeast area. From the theoretical model perspective, there are five banks maximizing results instead of three incorporated in baseline results. Consequently, the exogenous public banks in this approach are Banrisul and BNB. Counterfactuals are made by inputting parameters from private banks to the public ones to see if they would behave as private banks. If true, we expect the relative weights of public banks to be close to private's.

Table 1.5 summarises all results from the theoretical model by putting the estimated coefficients from Table 1.4, the observed mean values of the relative weights, the baseline estimation of the model, presented in Figure 1.5, and the results from the counterfactual scenarios. Note that in the “Counterfactual Bradesco", for example, we set the Bradesco’s coefficients for BB and CEF. The same holds for “Counterfactual Itau" and “Counterfactual Santander".

As can be seen in Table 1.5, the relative weights of BB and CEF, and consequently the profit, are very similar with the bank whose parameters were replaced. See that BB and CEF have very similar results of Bradesco in the “Counterfactual Bradesco". The same holds for “Counterfactual Itau". The only difference is “Counterfactual Santander", where CEF deviates from BB and assumes different relative weights.

Looking specifically over the results of profits. Focusing specifically on the results for profits of the counterfactuals it is possible to see that profits does not necessarily decrease when more players are optimizing. Standard microeconomic theory suggests that an increase in competition tends to reduce firms’ profits. In our counterfactual exercise, public banks adopt the parameters of private banks and begin to behave as strategic competitors. However, this does not represent the entry of new competitors per se, as public banks were already present in the baseline model, albeit as exogenous players. The key change is that, in the counterfactual scenarios, more banks participate actively in the strategic optimization process by choosing their best responses to the actions of others. It is also important to emphasize that the optimization problem includes constraints only at the individual bank level—specifically, each bank must allocate its portfolio such that $\sum_{i=1}^{I} \omega_{ij} = 1$ for all $j \in J$ and does not impose aggregate constraints on the entire economy. For this reason, we argue that profits do not necessarily decline in the counterfactuals, despite the increased number of optimizing agents. The shift reflects a change in strategic interaction, not an increase in market saturation.

The results from our counterfactual exercise help address the question: what would happen to the composition of Brazilian banks’ credit portfolios if mandatory restrictions on public bank operations were removed? Our findings indicate that, in the absence of such restrictions, public banks would behave similarly to private banks, reallocating credit across segments in a comparable manner. Specifically, both BB and CEF would prioritize credit in the categories of *invoice & loans* and *others*, while reducing their exposure to *agriculture* and *real estate*, closely mirroring the allocation patterns of private banks. However, our framework is silent on which institutions would take over the financing of agriculture and real state in the absence of public bank intervention. This limitation stems in part from the fact that our model does not explicitly account for the demand side of the credit market.

Table 1.5: Bank Performance Metrics for baseline Nash Equilibrium model and counterfactuals

| Bank | Specification | Profit | Invoice & Loans | Agriculture | Real State | Others |
|---|---|---|---|---|---|---|
| Bradesco | Coefficients | - | 0.1962*** | 0.0297 | -1.5613*** | 0 |
| | Observed (mean) | 0.1197 | 0.5612 | 0.0589 | 0.0718 | 0.3081 |
| | Baseline | -0.8595 | 0.1939 | 0.0000 | 0.7112 | 0.0949 |
| | Counterfactual Bradesco | -0.3970 | 0.4443 | 0.0592 | 0.3881 | 0.1084 |
| | Counterfactual Itau | -0.6960 | 0.2850 | 0.0001 | 0.6162 | 0.0987 |
| | Counterfactual Santander | -0.2673 | 0.4276 | 0.1164 | 0.2847 | 0.1713 |
| Itau | Coefficients | - | -0.2047 | -0.1505 | -1.9545** | 0 |
| | Observed (mean) | 0.1540 | 0.5580 | 0.0301 | 0.0898 | 0.3220 |
| | Baseline | -0.2302 | 0.6638 | 0.0882 | 0.1018 | 0.1462 |
| | Counterfactual Bradesco | -0.1847 | 0.6638 | 0.0882 | 0.1018 | 0.1462 |
| | Counterfactual Itau | -0.0942 | 0.4990 | 0.0562 | 0.2052 | 0.2396 |
| | Counterfactual Santander | -0.3214 | 0.4621 | 0.1772 | 0.1475 | 0.2133 |
| Santander | Coefficients | - | 2.1495*** | 1.4227 | 1.5577 | 0 |
| | Observed (mean) | 0.0597 | 0.4478 | 0.0296 | 0.0747 | 0.4479 |
| | Baseline | 2.4155 | 0.4592 | 0.1907 | 0.1398 | 0.2102 |
| | Counterfactual Bradesco | 5.2444 | 0.0004 | 0.0011 | 0.0000 | 0.9985 |
| | Counterfactual Itau | 1.9735 | 0.6637 | 0.0883 | 0.1018 | 0.1463 |
| | Counterfactual Santander | 1.9224 | 0.6635 | 0.0883 | 0.1018 | 0.1463 |
| BB | Coefficients | - | - | - | - | - |
| | Observed (mean) | 0.1631 | 0.4192 | 0.2391 | 0.0287 | 0.3130 |
| | Baseline | - | - | - | - | - |
| | Counterfactual Bradesco | -0.3970 | 0.4436 | 0.0602 | 0.3881 | 0.1081 |
| | Counterfactual Itau | -0.0458 | 0.5172 | 0.0304 | 0.2144 | 0.2380 |
| | Counterfactual Santander | 1.9224 | 0.6635 | 0.0883 | 0.1018 | 0.1464 |
| CEF | Coefficients | - | - | - | - | - |
| | Observed (mean) | 0.1451 | 0.2472 | 0.0073 | 0.5998 | 0.1458 |
| | Baseline | - | - | - | - | - |
| | Counterfactual Bradesco | -0.4025 | 0.4434 | 0.0601 | 0.3886 | 0.1079 |
| | Counterfactual Itau | -0.0496 | 0.5172 | 0.0304 | 0.2144 | 0.2380 |
| | Counterfactual Santander | 5.1863 | 0.0119 | 0.0122 | 0.0000 | 0.9759 |

**Note:** This table shows the results for the counterfactual exercise. For each bank, it presents the parameters used in the Nash Equilibrium model (first line for all banks), the mean of profit and $\omega_{ij}$ observed (second line), the baseline results from the theoric model (third line), the results that consider public banks with Bradesco's parameters, Itau's parameters, and Santander's parameters (last three lines).

Altogether, despite being untargeted, the model performs reasonably well in replicating the relative credit portfolio weights of private banks (e.g., $Pri1$). Building on this baseline, we construct counterfactual scenarios to examine how public banks would behave if they operated as profit-maximizing. To implement this, we calibrate the profit-maximization parameters of public banks using those estimated for private banks. The counterfactual results suggest that, under these conditions, public banks would reallocate their credit portfolios in a way that closely imitates private sector behavior.

## 1.8 Conclusion

Firms differentiate their products to soften competition and enhance profitability. The same logic applies to the credit market, where banks may specialize in particular credit lines, geographic regions, or borrower risk profiles to increase profits. This paper documents evidence of such behavior by integrating banking data with insights from the marketing literature, employing clustering techniques to identify segments within the Brazilian credit market.

Our results indicate that the credit market is indeed segmented, and that portfolio differentiation is an important determinant of bank profitability. Using data from the five largest Brazilian banks - Banco do Brasil (BB), Caixa Econômica Federal (CEF), Bradesco, Itau, and Santander — we apply a clustering algorithm that identifies three credit market segments. Private banks cluster into one segment, while BB and CEF each form their own distinct clusters. This segmentation is consistent with both regulatory mandates and funding constraints established by the National Monetary Council (CMN). One interpretation of these findings is that BB and CEF are fundamentally different public banks, each serving distinct roles within the Brazilian financial system by operating in market segments not typically served by private banks. Further analysis shows that greater differentiation in credit portfolios is positively associated with private banks' profitability.

We develop a Nash equilibrium model in which Bradesco, Itau, and Santander simultaneously choose their portfolio allocations to maximize profits, treating the relative weights of public and smaller private banks as exogenous. The baseline model performs reasonably well in matching observed data. Based on this framework, we conduct counterfactual simulations in which public banks are assigned the same parameters as private banks. The results suggest that, under such conditions, public banks would reallocate their credit portfolios to closely resemble those of private banks.

There are several avenues for future research. One is to investigate the implications for the provision of agricultural and housing credit if public banks were to behave as private profit-maximizers. Another is to extend the current model by implementing a leader-follower framework, where the largest private banks act as leaders and all other banks behave as followers. Such an approach may offer a richer explanation of the dynamics in the Brazilian credit market.

# Appendix A

## Clustering: Algorithms and Additional Results

### Algorithms

#### 1.8.0.0 K-Means

Steps of the k-means algorithm

1. Initialization: Choose the number of clusters ($K$) and randomly attribute a value to the $K$ cluster centroids.

2. Assignment Step: For each data point, calculate its distance to each cluster centroid (commonly using Euclidean distance, as we do). Assign the data point to the cluster with the nearest centroid.

3. Update Step: Recalculate the cluster centroids as the mean of all data points assigned to that cluster.

4. Repeat: Repeat the assignment and update steps until the centroids no longer change significantly (convergence) or a maximum number of iterations is reached.

#### 1.8.0.0 K-Medoids

The main difference between K-Means and K-Medoids lies in how they define the cluster center and compute the distances, which affects their robustness.

In the K-Means method, the cluster center is the mean of all data points in a cluster. Therefore, the centroid may not necessarily correspond to an actual data point. In contrast, in the K-Medoids, the cluster center (medoid) is the most centrally located data point in the cluster, then this medoid is an actual data point, making the method more interpretable. Moreover, the K-Medoids is more robust to outliers because the medoid is an actual data point, reducing the influence of extreme values. The K-Medoids method's drawback is that it requires evaluating distances between all pairs of points to find the medoid, which can be computationally costly.

### Delimiting Segments in the $\mathbb{R}^2$

To delimit these segments in the $\mathbb{R}^2$ – see Figure 1.4 – we proceed as follows:

1. Take the first two principal components of the space of characteristics using all observations in the sample.

2. Using $k = 5$ – the optimal number of clusters computed using the Silhouette coefficient and the whole sample – we obtain the centroid of each segment in the $\mathbb{R}^2$, i.e. we cluster banks representing them by their two principal components and calculate the centroid of each cluster.

3. We compute a fine grid of points in the $\mathbb{R}^2$ using as limits the maximum and the minimum of each principal component.

4. Using the clustering algorithm and the centroids obtained in step step 2, we assign each point of the $\mathbb{R}^2$ (grid points obtained from step 4) to each of the 5 segments represented by each centroid.

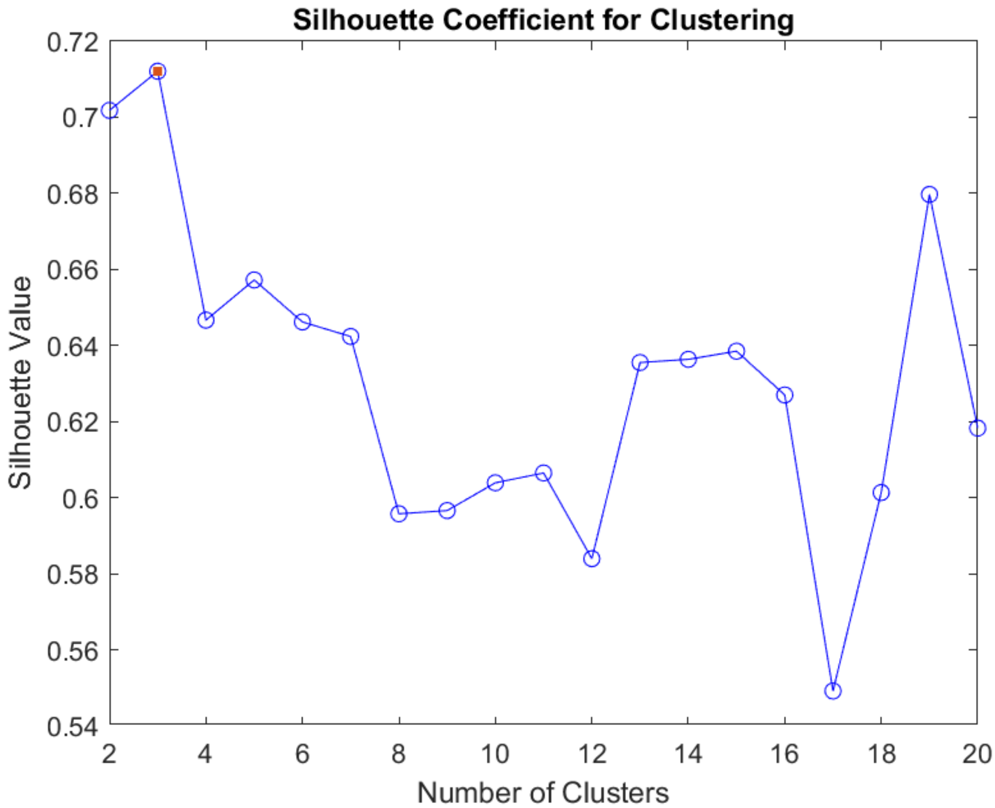
### Additional Results

Figure 1.6 shows the plots the average Silhouette coefficient, $S_k$ – see Appendix 1.8 – for different values of $k$. The Silhouette coefficient peaks at $k = 5$ clusters which suggests that the Brazilian credit market has 5 segments. When $k = 5$, the average Silhouette coefficient is 0.8, which suggests that when $k = 5$ observations are well matched to their clusters.

Figure 1.7 has a three dimensional representation of the space of characteristics. Each axis in the figure represents one of the three first principal components of the space of characteristics.[1.17] Visually, this figure resembles Figure 1.4. It also illustrates how the reduction in the dimension of the space using principal components works. Roughly speaking each point in the $\mathbb{R}^2$ is the vertical "shadow" of the corresponding point in the $\mathbb{R}^3$.

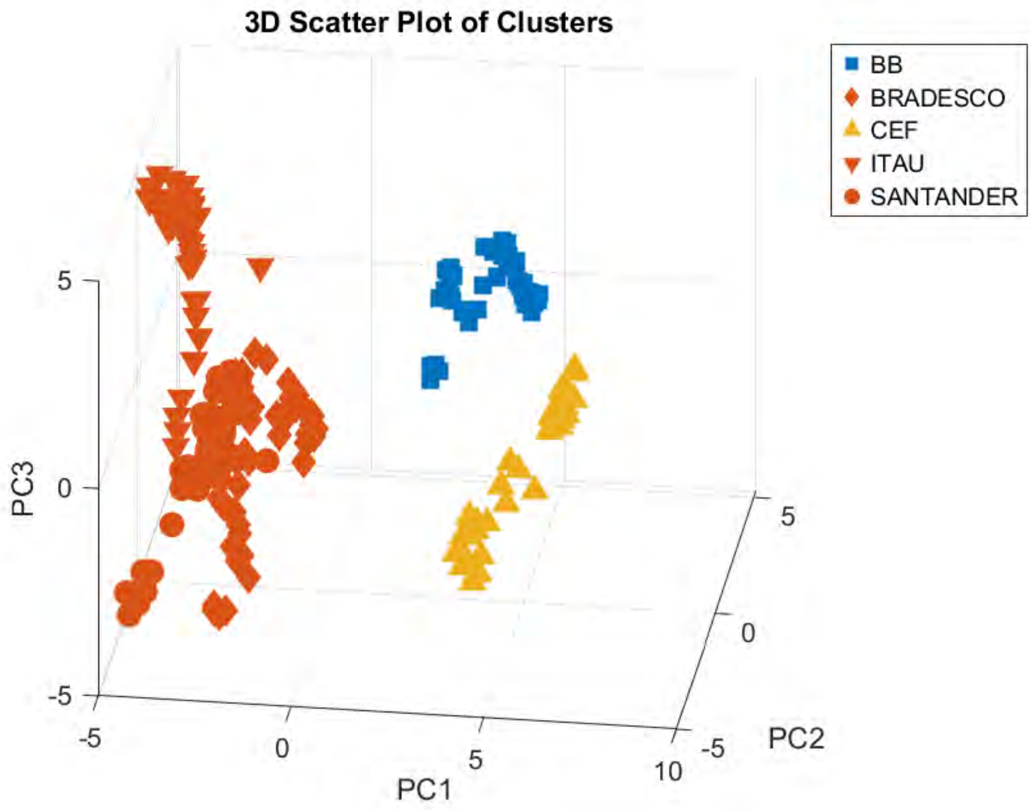
[1.17] These three principal components explain approximately 70% of the variation in our data.

Figure 1.6: Silhouette Coefficients for Different Number of Clusters




**Note:** This figure plots the average Silhouette coefficient, $S_k$, for different values of $k$. It shows that the optimal number of clusters is 3.

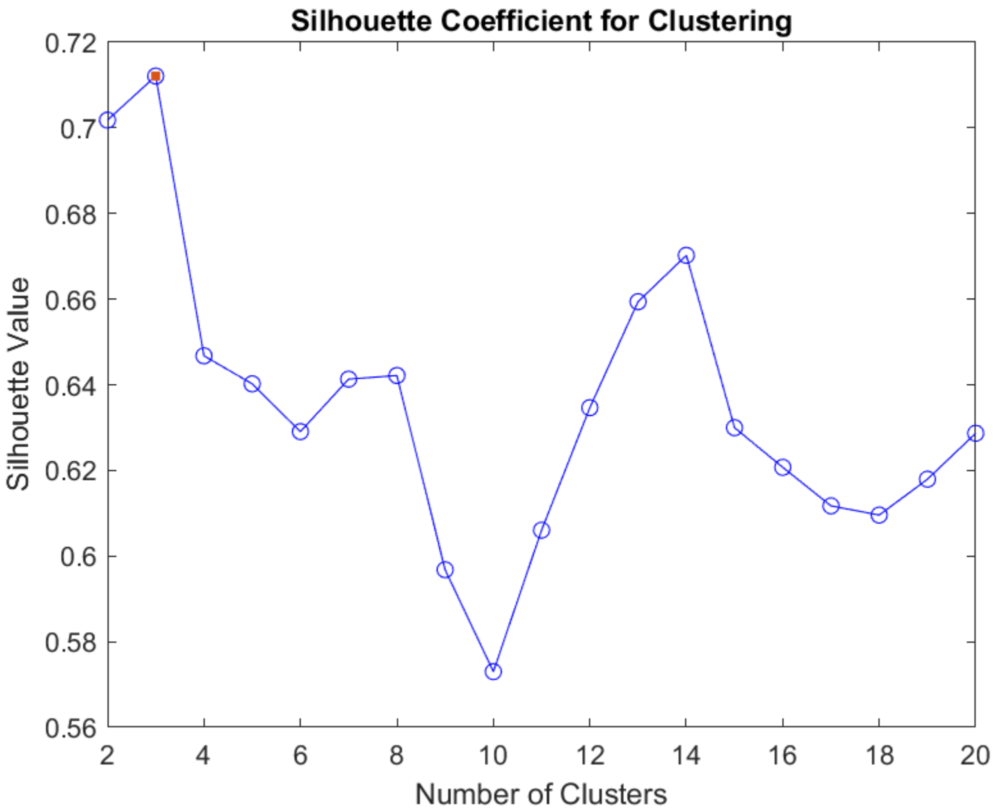
Figure 1.7: Three Dimensional Representation of the Space of Characteristics




**Note:** This figure provides a visual representation of the position occupied by each bank in a $\mathbb{R}^3$ representation of the space of bank characteristics. The symbols represent an observation over time for all five biggest Brazilian banks. All observations from the same bank are close. In this representation, the algorithm indicates there are three clusters (as seen in Figure 1.6), with CEF in one of the clusters, BB within another, and a third cluster occupied by private banks.

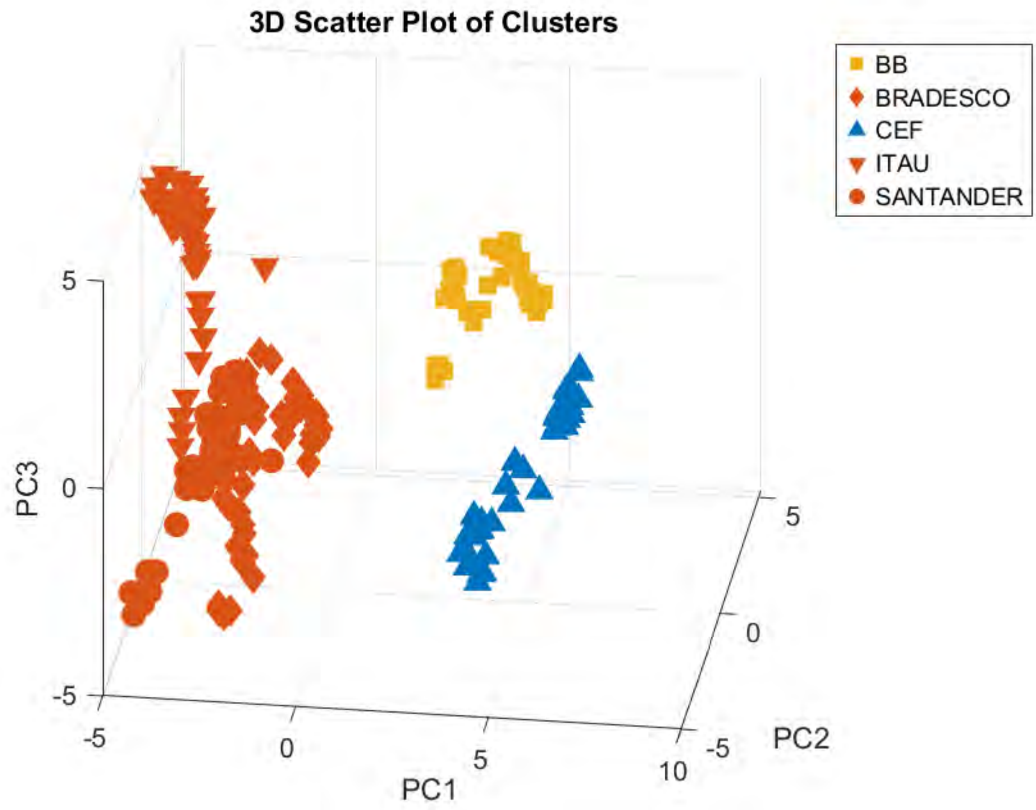
### K-Medoids Results

Figure 1.8: Silhouette Coefficients for Different Number of Clusters - K-Medoids method




**Note:** This figure plots the average Silhouette coefficient, $S_k$, for different values of $k$. It shows that the optimal number of clusters using the K-Medoids method is 3.

Figure 1.9: Two Dimensional Representation of the Space of Characteristics




**Note:** This figure provides a visual representation of the position occupied by each bank in a $\mathbb{R}^3$ representation of the space of bank characteristics. The symbols represent an observation in the time for all five biggest Brazilian banks. All observations from the same bank are close. In this representation, the algorithm indicates there are three clusters (as seen in Figure 1.8), with CEF in one of the clusters, BB within another, and a third cluster occupied by private banks.

### Optimization results

### Computational solution of the model

Let $\{\omega_1, \ldots, \omega_J\}$ be the portfolio of each $j \in J$ bank in the bank system, where $\omega_j$ is the allocation vector of bank $j$, i.e. $\omega_j = \{\omega_{1j}, \ldots, \omega_{Ij}\}$, where $\omega_{ij}$ is the relative weight of credit subdimension $i \in I$.

We measure portfolio distance between banks $j$ and $j^{'}$ by the Euclidean distance of their relative credit weights

$$D_{jj'} = \sqrt{\sum_{i=1}^{I} (\omega_{ij} - \omega_{ij'})^2} \tag{1.7}$$

In this model S1 private banks choose their relative credit weights simultaneously, whereas S2 private banks and public banks are taken as exogenous. Then the S1 private banks problem is the same as presented in Equation 1.6:

$$\begin{aligned} &\max_{\omega_j} \Pi_j \left(\omega_j, \omega_{j'}, \bar{\omega}_{-Pri1}, \bar{\omega}_{Pub}\right) = \alpha_j \frac{\sum_{j=1}^{N_{Pub}} D_{j,Pub}}{N_{Pub}} + \beta_j \frac{\sum_{j=1}^{N_{Pri}} D_{j,Pri}}{N_{Pri}} + \gamma_j \omega_j \\ &s.t \quad \sum_{i=1}^{I} \omega_{ij} = 1, \quad \forall j \in J \\ &\qquad 0 \leq \omega_{ij} \leq 1, \forall \omega_{ij}, \quad i \in I \text{ and } j \in J \end{aligned} \tag{1.8}$$

where $N_{Pub}$ denotes the total number of public banks, $N_{Pri} = N_{Pri1} + N_{-Pri}$ represents the total number of private banks, $D_{j,Pub}$ is the Euclidean distance between portfolios of bank $j$ and public banks, and $D_{j,Pri}$ is the Euclidean distance between credit allocation of bank $j$ and another private bank, including the other $j^{'}$ banks from $Pri1$ and the smaller ones $(-Pri1)$. Bank $j$'s optimal value is denoted by $\omega_j^* = \left(\omega_j, \omega_{j'}, \bar{\omega}_{-Pri1}, \bar{\omega}_{Pub}, \alpha_j, \beta_j, \gamma_j\right)$. Variable $\omega_j$ and $\omega_{j'}$ are simultaneously calculated, while $\bar{\omega}_{-Pri1}$ and $\bar{\omega}_{Pub}$ are exogenous.

Then we take the first order condition (FOC) for every $\omega_{i,j}$, where $i = \{1, 2, 3, 4\}$ and $j = \{1, 2, 3\}$

$$\frac{\partial \Pi_j}{\partial \omega_{ij}} = f_{ij}(\omega, \theta) \tag{1.9}$$

As we have three S1 private banks ($J = 3$) and four credit subdimensions ($I = 4$) we are looking for a solution of a system with 12 equations and 12 unknown variables. Then, we minimize all $\omega_{ij}$ together respecting all constraints in the way as follows

$$\begin{aligned} &\min_{\omega_{ij}} \sum_i \sum_j \left[\omega_{ij} - f_{ij}(\omega, \theta)\right]^2 \\ &s.t \quad \sum_{i=1}^{I} \omega_{ij} = 1, \quad \forall j \in J \\ &\qquad 0 \leq \omega_{ij} \leq 1, \forall \omega_{ij}, \quad i \in I \text{ and } j \in J \end{aligned} \tag{1.10}$$

This problem is numerically solved using *fmincon* matlab function. To do this, it is necessary to input initial values for the relative weights $\omega_{ij}$, which are the observed relative weight mean.

# 2
# From Expansion to Shrinkage: Evidence on Government-Owned Bank Closures in Brazil

**Abstract:** In this paper, we explore the impacts of government-owned bank branch closures occurred in Brazil since 2015. Brazil expanded bank coverage through the *Banco para Todos* (Bank for All) program, but more than 30% of these bank branches were closed since 2015. We investigate the effects on local banking outcomes, such as the number of banks, deposits, and lending. We also measure the possible losses on the local economy (number of firms, employment, and wage) of these branch closures and find no effect.
**Keywords:** Bank branches, closure, presence, credit, deposits

## 2.1 Introduction

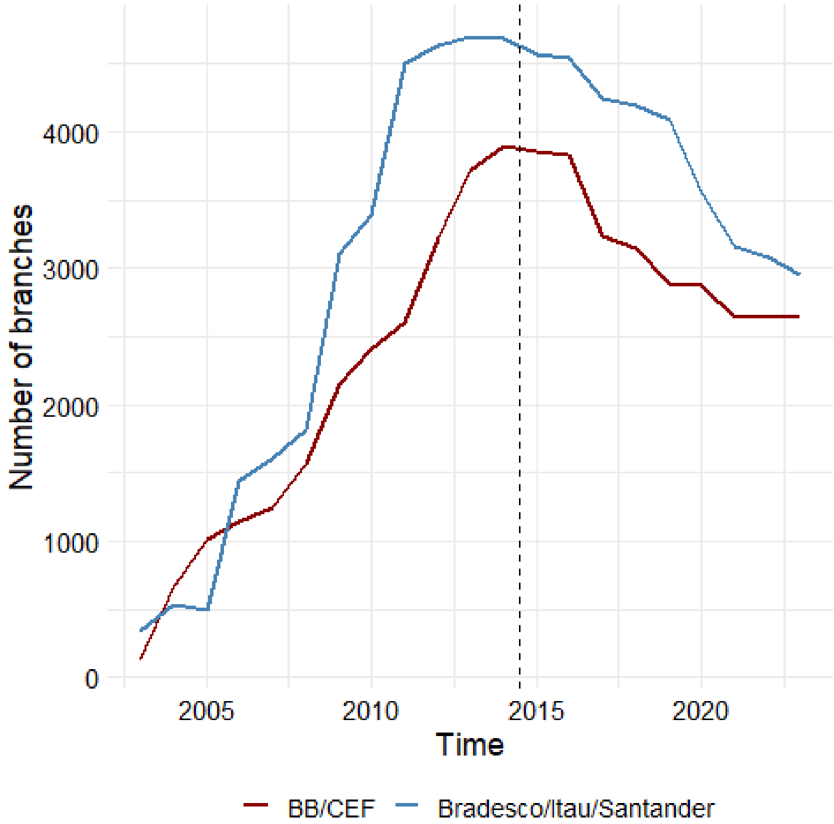
Local banks are important for provide financial services to soften consumption during life time, enable great project through financial loans, and facilitate transactions. Bank proximity is either associated with screening reduction, decrease in moral hazard, and offering more valuable solutions for consumers (Greenwood & Jovanovic (1990), Townsend & Ueda (2006), Berger *et al.* (2008)). The benefits of banking inclusion are worthwhile (Burgess & Pande (2005), Célerier & Matray (2019)), but how about its access limitation? What are the consequences of banking shinkage in financial outcomes an labor market in places where banks exit? In this paper we address some of these questions.

Brazil expanded bank coverage through the *Banco para Todos* (Bank for All) program, a federal government initiative that opened numerous government-owned bank branches between 2003 and 2014. Focusing on the implementation period of the program, Fonseca & Matray (2024) found that this program had a significant positive impact on the local economy, notably increasing the number of banks, deposits, lending, entrepreneurship, employment, and wage growth. However, 30,4% of these bank branches were closed during the 2016-2022 period, limiting the bancarization process initiated by the program. Figure 2.1 provides a visual representation of the government owned bank branches expansion during 2003-2014 and the sequential period where many of those branches closed.

In this paper, we explore the impacts of government-owned bank branch closures that have occurred in Brazil since 2015. We aim to provide a more complete account of the program's history by including the significant wave of branch closures after 2014. Asymmetric effects may drive the outcomes observed during the opening and closure phases. We investigate the effects on local banking outcomes, such as the number of banks, deposits, and lending. We also investigate if there were losses on the local economy (firms creation, employment, and wage) of these branch closures.

To do this, we examine cities that received their first state-owned banks during the *Banco para Todos* program and compare the outcomes of cities that lost these state-owned bank branches with those that retained them. The approach is centered in investigate what happened with financial and economic activity outcomes after the shinkagem of these bank branches. We implement a stagared difference-in-differences method based on Callaway & Sant'Anna (2021). Following this setting we can measure the effect of those closures along time, departing from the point that branches exit a municipality.

Figure 2.1: Number of public and private bank branches created during *Banco para Todos* program




**Note:** This figure plots the number of public and private bank branches created during 2003-2014 and the sequential period where many of those branches closed. Private banks were presented to be a comparison.

Results suggest that there was a reduction in the banking presence, driven by the shrinkage of public banks. The overall amount of deposits and lending also declined as a consequence. While public banks are the main source of this contraction, private banks demonstrated a small increase in these variables some years after the public bank branch closure. Furthermore, we investigate the effects of this closure in municipalities development measuring throught criation/destruction of firms and jobs, and increase/decrease in wages but we find no significant effect. A possible explanation for this results is that once financial services are implemented, individuals and firms find alternative options to overcome the banking services supply, in particular, they can go to another city, or can be assisted to other financial institutes, such as private banks, banking correspondents, credit unions, or internet banking institution.

This paper is related to the existing literature on financial services supply. Recent work demonstrate the relationship between banking services acess with financial inclusion and wealth accumulation, inequality and growth (Célerier & Matray (2019), Ji *et al.* (2021)). In Brazil, Joaquim *et al.* (2019) shown the effects of M&A processes, Mariani (2021) studied privatization effect on local economies, Fonseca & Van Doornik (2022) demonstrated changes in the labor market caused by changes in financial supply, Bustos *et al.* (2020) found evidence on structural transformation caused by bank branches presence, and Fonseca & Matray (2024) examined in implementation of the *Banco para Todos* program. For this literature we contribute by investigating the consequences of physical limitation to banking services acess.

Our paper builds on the literature that studies the consequences of interruptions of branch services. Bonfim *et al.* (2021) and Nguyen (2019), among others, document negative effects on credit for clients directly exposed to a branch closure. In Brazil, Mariani *et al.* (2023) investigate the technology adoption after bank branches heists that interupted cash services. Fang & Vlaicu (2024) also studied closure of Brazilian bank branches occurred during 2011-2020 and they found impact on economic activity. We contribute to this literature by measuring the effect of a massive closure of state-owned bank branches.

The remaining of this paper is organized as follows. Section 3.2 presents the Brazilian institutional background. Section 3.4 introduces the data and the empirical strategy. Section 3.5 shows the effects of bank branches closure. Section 3.6 concludes.

## 2.2 Institutional Background

Brazil has three types of public banks: the ones controlled by the federal goverment (Banco do Brasil, Caixa Econômica Federal, Banco do Nordeste, and Banco da Amazônia), the ones controlled by the states, and a national development bank (BNDES). Banks controlled by states, and especially those controlled by the federal government, act as commercial banks because they are profitable and their performance are comparable with private counterparts (Mettenheim (2010)). At the same time, the national development bank provides subsidized loans to targeted sectors, which is closer to the practice of public banks in developing countries.[2.1] BNDES and state-owned banks were not involved in the federal government's banking expansion program.

*Banco para Todos* was a federal government program explicitly designed to target underbanked cities to include this population in the banking system as users of financial products and services (Ministério da Fazenda (2007)). The program was announced in 2004 and was part of the 2004-2007 government's multi-year plan (*Plano Plurianual*). The main strategy of the program was to

[2.1] One example is the case of India in Burgess & Pande (2005).

increase the action of federal government banks in the country, especially BB and CEF.

To implement the program, public banks expanded their physical presence by opening new branches, many of which were established in previously unbanked areas.[2.2] Although the program was formally launched, there is no publicly available information detailing the banks' expansion strategies. Official evaluations of the program's early years are available (Ministério da Fazenda (2005), Ministério da Fazenda (2006), Ministério da Fazenda (2007)), but these reports focus solely on the outcomes achieved and do not provide insight into the strategic decisions behind the geographic expansion. The design and execution of branch placement remained an internal matter of the banks. Table 2.1 shows the number of public bank branches opened by year since 2003 until 2014 and the quantity of these branches that closed during the 2003-2022 period.

Table 2.1: Distribution of Openings and Closures by Year

| Year | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| Open | 138 | 526 | 350 | 132 | 112 | 327 | 665 | 238 | 226 | 597 |
| Closure | 1 | - | 2 | 1 | 7 | 1 | 19 | - | 42 | 10 |

| Year | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| Open | 493 | 178 | - | - | - | - | - | - | - | - |
| Closure | - | 2 | 46 | 273 | 328 | 65 | 298 | 1 | 239 | 8 |

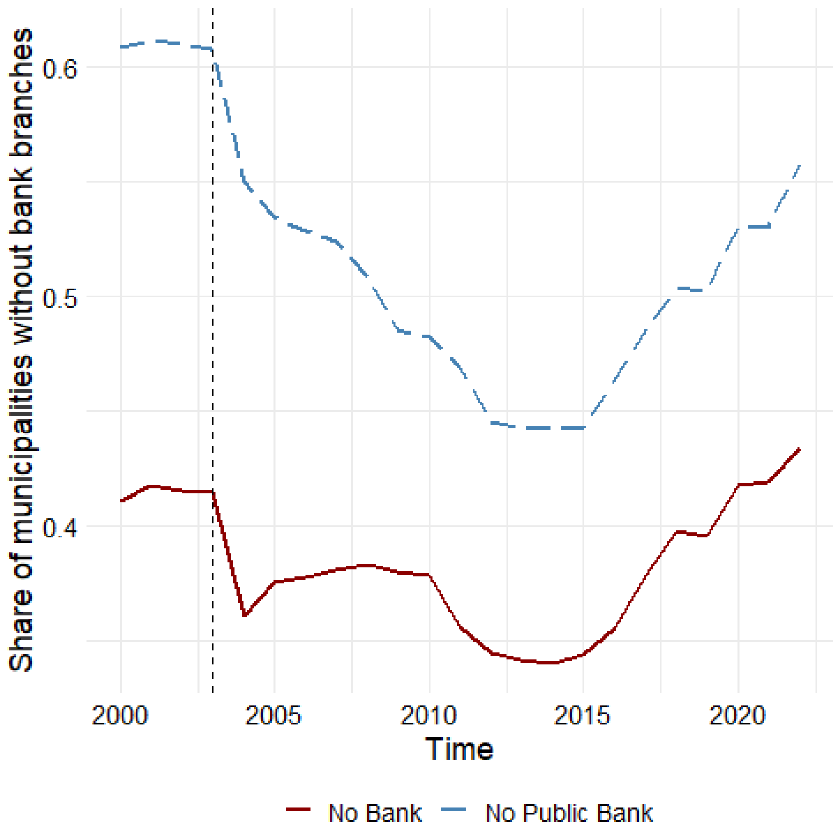
Figure 2.2 displays that the share of municipalities without public bank branches declined from 60.7% in 2003 to 44.2% in 2014.[2.3] Such decreasing also happened when we consider all banks: 41.4% of Brazilian municipalities did not have bank branches in 2003 and 34.0% in 2014. Ministério da Fazenda (2007) claimed that the program included 1.4 million low-income people, reaching more than 7.8 million accounts opened since 2004.

Figure 2.2 also shows that the number of municipalities without bank branches has increased since 2015. A big shift in the economic conduct occurred in 2016. Brazilian President Dilma Rousseff was impeached, and her successor,

[2.2] *Banco para Todos* also spreads out banking corresponds (*correspondentes bancários*), which consist of banks hiring other commercial agents — commonly lottery retailers, post offices, and pharmacies — to serve as distribution outlets for financial services. Prior to 2003, correspondents essentially provided bill payment, being a bad substitute of banking services, and were not a sufficient support for firms (Bittencourt *et al.* (2005)). Even after 2003, only a small proportion of the population use this channel for opening or transacting through a bank account, for accessing credit, withdraw, or make deposit through this channel (Sanford (2014)).

[2.3] This time period comprehends the study of Fonseca & Matray (2024).

Figure 2.2: Share of municipalities without bank branches




**Note:** This figure plots the evolution of the share of municipalities without at least one federal-owned bank branch in blue and the share of municipalities without any bank branches in red. The vertical dashed line stays at 2003, one year before the *Banco para Todos* announcement.

Michel Temer, adopted a markedly different approach to economic policy. Temer's administration was more fiscally austere than last years mandate of Workers Party (PT).[2.4] Temer either changed the actions of state-owned companies: he signed a law banning the appointment of politicians to positions in state-owned companies;[2.5] he made changes to the composition and mandate of the BNDES board;[2.6] during his interim presidency, Temer changed five state-owned companies' presidents in the same week, including Banco do Brasil, Caixa Econômica Federal and BNDES.[2.7] All these events help to explain the change in the public banks' strategy, in the way they started to close bank branches. In 2015, 44.2% of Brazilian municipalities do not have

[2.4] Michel Temer approved the Constitutional Amendment 95, which prohibited adjusting expenses above inflation to pursue government primary surpluses.

[2.5] https://www.gov.br/casacivil/pt-br/assuntos/noticias/2016/junho-1/temer-sanciona-lei-de-responsabilidade-das-estatais

[2.6] https://www.correiobraziliense.com.br/app/noticia/economia/2016/08/31/internas$_e$*conomia*, 546704/*temer* − *faz* − *alteracoes* − *na* − *composicao* − *e* − *no* − *mandato* − *da* − *diretoria* − *do* − *bndes.shtml*

[2.7] https://g1.globo.com/politica/noticia/2016/06/governo-da-posse-presidentes-de-petrobras-bb-caixa-bndes-e-ipea.html public bank branches while the number was 50.3% in 2018, Temer's last year mandate.

## 2.3 Data and Empirical Strategy

This section details the datasets and the empirical strategy. Following Fonseca & Matray (2024), we transform all variables into year information. The empirical approach relies on a stagered difference-in-diferences method based on Callaway & Sant'Anna (2021). Hereafter, municipality and city are taken as synonyms.

### 2.3.1 Data

The main data source is the ESTBAN from the Brazilian Central Bank. This dataset contains the monthly balance sheets of all bank branches, then we are able to identify the number of bank branches, lending activity, and deposits for public and private banks. The data does not include information on banking correspondents.

We measure the banking effect over the real sector using the RAIS dataset (*Relação Anual de Informações Sociais*), which contains information on employer-employee contracts. We are capable to find total number of firms, all hired workers and the average salary payed in municipalities over time.

Municipal characteristics come from the IBGE (*Instituto Brasileiro de Geografia e Estatística*), as population and municipal GDP. The 2010 Census from IBGE either provides municipal cross sectional characteristics as well as education, urban housing rate, gender rate and sanitary conditions.

We also use mandatory municipalities transfers from states and federal governments coming from the *Tesouro Nacional*, such as *Fundo de Participação dos Municípios*,[2.8] *FUNDEB*,[2.9] and financial support for exportations.

The 4G connectivity comes from ANATEL (*Agência Nacional de Telecomunicações*). This variable help us to control results for the possibility that branches could exist to be replaced by the internet coverage and the internet banking migration.

[2.8] The main national transfer for municipalities. See Corbi *et al.* (2019) for more details on the fiscal multiplier of this transfer.

[2.9] *Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação* is a government resourses fund dedicated to promote basic public education funding.

### 2.3.2 Empirical Strategy

We explore the effect of bank branch closure, after a period of an opening boom caused by the *Banco para Todos* program. To do this, we are interest in cities that received the first public branch during the *Banco para Todos* program period. We compare the outcomes of those cities where branches continued to work after the end of the program with those sites where the federal government bank branches shrank after 2014. Therefore, municipalities where federal government bank branches closed comprise the treated group, while municipalities where the branches remained open compose the control group. Both groups are accompanied before and after the end of the program. Our identification assumption is that treated and non-treated municipalities would follow parallel trends if branch closures did not occurred.

This framework composes the difference-in-differences (DiD) approach. Because closures in the treated group occurred in different years, we implement Callaway & Sant'Anna (2021)'s DiD method with multiple time periods. The group-time average treatment effect for units first treated in period $g$, evaluated at time $t$, is given by:

$$ATT(g,t) = \mathbb{E}[Y_{mt}(1) - Y_{mt}(0) \mid G_m = g] \tag{2.1}$$

where $Y_{mt}$ is the outcome from municipality $m$ at time $t$, $Y_{mt}(0)$ is the potential outcome without treatment, $Y_{mt}(1)$ is the potential outcome with treatment, and $G_m$ is the treatment cohort, the first period $m$ receives treatment. In the context of this paper $G = \{2015, \dots, 2019\}$. for all these groups, $ATT(g,t)$ is estimated for each time period $t$.

Once all $ATT(g,t)$ are estimated, the overall average is given by the $ATT^{Group}$, which summarises the effect across all treatment groups and time periods.

$$ATT^{Group} = \sum_{g,t} \omega_{g,t} \cdot ATT(g,t) \tag{2.2}$$

The weights $\omega_{g,t}$ depend on the number of units in group $g$ and the availability of data for time $t$.

We also implement a less restrictive assumption by comparing the treated group with not-yet-treated municipalities. This approach compares the average group-time treatment effect of group $g$ with group $g^{'}$ not-yet-treated, where $g^{'>g}$. by doing this

$$ATT(g,t)^{NYT} = \mathbb{E}[Y_{mt}(1) - Y_{mt}(0) \mid G_m = g] \tag{2.3}$$

where $\mathbb{E}[Y_{mt}(0) \mid G_m = g] \approx \mathbb{E}[Y_{mt} \mid G_m = g^{'}, g^{'} > t]$.

Table 2.2 summarizes the statistics for both treated and control cities. Table 2.3 displays descriptive statistics of the whole sample. Overall, treated municipalities have less banks, fewer number of firms, employment, wage, population, and *per capita* GDP, more amount of credit relative to GDP, higher FPM government transfers, and major rural households.

Figure 2.3 shows the geographic distribution of treated and control groups. The final sample considers only branches closed after 2014. There are 627 municipalities, with 282 of them being treated.

Notably, treated and control groups are different but it does not impose restriction on the estimation. The basic assumption of the DiD setting is the existence of parallel trends. To mitigate this, we perform regressions controlling for those characteristics and use event-study framework to confirm that treated and control cities had similar pre-trends in key outcomes.

Table 2.2: Characteristics comparison between groups (2014)

| Variable | Treated | Control | Difference | p-value |
|---|---|---|---|---|
| No. Banks | 1.099 | 1.733 | -0.634 | 0.000 |
| No. Banks/Thousand Hab | 0.170 | 0.158 | 0.013 | 0.138 |
| Deposits/GDP | 1.370 | 1.376 | -0.006 | 0.550 |
| Credit/GDP | 1.420 | 1.398 | 0.022 | 0.025 |
| Mean No. Firms | 6.146 | 6.676 | -0.531 | 0.000 |
| No. Firms/Thousand Hab | 0.989 | 0.667 | 0.322 | 0.000 |
| Total employment | 7.415 | 8.006 | -0.591 | 0.000 |
| Wage | 7.527 | 7.572 | -0.045 | 0.003 |
| FPM/Hab | 1299.361 | 940.922 | 358.439 | 0.000 |
| Log other government transfers | 27.484 | 27.919 | -0.435 | 0.105 |
| Population | 9787.004 | 15088.736 | -5301.733 | 0.000 |
| Log GDP per capita | 2.972 | 3.107 | -0.135 | 0.006 |
| 4G Signal | 0.004 | 0.000 | 0.004 | 0.318 |
| Urban Households | 0.581 | 0.633 | -0.051 | 0.002 |

**Note:** This table reports summary statistics of average municipality-level characteristics of the final sample. Monetary values are in 2020 BRL. Number of bank branches, lending activity and deposits are from the ESTBAN database. Wage, employment, and other labor market variables are from the RAIS database. Local GDP per capita, population, percentage of urban households are from the Brazilian Institute of Geography and Statistics.

A treated unit is all those municipalities that received a government bank branch during the *Banco para Todos* program and were closed after this period.

We consider the first year of treatment to be the same of the branch closure because 62% of all branch shrinkage occurred in the first third of the year. Therefore, they experience the largest part of the year without the closed bank branch. Figure 2.4 displays the frequency of closures throughout all months.

Table 2.3: Descriptive statistics

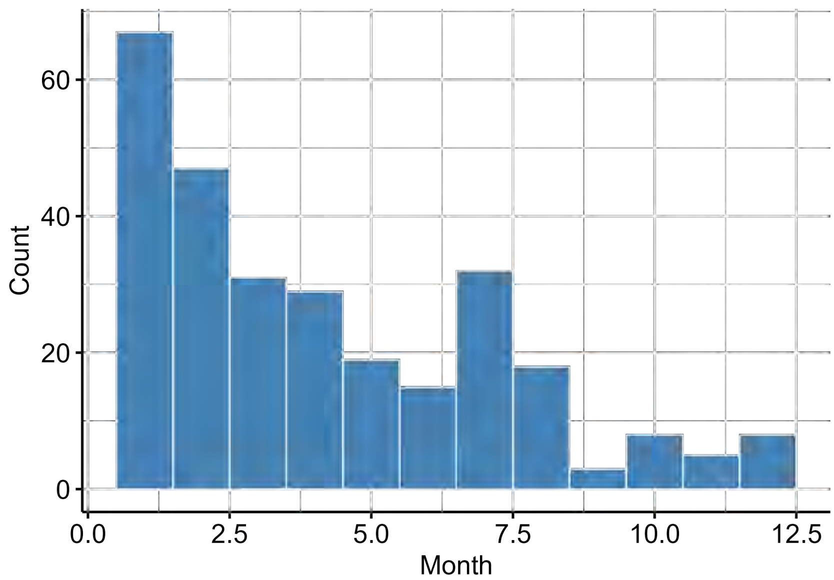
| Variable | Mean | Median | St. Dev. | N |
|---|---|---|---|---|
| Bank presence | 0.872 | 1.000 | 0.335 | 8151 |
| Public bank presence | 0.826 | 1.000 | 0.379 | 8151 |
| Private bank presence | 0.307 | 0.000 | 0.461 | 8151 |
| Branches number | 1.204 | 1.000 | 0.737 | 8151 |
| Public branches number | 0.839 | 1.000 | 0.403 | 8151 |
| Private branches number | 0.365 | 0.000 | 0.591 | 8151 |
| Deposits | 14.463 | 16.609 | 5.744 | 8151 |
| Public deposits | 13.443 | 16.352 | 6.388 | 8151 |
| Private deposits | 5.032 | 0.000 | 7.583 | 8151 |
| Credit | 14.581 | 16.777 | 5.802 | 8151 |
| Public credit | 13.802 | 16.704 | 6.553 | 8151 |
| Private credit | 4.509 | 0.000 | 6.833 | 8151 |
| Credit invoice and loans | 13.888 | 16.006 | 5.519 | 8151 |
| Public credit invoice and loans | 13.096 | 15.921 | 6.216 | 8151 |
| Private credit invoice and loans | 4.418 | 0.000 | 6.695 | 8151 |
| Credit agriculture | 12.512 | 15.344 | 6.435 | 8151 |
| Public credit agriculture | 12.159 | 15.225 | 6.656 | 8151 |
| Private credit agriculture | 1.897 | 0.000 | 4.836 | 8151 |
| Credit real state | 7.594 | 11.742 | 6.649 | 8151 |
| Public credit real state | 7.594 | 11.742 | 6.649 | 8151 |
| Private credit real state | 0.000 | 0.000 | 0.000 | 8151 |
| Credit others | 11.066 | 13.391 | 4.990 | 8151 |
| Public credit others | 10.528 | 13.382 | 5.552 | 8151 |
| Private credit others | 2.308 | 0.000 | 4.125 | 8151 |
| No. firms | 6.390 | 6.378 | 0.601 | 8151 |
| No. micro firms | 7.671 | 7.637 | 0.701 | 8151 |
| No. small firms | 2.882 | 2.944 | 1.041 | 8151 |
| No. medium firms | 0.856 | 1.099 | 0.897 | 8151 |
| No. large firms | 1.425 | 1.099 | 0.495 | 8151 |
| No. agriculture sector firms | 3.972 | 4.143 | 1.535 | 8151 |
| No. industry sector firms | 3.672 | 3.714 | 1.028 | 8151 |
| No. construction sector firms | 0.503 | 0.000 | 0.598 | 8151 |
| No. commercial sector firms | 2.531 | 2.565 | 1.017 | 8151 |
| No. service sector firms | 6.033 | 6.038 | 0.584 | 8151 |
| Total employment | 7.671 | 7.637 | 0.701 | 8151 |
| Micro firms employment | 6.172 | 6.232 | 0.745 | 8151 |
| Small firms employment | 5.601 | 5.855 | 1.453 | 8151 |
| Medium firms employment | 2.957 | 4.673 | 2.824 | 8151 |
| Large firms employment | 6.833 | 6.872 | 1.168 | 8151 |
| Agriculture firms employment | 4.684 | 5.118 | 1.970 | 8151 |
| Industry firms employment | 4.977 | 5.293 | 2.092 | 8151 |
| Construction firms employment | 0.650 | 0.000 | 1.070 | 8151 |
| Commercial firms employment | 2.535 | 2.708 | 1.877 | 8151 |
| Service firms employment | 7.218 | 7.229 | 0.634 | 8151 |
| Wage | 7.500 | 7.497 | 0.210 | 8151 |
| Log GDP per capita | 2.988 | 2.993 | 0.635 | 8151 |
| Log municipality transfer | 15.886 | 15.938 | 1.845 | 8151 |
| 4G Signal | 0.208 | 0.000 | 0.406 | 8151 |
| Urban Households | 0.610 | 0.614 | 0.204 | 8151 |

**Note:** This table reports summary statistics of average municipality-level characteristics of the final sample. Monetary values are in 2020 BRL. Number of bank branches, lending activity and deposits are from the ESTBAN database. Wage, employment, and other labor market variables are from the RAIS database. Local GDP per capita, percentage of urban households are from the Brazilian Institute of Geography and Statistics.

Figure 2.3: Geographical distribution of treated and control cities


**Note:** This figure displays the geographical distribution of treated and control cities.

Figure 2.4: Months of closure histogram




**Note:** This figure plots the number of closures occured in each month.

## 2.4 Results

This section presents the effect of bank branch closure on financial and real economy issues. From the banking sector we explore the effect of government banh branch closure such as bank presence, deposits, and loans, while from the real sector economy we measure the impact on wages, employment, and number of firms. In general, there is a great impact on financial variable but no treatment effect on economic activity. We also present on the Appendix 2.5 the estimation comparing treated groups with not-yet-treated group as robustness check. In summary, all results are maintained.

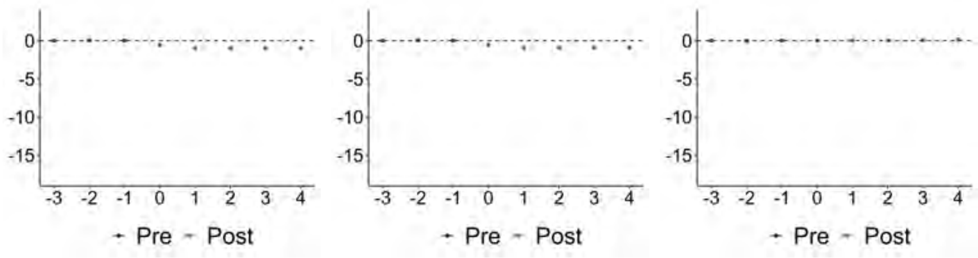
### 2.4.1 Effect on financial outcomes

The closure of government owner bank branches limited the access of banks in municipalities that received the first public bank during the *Banco para Todos* program. It was expected because many of those cities had been selected by the program to take their first bank and increase banking access. We follow Fonseca & Matray (2024) and build a dummy variable that indicates if there is a bank in the municipality.

The first part of Table 2.4 shows the results of the branch closures in the probability of having a bank branch. The ATT is reported, and it displays that there is a reduction of 9 percent in the likelihood of having bank branches. We also separate this dummy variable to capture the probability of having public and private banks. Results indicate that the reduction in public banks is modestly compensated by the opening of private ones.

Figure 2.5 displays event study of the likelihood of having a bank branch in event time. The first thing to note is that there are parallel trends for all variables. Second, the effect of reducing presence of all (public and private) and only public bank branches are significant in the same year of the treatment occurs, while an increase in the presence of private banks is significant three years after shrinkage of the government bank branch installed during *Banco para Todos*.

Figure 2.5: Effect of the closure of government bank on having a bank branch




(a) All (b) Public (c) Private

**Note:** This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are dummies that equal one if the city has at least a branch of any bank, a public bank, or a private bank, respectively. Standard errors are clustered at the municipality level.

Table 2.4: Effect of bank branch closure on branch presence, credit, and deposits

| | **Has Bank Branch** | | | **Deposits** | | | **Credit** | | |
|---|---|---|---|---|---|---|---|---|---|
| | All | Public | Private | All | Public | Private | All | Public | Private |
| ATT | $-0.907^{***}$ | $-0.865^{***}$ | $0.037^{**}$ | $-14.456^{***}$ | $-13.772^{***}$ | $0.484^{**}$ | $-14.912^{***}$ | $-14.350^{***}$ | $0.496^{**}$ |
| | (0.006) | (0.011) | (0.015) | (0.239) | (0.308) | (0.234) | (0.181) | (0.228) | (0.195) |
| More controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 |

Note: $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

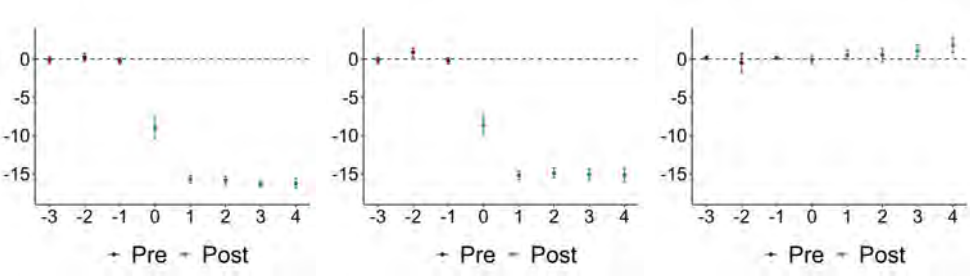
**Note:** This table reports the ATT estimation of the federal government bank branch closure started after 2014. Dependent variables are bank presence, total deposits, and total lending. Results are separated in all banks (public and private), public, and private banks. Standard errors are clustered at the municipality level.

We also study how the lower presence of banks affects deposits and credit supply. To do this, we sum all amount of credit given and deposits made in all municipalities at each time. Because treated municipalities commonly have zero amount of credit and deposit, we apply the log-plus-one transform on these variables.

The effects on credit and deposits are either at Table 2.4. Both credit and deposits amount reduce in municipalities after government owner bank closure. A great reduction occurs in public banks and a part of the contraction is absorbed by private banks. Figure 2.6 and 2.7 presents the event study of deposits and credit, respectively. They show the same pattern: considering all banks (public and private) there is a sharp decrease when treatment starts, what coincides with public banks effect (Part (b) of Figures 2.6 and 2.7).

Private banks increase credit and deposits over time, but it is significant since the third year after treatment.

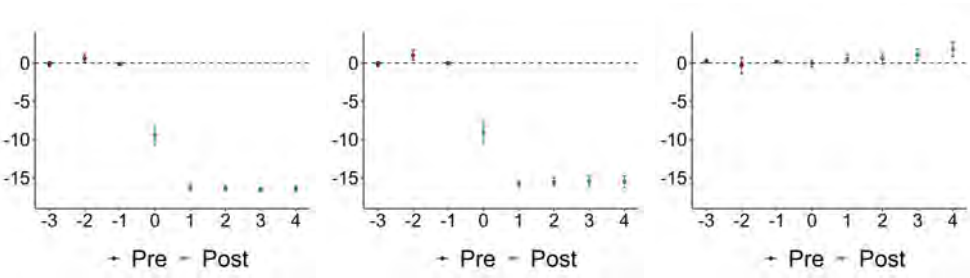
Figure 2.6: Effect of the closure of government bank on deposits




(a) All (b) Public (c) Private **Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total deposits in the city in any bank, in public bank, or in private bank, respectively. Standard errors are clustered at the municipality level.

Figure 2.7: Effect of the closure of government bank on credit




(a) All (b) Public (c) Private **Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total credit in the city in any bank, in public bank, or in private bank, respectively. Standard errors are clustered at the municipality level.

Specifically looking on credit types, it is possible to investigate the behavior of banking closures on credit lines. To do this, we aggregate credit lines in four categories: invoice&loans, agriculture, real state, and others. Table 2.5 presents the ATT of these variables, separating the effects for all kinds of banks (public and private), just public, and just private. For categories invoice&loans and others, the effects are close to those in Table 2.4. It happens because categories agriculture and real state are special credit lines that compose Brazilian public polices, then they are distributed mainly by public banks and they are subsidized. For this reason, Parts (a) - (c) and (j) - (l) from Figures 2.8 follow the same general shape of the curve of the total credit amount in the event study (see Figure 2.7). In agriculture and real state credit lines, the effect of the treatment is significant in the first year of closure when considering all banks and only public banks, while it is not significant in the horizon of four years after the treated.

Table 2.5: Effect of bank branch closure on credit lines

| | Invoice&loans | | | Agriculture | | |
|---|---|---|---|---|---|---|
| | All | Public | Private | All | Public | Private |
| ATT | $-13.863^{***}$ | $-13.313^{***}$ | $0.533^{**}$ | $-13.043^{***}$ | $-12.848^{***}$ | 0.041 |
| | (0.194) | (0.228) | (0.212) | (0.347) | (0.328) | (0.114) |
| | **Real state** | | | **Other** | | |
| | All | Public | Private | All | Public | Private |
| ATT | $-10.764^{***}$ | $-10.764^{***}$ | 0.000 | $-12.389^{***}$ | $-12.238^{***}$ | $0.226^{*}$ |
| | (0.366) | (0.370) | ($NA$) | (0.152) | (0.185) | (0.145) |
| More controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 |

Note: $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

**Note:** This table reports the ATT estimation of the federal government bank branch closure started after 2014. Dependent variables are credit lines. Results are separated in all banks (public and private), public, and private banks. Standard errors are clustered at the municipality level.

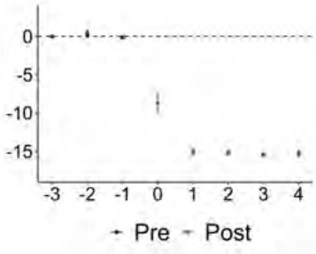
## 2.4.2 Effect on economic development

Regarding the literature on financial friction, we expect that the reduction on the local financial market could deteriorate local economy. However, it is not the case in the present setting. We measure impact of public bank closure after the end of *Banco para Todos* program in variables that could capture some deterioration in the local market, but it does not happen.

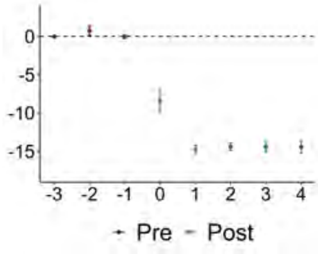
The results from the impact in the local economy is in Table 2.6. Starting from the number of firms, the ATT is not significant and the event study corroborate this findings because parameters are not significant in the treatment period. The same holds for the number of employment, for all size of firms and all kinds of sector (agriculture, industry, construction, commerce, and services) and sizes (micro, small, medium and large).[2.10] The wages are the mean values of all municipality and the same pattern occurred: no impact on the ATT estimation neither in years after treatment (Figures 2.9). We omit

[2.10]We select micro firms as those that have until 10 employees, small firms have between 11 and 50, medium have 51-100, and large firms have more than 100 employes.

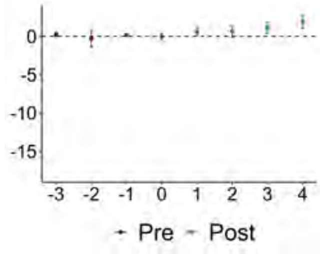
Figure 2.8: Effect of the closure of government bank on credit lines



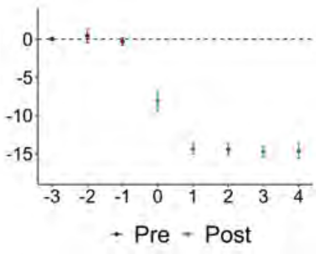

(a) Invoice&loans all



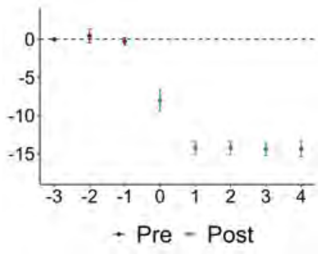

(b) Invoice&loans public



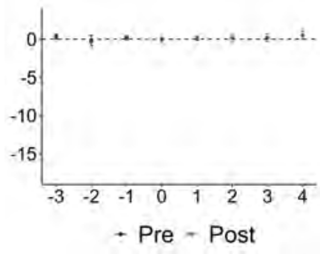

(c) Invoice&loans private



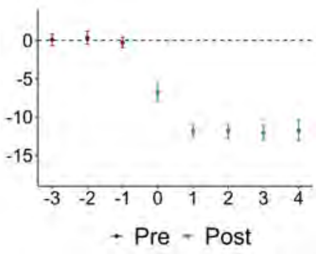

(d) Agriculture all



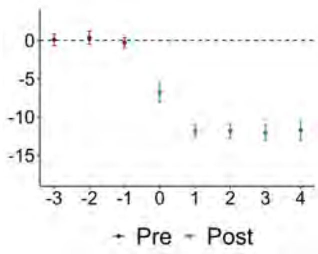

(e) Agriculture public



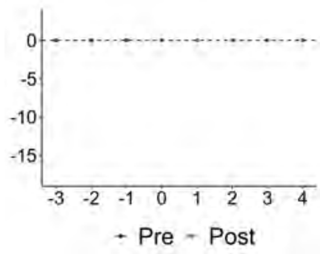

(f) Agriculture private



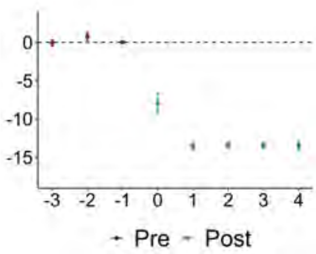

(g) Real state all



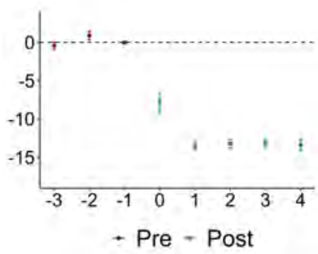

(h) Real state public



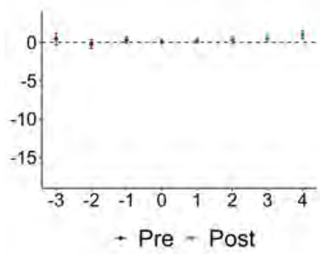

(i) Real state private




(j) Others all




(k) Others public




(l) Others private

**Note:** This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total credit separated by credit lines in the city in any bank, in public bank, or in private bank. Standard errors are clustered at the municipality level.

results for firms and job creation by sector and size of firms because result are similar with those presented.

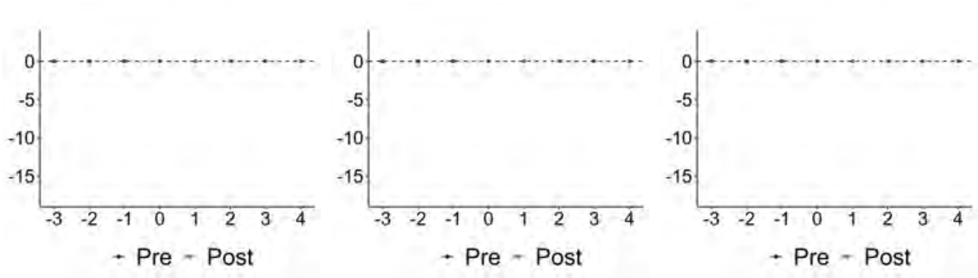
Table 2.6: Effect of bank branch closure on firms and employment

| | **Firms (All)** | **Micro Firms** | **Small Firms** | **Employment** | **Wage** |
|---|---|---|---|---|---|
| ATT | 0.009 | 0.014 | −0.009 | 0.014 | −0.006 |
| | (0.010) | (0.017) | (0.030) | (0.017) | (0.007) |
| More controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,151 | 8,151 | 8,151 | 8,151 | 8,151 |

Note: $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

**Note:** This table reports the ATT estimation of the federal government bank branch closure started after 2014. Dependent variables are number of firms, number of micro and small firms, total employment, and wage. Standard errors are clustered at the municipality level.

Figure 2.9: Effect of the closure of government bank on development




**Note:**

(a) Firms (All) (b) Employment (c) Wage

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are number of firms, the total employed workers, and the wage mean, respectively. Standard errors are clustered at the municipality level.

There are several reasons why the effects of federal government bank branch closures may appear in financial variables but not in real sector economic outcomes. First, a substantial portion of the financial effects is mechanical: when a branch closes, the associated deposit and lending activity disappear from the registry data. That is, the closure removes the branch from the reporting system, and consequently, all transactions linked to that branch no longer appear in the dataset. Second, public banks in the selected sample held a significant share of total credit and deposit volumes. Recall that one of the main objectives of the *Banco para Todos* program was to extend financial services to previously unbanked areas. As a result, many of the treated municipalities initially had only the public bank branch that was later closed a few years after its opening. Third, given that the program was initially successful in expanding banking access, increasing deposits and credit, and promoting local development (see Fonseca & Matray (2024)), individuals and firms may have adapted over time by seeking alternative financial service providers.

We can enumerate five non excludable alternatives to the physical public bank branch that was closed. First, private banks could absorb a part of the demand for deposits and credit. Although, we show that this mechanism was limited because presence, deposits, and credits had significant increase after some years after the public bank closure. Second, a part of the credit and deposits demand could increase the usage of banking correspondents, which had a limited financial services in the first years of implementation, but there were innovations along time. Third, there could be spilovers to credit unions, which had a sharp increase in Brazil since the 2010s. Credit unions are different form private commercial banks because they just provide financial services to their associates. Furthermore, in the Brazilian data, credit unions are considered as banking correspondents even that they usually have independent physical infrastructure, what is totally different from standard commercial bank correspondents, which associate themselves to pharmacies, pet shops, etc. Another caveat is that the Central Bank provides reliable information on credit unions since 2016. Fourth, when a branch close its banking accounts are transferred to another branch of the same bank that is much closer. Credit and deposits from individuals and firms do not colapse. In this way, inhabitants of the closure bank cities could continue to use financial services physically in another municipality. Fifth, the increasing coverage of internet access since 2013 has brougth the option to migrate to internet banking services. Rather, it is challenging to measure the local impact of this alternative because all accounts of the same bank are registered in one local, does not matter where individuals live or firms are installed.

## 2.5 Conclusion

This paper investigates the effects of a reduction in local financial services. Between 2003 and 2014, Brazil implemented a nationwide program called *Banco para Todos*, which aimed to expand access to financial services in previously unbanked areas. Although the program initially led to a significant expansion of bank branches, approximately 30% of them were later closed. To assess the impact of these closures, we focus on municipalities that received their first public bank branch during the program. We compare financial and non-financial outcomes between cities where the state-owned bank branches remained (control group) and those where they were subsequently closed (treatment group).

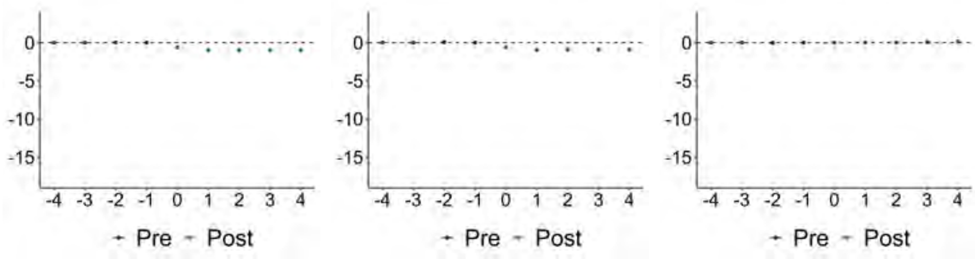
We estimate results using Callaway & Sant'Anna (2021) method, that allows the implementation of treatment in multiple time. The main finding show that banking presence, deposits, and loans decreased in the year treatment started. However, we do not find effects of the financial shrinkage in the labor market.

This paper can be improved by investigating the spilovers effects on banking outcomes in near cities when a public bank branch exits. Another way to advance is examining the possibility of substitution effect on public bank financial services to its private counterparts, mainly credit unions, banking correspondents, and internet banking. For this purpose it would be necessary to explore individual accounts registration.

## Appendix B

### Robustness check with not-yet-treated sample

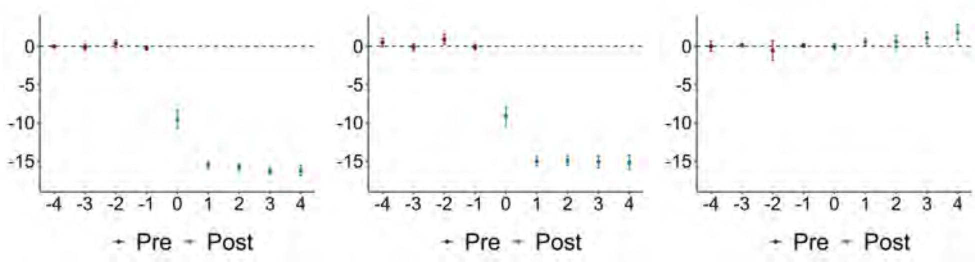
Figure 2.10: Effect of the closure of government bank on having a bank branch




(a) All (b) Public (c) Private **Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are dummies that equal one if the city has at least a branch of any bank, a public bank, or a private bank, respectively. Standard errors are clustered at the municipality level.

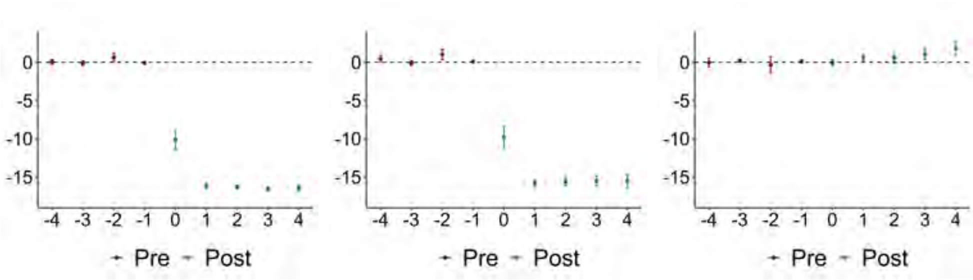
Figure 2.11: Effect of the closure of government bank on deposits




(a) All (b) Public (c) Private **Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total deposits in the city in any bank, in public bank, or in private bank, respectively. Standard errors are clustered at the municipality level.

Figure 2.12: Effect of the closure of government bank on credit

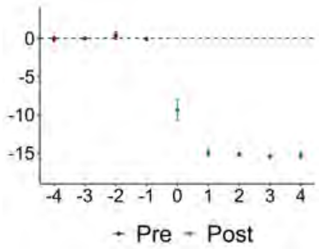



(a) All (b) Public (c) Private

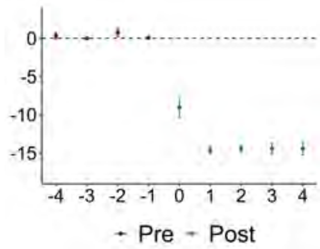
**Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total credit in the city in any bank, in public bank, or in private bank, respectively. Standard errors are clustered at the municipality level.

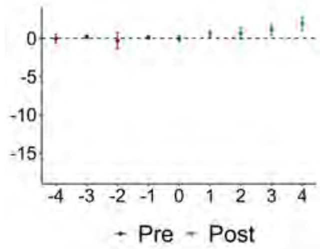
Figure 2.13: Effect of the closure of government bank on credit lines



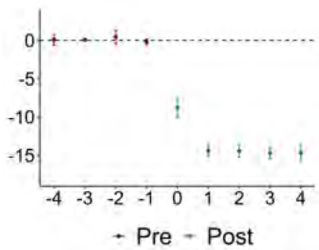

(a) Invoice&loans all



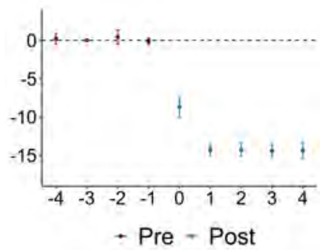

(b) Invoice&loans public



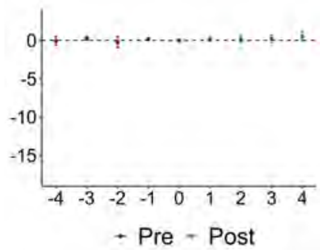

(c) Invoice&loans private



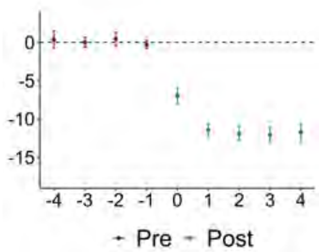

(d) Agriculture all



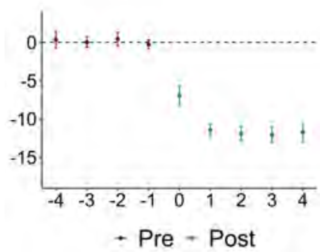

(e) Agriculture public



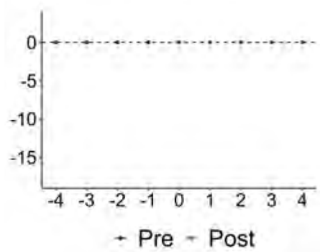

(f) Agriculture private



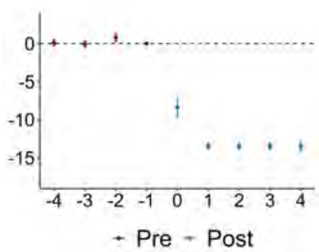

(g) Real state all



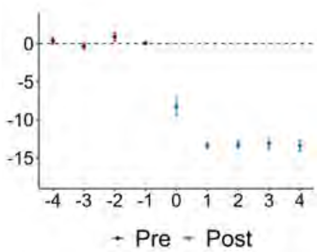

(h) Real state public



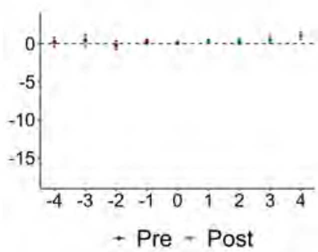

(i) Real state private




(j) Others all




(k) Others public

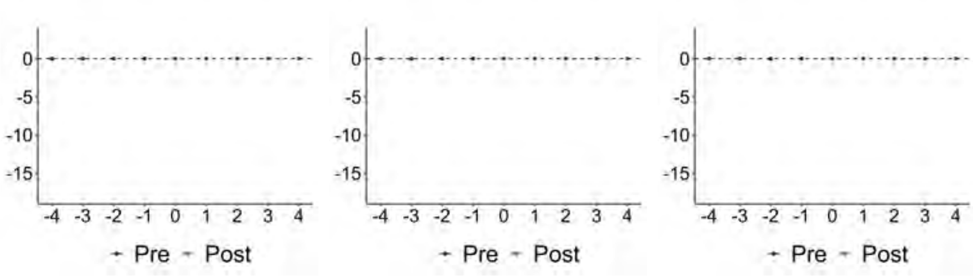



(l) Others private

**Note:**

This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are total credit separated by credit lines in the city in any bank, in public bank, or in private bank. Standard errors are clustered at the municipality level.

Figure 2.14: Effect of the closure of government bank on development




(a) Firms (All) (b) Employment (c) Wage

**Note:** This figure plots the yearly coefficients and 95% confidence intervals of the difference-in-differences estimator of the federal government bank branch closure started after 2014. Dependent variables are number of firms, the total employed workers, and the wage mean, respectively. Standard errors are clustered at the municipality level.

# 3
# What happens when incumbents decide on institutions? The local legislature size in Brazil

**Abstract:** How do institutions persist over time? This paper aims to uncover the motives behind institutional persistence. To do that, I investigate the case of the determination of legislature size in Brazil, which has a wide variation in demographic, socioeconomic, and electoral characteristics. Brazil also changed its legal autonomy twice to legislate over the size of city councils, providing an opportunity to test the persistence of political institutions. I show that legislators have private motives to perpetuate the legislature size but this maintenance depends on the distribution of power within municipalities. An additional chair in the city council is associated with an increase of 15 percentage points in concilors' reelection likelihood. It is also important to have a political alignment: legislators increase their seats if the largest coalition receives support from the executive.
**Keywords:** Institutional persistence, legislative size, incumbents, political benefits

## 3.1 Introduction

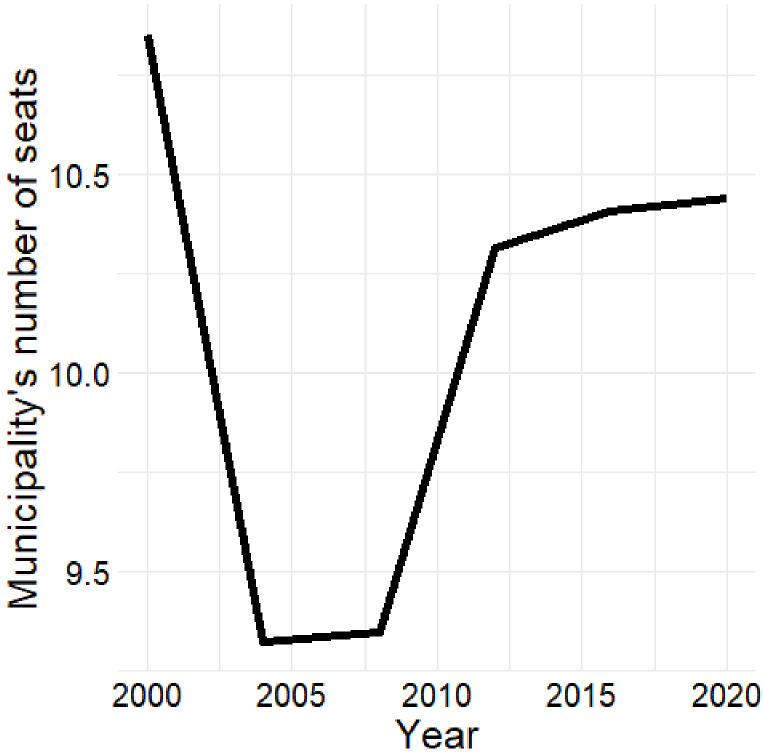
How do institutions persist over time? Institutions are central to shaping the long-term evolution of societies. They can either foster progress or hinder development, depending on the incentives they create and the stability they offer over generations (Acemoglu & Robinson (2006)). Understanding the mechanisms behind institutional persistence is essential for analyzing political and economic outcomes. Despite significant advances, most empirical studies focus on historical cultural influences (Dell (2010), Lowes *et al.* (2017)) or cross-country comparisons (Norris (2004)), leaving open questions about the role of contemporary political incentives in maintaining or altering institutions.

This paper examines the persistence of municipal legislative size as an institution in Brazil, offering insights into the motivations behind institutional stability. Brazil's unique case of legislative size changes — triggered by two successive laws - provides an ideal opportunity to analyze how local politicians respond to changes in institutional constraints. Specifically, I investigate how personal and political motives are associated with decisions over restoring or altering city council size after the decentralization of legislative authority.

The Brazilian context is particularly suitable for studying institutional persistence for three reasons. First, the two laws introduced abrupt changes in the determination of municipal council size, resulting in substantial cross-sectional variation. In 2004, legal reforms capped council sizes, leading to a significant reduction in seats. By 2009, a Constitutional Amendment restored local authority, allowing municipalities to increase council size. As a result, many municipalities reverted to pre-reform levels, reflecting patterns of persistence. Second, Brazil's decentralized governance structure allows local governments significant discretion over public services such as education, health, and transportation. Third, while local institutions vary across municipalities, macro-level institutions remain constant, enabling a controlled analysis of institutional variation (Dahis (2015)).

Figure 3.1 illustrates the evolution of council size in Brazilian municipalities from 2000 to 2020. This figure highlights a striking pattern: once autonomy was restored, many municipalities increased council sizes, reversing earlier reductions. In 2004, 2402 municipalities lost seats, and 1692 of them increased council size between the 2008 and 2012 elections. The council size mean dropped from 10.9 seats in 2000 to 9.3 seats in 2004 and 2008, then rebounded to 10.3 in 2012 and stabilized around 10.4 seats in subsequent elections. This persistence underscores the role of local politicians in reestablishing pre-reform institutional norms.

Figure 3.1: Mean of the municipality's number of seats from 2000 to 2020




**Note:** This figure displays how the number of council seats varies across municipalities over each municipality election year starting from 2000. When local legislators are more free to choose the city council size (2000, 2012, 2016, and 2020), the municipality's legislature size mean is higher from 10.2 seats, contrasting with the elections of 2004 and 2008, when the mean is 9.3 councilors.

To investigate this case, I construct a hypothetical scenario and derive a set of simple, testable claims. The counterfactual exercise simulates the allocation of one additional seat in the city council for the 2008 elections, four years before incumbents had the authority to make this decision. The central hypothesis is that councilors are able to anticipate the political consequences of increasing the number of seats and make decisions accordingly. The analysis compares the actual decisions made by incumbents in 2012 with the hypothetical allocation of the additional seat in 2008. This comparison provides evidence on whether councilors' later decisions aligned with the incentives revealed by the earlier electoral configuration.

I show that legislators have private motives to perpetuate the institutions of legislature size but this maintenance depends on the distribution of power within municipalities. The personal motive is manifested in the councilors' will to maintain themselves in charge after they restore decision-making power over legislative size. The analysis shows that an additional chair in the city council is associated to an increase of 15 percentage points in legislators' reelection likelihood. However, this behavior is contingent on specific political conditions. For example, when the mayor has the largest coalition it is positively correlated with the probability of increasing council size, reflecting the procedures required to modify the legislative size. Conversely, narrow majorities or a lack of one-third support among councilors are negatively associated with the increase in legislature size.

In Brazil, extra seats are associated with extra public spending, more female candidates, and additional corruption cases. Larger councils have significantly higher expenditures on social goods, increased party diversity, and greater representation of women in politics (Schneider & Veras (2023) and Correa & Madeira (2014)). Furthermore, Britto & Fiorin (2020) argue that larger councils have a positive causal impact on corruption levels detected by random federal audits. However, when the opposition captures the additional seat, monitoring increases and corruption does not worsen.

The literature on legislative size started with Weingast *et al.* (1981), and since then many authors have studied its effects. There is no common rule for determining the optimal number of legislators, it depends on the internal institutions of each region. An important stylized fact is that population is a strong determinant of legislature size (De Santo & Le Maux (2023)). The literature concerns two main subjects. On the one hand, a large legislature size can (i) increase the representation of women and minority groups (Brooks *et al.* (2011), Gerring & Veenendaal (2020)), (ii) enhance the relatedness between voters and representatives (Stadelmann *et al.* (2014)), and (iii) contribute to party representation (Taagepera (2007) Lundell *et al.* (2012)). On the other hand, the literature relates to the public spending levels.[3.1] This paper advances the understanding of legislative size by showing that institutional persistence plays a critical role in shaping council size decisions.

Institutional persistence refers to conserving a collection of economic institutions in a community (Acemoglu *et al.* (2001)). Bisin & Verdier (2024) show the role of elites and cultural norms in shaping institutions over time. Institutional changes can be costly to current political incumbents, who may design institutions to maintain stability (Acemoglu *et al.* (2021)). This is the case in Brazil, where local politicians increased the number of legislative seats after losing seats through a top-down decision years earlier. In this way, this paper adds to the literature on institutional persistence through an empirical

[3.1] A high number of representatives is associated with increased spending (MacDonald (2008), Matsusaka (2005)), reduced spending (Pettersson-Lidbom (2012), Lewis (2019)), or both, depending on the comparison: higher or lower chambers (Primo (2006), Lee & Park (2018)). At the same time, Kessler (2010) shows that a smaller group of legislators tends to reduce political spending and increase the performance of the decision-making process.

investigation using cross-sectional variation in the same macro institutional framework, which is different from historical or cross-country analyses.

The remaining of this paper is organized as follows. Section 3.2 presents the Brazilian institutional background. Section 3.3 discusses the conceptual framework. Section 3.4 introduces the data and the empirical strategy. Section 3.5 shows the empirical results of the investigation on institutional persistence in council size. Section 3.6 concludes.

## 3.2 Institutional Background

This section describes the evolution of some Brazilian federal laws regarding legislative size and the rules that determine local legislatures. Understanding the evolution of laws governing legislative size in Brazil is crucial for examining how this institution persists. Figure 3.2 summarises the changes over time. This figure illustrates significant fluctuation in council size across municipalities, reflecting both the top-down restrictions imposed in 2004 and the resurgence of local control post-2009.

### 3.2.1 Local legislative size

The 1988 Brazilian Constitution imposes general instructions for the legislative size allowing a large range of possibilities, as can be seen in figure 3.2. Municipalities with 1 million inhabitants or less (99% of the Brazilian municipalities) could discretize between 9 and 21 legislators. Municipalities between 1 million and 5 million inhabitants must have more than 33 legislators and less than 41, and municipalities with a population bigger than 5 million must have between 42 and 55 councilors. This setting permitted different decisions over possibilities. Two extreme cases can illustrate the differences in municipalities' choices. With 29435 inhabitants, *Nova Russas* (CE) had 21 legislators, while *Buritticupu* (MA) had 9 seats even with 53348 people living there.

Some municipalities exploited ambiguities in the law to push for disproportionate increases in seats and reshaped the system. Taking advantage of the dubious written law, *Mira Estrela*, with 2600 inhabitants, tried to change its seats from 9 to 11 in 2002. The case went to the Supreme Court, which decided to enforce proportionality between population and legislature size. Following the Court's decision, the *Tribunal Superior Eleitoral* (TSE) approved Resolution 21.702, which established new boundaries for the municipality's legislature size. Since then, municipalities with up to 1 million inhabitants must have a minimum of 9 councilors and have an extra seat for each additional 47619 inhabitants.[3.2] A similar increase was determined for municipalities bigger than 1 million inhabitants. The Resolution was publicized seven months before the elections of 2004, in a way politicians could not anticipate the change. The rule prevails for the 2004 and 2008 elections (Figures 3.2 (b) and (c)).

The second important modification in the legislature size law happened in 2009. After many years of controversy, a constitutional Amendment, called PEC 58/2009, was approved. This modification brought back local decision power to choose the number of councilors giving certain limits. The Amendment created an upper bound according to population, respecting the minimum of 9 seats (see Figure 3.2 (d)). Since then, those local legislators that were allowed to select could decide the council size for the elections of 2012.

Most municipalities that were allowed to increase their number of council seats following the 2009 Resolution did so in the 2012 elections. In total, 2178 municipalities were eligible to expand their legislative size, and approximately 65% chose the maximum number of chairs they could. Figure 3.3 illustrates this decision pattern. From a general perspective, municipalities that lost more seats between the 2000 and 2004 elections were more likely to recover those seats once they gained discretion over legislative size. In other words, the greater the initial seat reduction, the higher the recovery.

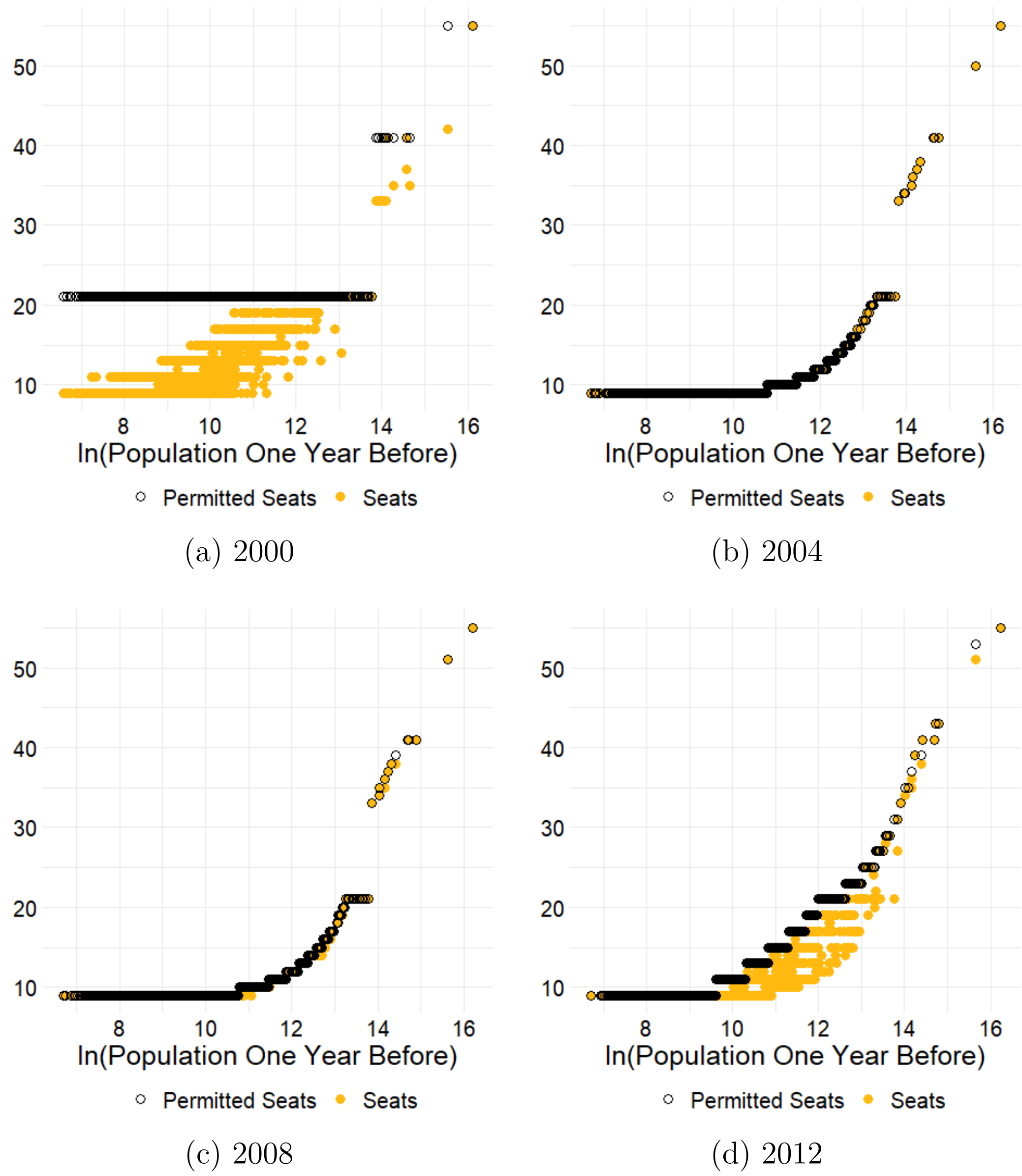
### 3.2.2
### Brazilian municipalities

Brazil is divided into more than 5550 municipalities, the lowest administrative units in the country. Municipalities have autonomous democratic authorities, which are directly elected every four years. A majoritarian vote names the mayor (executive) and the city council is appointed through an open list in a proportional representation system. Municipality election happens at the same time in the whole country. Municipalities also have certain legislative and fiscal authority: they can legislate on some specific areas, have the power to raise revenue, and decide how to allocate transfers from state and federal governments. Municipalities are responsible for important areas, such as basic health care, primary education, and local infrastructure.

Incumbents need to change the city council's bylaws, named *Lei Orgânica*, to modify the legislature size. The specific steps needed to alter *Lei Orgânica* are particular for every municipality. In general, there are three ways to propose an amendment or modification in *Lei Orgânica*: (i) mayor request; (ii) claim of one-third of the city council; and (iii) popular initiative

[3.2] This rule comes from $\frac{1000000}{21}$.

Figure 3.2: Population and Council Seats




(a) 2000

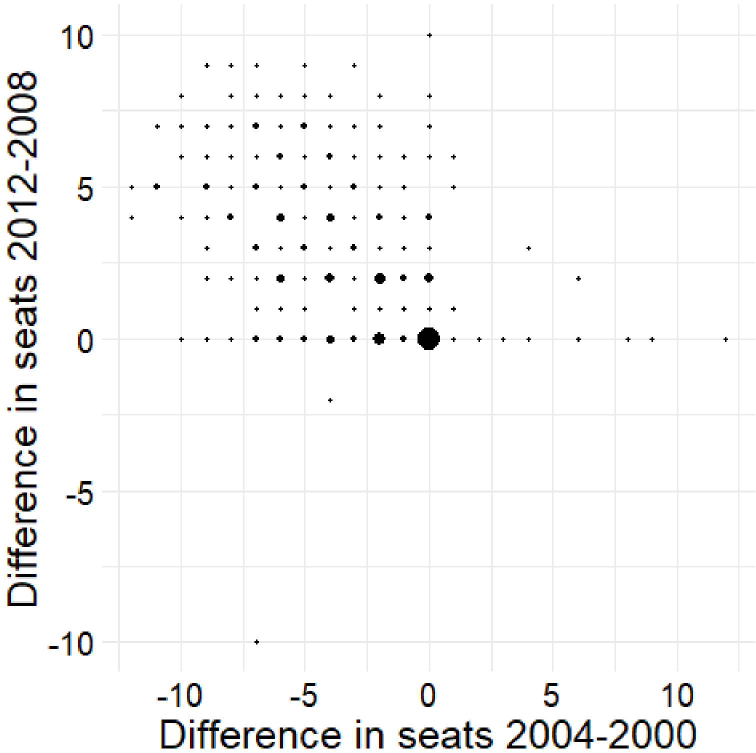
(b) 2004

(c) 2008

(d) 2012

**Note:** These figures plot municipalities' number of city council seats comparing the observed values with the legal upper limit. Permitted seats were assembled based on the applicable law's limits for each election year. In 2000 it was the Constitution from 1988, in 2004 and 2008 it was the Resolution 21.702 elaborated by TSE, and in 2012 it was the PEC 58/2009. The number of permitted seats was calculated for each municipality based on its estimated population one year before the election.

Figure 3.3: Seats Recovery from 2004 to 2012




**Note:** This figure compares the municipalities's loss of council seats, in 2004, with their gain in the 2012 elections. The Resolution 21.702 determined losses calculated by the difference in legislature size between the 2000 and 2004 elections. Many municipalities could recover seats in the 2012 elections after the PEC 58/2009. As can be seen, most municipalities that lost chairs in 2004 recovered them in 2012.

coming from at least 5% of voters. Independent of the source of the initial proposal to modify a law, the requirement needs to be approved by two-thirds of the city council and after, needs to be sanctioned by the city mayor. On the specific case of altering the legislative size, proposals normally come from the council side, arguing to increase population representativity.

## 3.3 Conceptual Framework

This section outlines the conceptual framework that predicts how councilors behave when they have the power to decide the legislative size of their municipalities. Eight testable hypotheses are proposed, rooted in personal and political motives of incumbents. The hypothesis behind these predictions is that incumbent councilors can anticipate the destination of an extra seat based on the configuration of the previous election run.

**Prediction 1 (P1):** *An increase in the number of seats is associated with a raise in legislators' reelection probability.*

Legislators, being forward-looking, strategically weigh the costs and benefits of increasing council seats, taking into account their chances of reelection. Diermeier *et al.* (2005) emphasize that politicians solve a dynamic optimization problem to maximize their lifetime utility, which, in this case, means that their decisions on council size affect their reelection prospects.

Incumbents look at the costs and benefits when deciding to raise the council size. The benefits involve altruistic and personal motives while the cost may relate to a wage cut. By voting for extra seats in the city council, politicians increase representativeness and may raise their reelection likelihood, because there are more seats from the same potential number of candidates.[3.3] In this sense, the incumbent, if reelected, receives the wages and prestige of another term. In contrast, when politicians vote for additional seats they may decrease their salary.[3.4] If the municipality legislative budget remains constant, the expenditures of additional seats need to be accommodated by an equal division of wages to all incumbents.

Politicians may be driven by both personal and pro-social motives when running for office and making legislative decisions, including the determination of council size. From an altruistic perspective, politicians might pursue social welfare objectives. Finan & Mazzocco (2021) argue that politicians could run for reelection with the intent to improve social welfare. In the Brazilian context, legislators often justify increasing council size as a way to enhance representativity. On the other hand, from a personal motivation standpoint, politicians seek election for the prestige, income, and power associated with holding office (Downs (1957)). Moreover, incumbents may design institutions to consolidate their power (Acemoglu *et al.* (2021)), including decisions to expand the city council if they anticipate personal electoral advantages.

While increased representativeness is ostensibly altruistic, the primary beneficiaries of additional legislative seats are often councilors, who gain a competitive edge from institutional inertia. First, increasing the number of city councils favors incumbents because they already have visibility, resources, and established voter bases (Boas & Hidalgo (2011)). Moreover, taking all else constant, larger council sizes might reduce the electoral threshold, lowering the vote share required for reelection.

**Prediction 2 (P2):** *There is a positive relationship between an increase in legislative size and the perspective of the largest coalition receiving the additional chair.*

[3.3] Correa & Madeira (2014) do not find a significant increase in the number of candidates when the number of seats increased in Brazil.

[3.4] It is a simplification but Article 29 from the Constitution determines a maximum wage for the local legislators as a fraction of state legislators' salary.

Incumbents may also pursue strategies that benefit their party or coalition, aiming to perpetuate power (Acemoglu *et al.* (2021)). In Brazil's electoral system, legislative seats are allocated based on coalition strength. This suggests that councilors are more likely to raise council size when they know which coalition will benefit from the additional seats.

To explore this, I created an algorithm to simulate seat allocation using the D'Hondt method.[3.5] The new seats are assigned to the largest coalition, defined as the coalition holding the largest share of seats in the council without additional chairs. This helps us determine if legislators are more inclined to increase seats when the largest coalition gains.[3.6]

**Prediction 3 (P3):** *There is a negative relationship between political competition and an increase in legislative size.*

When party coalitions are more competitive, the strategy might differ. In municipalities with many competing coalitions, the potential gains from additional seats could be harder to predict, making incumbents less likely to increase legislative size.

An additional argument is that party coalitions are not stable in Brazil, besides its relevance for elections. First, parties´ ideological position swings over time in the federal sphere (Zucco & Power (2023)), and the ideology is even weaker in municipalities.[3.7] Second, parties' alignment is stronger when the interest is in public resources. Finally, parties can form different coalitions every election cycle. At the same time, election rules favor party coalitions in legislative seats allocation, therefore it needs to be considered in the analysis.

**Prediction 4 (P4):** *The existence of a narrow majoritarian coalition is negatively associated with an increase in legislative seats.*

**Prediction 5 (P5):** *There is a negative correlation between municipalities that do not have coalition holding at least one-third of the seats and the increase in council size.*

Prediction P4 and P5 elapse directly from the legal process required to increase council size (see section 3.2.2). They are very close to P3, which argues against competitions in the decision-making process of rising legislative size. In this context, competition rises the uncertainty of the gains associated with the extra seat in the city council. From Prediction 4, independently on the number

[3.5] Many countries, including Brazil, use the D'Hondt method to distribute seats through parties. This method was built to favor minority coalitions.

[3.6] It is possible that a municipality could not have a largest coalition. Assume there is a municipality with 9 councilors and three coalitions with the same number of elected candidates.

[3.7] An example of this is that PT and PSDB were opponents in the 2010 and 2014 presidential elections, while they formed a coalition in 748 municipalities (13% of total municipalities) in 2012 local elections.

of coalitions, if there exists a narrow coalition majority, gains of an extra seat are unclear and harder to be approved by the council, then politicians prefer not to increase council chairs. Further, Prediction 5 explores that in Brazil's municipal system, initiating a proposal to amend the *Lei Orgânica* requires at least one-third of council members' support. Without a coalition meeting this threshold, such proposals cannot move forward, effectively preventing any changes to council size.

**Prediction 6 (P6):** *There is a positive relationship between a qualified majority (two-thirds of seats or more) and the increase of legislative size.*

Prediction P6 is also based on the legal process required to increase council size. The P6 stays that when a qualified majority exists, legislative expansion becomes procedurally straightforward because the coalition has enough votes to approve amendments in the *Lei Orgânica*. Of course, a qualified majority is not sufficient for rising chairs, once it is also necessary to have the mayor's approval.

**Prediction 7 (P7):** *There is a negative correlation between corruption cases and an increase of legislative seats.*

**Prediction 8 (P8):** *There is a positive correlation between opposition gaining extra seat when corruption cases are detected and an increase of legislative size.*

Corruption is another important factor influencing council size decisions. Ferraz & Finan (2008) show that voters tend to punish corrupt politicians when information about corruption practices is publicized. In the context of council size, Britto & Fiorin (2020) claim that the increase in chairs raises corruption, but if the opposition is smaller and absorbs the extra seat, monitoring increases and corruption reduces. Prediction 7 and 8 are connected with these findings.

The conceptual framework outlined in this section presents eight testable predictions that highlight the interplay between institutional rules, political incentives, and strategic behavior of incumbents in determining municipal legislative size. Predictions 1–3 emphasize how personal benefits, coalition dynamics, and electoral uncertainty drive legislators' decisions, while Predictions 4–6 focus on the procedural constraints imposed by the *Lei Orgânica*, such as the need for qualified majorities and coalition thresholds. Predictions 7–8 incorporate the role of corruption and public accountability, suggesting that transparency and opposition strength act as checks on legislative expansion.

## 3.4 Data and Empirical Strategy

This section details the datasets and the empirical strategy employed to test the predictions about institutional persistence in municipal legislature sizes exposed in the previews section. The analysis leverages data from three sources: TSE, IBGE (*Instituto Brasileiro de Geografia e Estatística*), and CGU (*Controladoria Geral da União*).

### 3.4.1 Data

The TSE dataset contains all information from elections. I collect data for the 2000, 2004, 2008, and 2012 elections. This data has information on candidates that ran each election, including the number of individual votes, party affiliation, coalition, personal characteristics, and if candidates were elected. It also contains the number of legislative seats of each municipality.

IBGE has information on population and other municipalities' characteristics. I collect data from the census of 2010, such as literacy rate, income, and the percentage of houses that have television and ratio.

Corruption data comes from random auditions of the (CGU) started in 2003, which gathers information on all federal funds transfers to the municipal government from 2001 onwards. Auditors inspect documents and accounts to discover irregularities in construction and public sector services delivery. After approximately one week of examination, auditors send an official report to the central office in Brasilia with a description of all irregularities they found. There are four classifications to the examination: "information", "formal failure", "medium failure", and "major failure". Further, the same inspected resource amount can receive many kinds of classification. Different from Ferraz & Finan (2011) and Brollo *et al.* (2013) that codified the official reports labeling irregularities, I simply use the dataset classification as a proxy for corruption. Until 2012, the last election year of the sample, 987 municipalities were audited by CGU.

To measure corruption, I construct two variables based on audit reports from CGU. The first variable, $Corruption1$, represents the share of total resources identified as having major failures during audits, providing a broad measure of corruption. The second variable, $Corruption2$, weights these failures by the quantity of major failures involved, offering a more nuanced measure of corruption intensity. Those variables are performed across municipalities, both ranging from 0 to 1, with values closer to 1 indicating higher level of perceived corruption among incumbents.

To explore how seat allocation influences council size decisions (P2-P8), I apply the D'Hondt method to simulate how an additional seat would have been distributed in the 2008 elections. This counterfactual scenario assumes that seat allocation is endogenous to the city council size, affecting candidates' and parties' strategies. The assumption also considers that the allocation of the additional chair is a predictor for 2012's election, where municipalities regained local power to decide council size. Therefore, incumbents elected in 2008 (for the 2009-2012 election term) could decide if they vote or not to increase the legislative in their municipalities.

I develop an algorithm to replicate the allocation of city council seats for all Brazilian municipalities. To validate its accuracy, I first apply it to the 2008 municipal elections, achieving a 98.1% success rate in predicting the distribution of seats across party coalitions. The same algorithm is then used to simulate a counterfactual scenario in which each municipality receives one additional legislative seat. This new seat is allocated to a party coalition according to the electoral rules in place.

This counterfactual scenario is valuable to anticipate councilors debate over the increase of city council size in the 2009-2012 legislative term. This debate determines if municipality will rise the number of chairs. For the purpose of this paper, results are also relevant to understand political incentives for maintaining political institutions.

This counterfactual exercise provides valuable insights into how councilors may have anticipated and discussed the potential increase in council size. This discussion was a key factor in determining whether a municipality would choose to expand the number of seats. In addition, the results are relevant for understanding the political incentives behind maintaining or reforming institutional arrangements. The way political actors respond to potential changes in institutional structures reveals strategic motivations that go beyond formal legal constraints.

### 3.4.2 Empirical Strategy

The empirical strategy aims to test predictions presented in Section 3.3 regarding the political dynamics influencing the persistence and change in municipal legislative size. The analysis uses a probit model to examine the reelection probability of incumbent legislators in municipalities that increased council size (P1). Additionally, a linear regression framework is employed to test the correlation between political characteristics and the decision of changing the number of legislative seats in the 2009-2012 election term (P2-

P8).

Equation (3.1) tests Prediction 1, in order to check if there exists an advantage to incumbent councilors raising the council size.

$$Pr(y_{im} = 1) = Pr(\alpha + \beta D_m + \gamma Z_{im} + \varepsilon_i > 0) \tag{3.1}$$

where $y_{im}$ assumes 1 when a councilor is reelected in the 2012 elections, and 0 if not. The vector $D_m$ is a dummy indicating if municipality $m$ increased council size and the vector $Z_{im}$ is a set of legislators characteristics.

For predictions P2-P3, equation (3.2) was implemented for the municipal level. The dependent variable is the change in legislative size between 2008 and 2012. The key independent variables include measures of municipal political fragmentation and the additional seats allocated using the D'Hondt method. These variables capture how political conditions in 2008 influenced council size decisions in 2012.

$$y_m = \alpha + \beta Variable_m \times LargestCoalition_m + \gamma Diff_m + \delta X_m + \epsilon \tag{3.2}$$

where $y_m$ is the absolute difference in legislative size between the 2012 and 2008 elections. The regressor $Variable_m$ represents many variables ($Mayor_m$, $Many_m$) depending on the tested prediction: $Mayor_m$ is a variable that captures whether mayor's coalition receives the additional hypothetical seat (P2); $Many_m$ is a dummy that indicates whether a municipality has eight or more coalitions (P3).[3.8]. The $LargestCoalition_m$ variable represents the additional chair allocated for the largest coalition by the D'Hondt method. Variable $Diff_m$ is the absolute difference in chairs between elections 2000 and 2004, in order to control for municipalities that lost seats with the TSE's decision, and vector $X_m$ is a set of municipal characteristics.

Equation (3.3) displays the tests for prediction P4 - P6, that study the *Lei Orgânica*l. The dependent variable is the same as in equation 3.2. The regressor $Variable_m$ serves as a placeholder for different variables, each corresponding to a specific prediction being tested: $Narrow_m$ is a dummy for municipalities where the largest coalition has a maximum of 56% of the council share[3.9] (P4); $LessOneThird_m$ indicates municipalities that do not have coalitions with more than one-third of the council share (P5); $Qualified_m$ admits 1 when the largest coalition in 2008 comprehends at least two-thirds of the legislative (P6). Again, variable $Diff_m$ is the absolute difference in chairs between elections 2000 and

[3.8] $Many_m$ was chosen based on the fact that the Brazilian municipal coalition mean was four in the 2008 elections. However, I test some alternative measures in the Appendix 3.6

[3.9] This share is determined with a municipality with nine councilors, five of them from the same coalition

2004, and vector $X_m$ is a set of municipal characteristics.

$$y_m = \alpha + \beta Variable_m \times Mayor_m + \gamma Diff_m + \delta X_m + \epsilon \tag{3.3}$$

Finally, equation (3.4) tests prediction P7 and P8. Dependent variable is the same as equation (3.2) but sample was reduced because the CGU's dataset is limited. $Corruption_m$ measures corruption in municipalities that receive CGU's audits, while $Opposition_m$ indicates municipalities where opposition receives the hypothetical seat calculated by the D'Hondt method. Again, variables $Diff_m$ and $X_m$ represents the same as before.

$$y_m = \alpha + \beta Corruption_m \times Opposition_m + \gamma Diff_m + \delta X_m + \epsilon \tag{3.4}$$

Omitted variable bias is a potential concern in any empirical framework, including this analysis. However, several steps mitigate this risk. First, the model includes key predictors directly tied to the conceptual framework, such as coalition characteristics, political fragmentation, and municipal attributes, which are theorized to influence council size decisions. Additionally, the inclusion of controls for municipal characteristics like population, income, and prior legislative changes reduces the likelihood of confounding factors. I also conduct robustness checks using a sample of all municipalities allowed to elevate city council size in 2012 elections. Results are presented in the Appendix 3.6. Together, these strategies minimize the risk of omitted variable bias and enhance the reliability of the results.

## 3.5 Results

This section shows results from the testable predictions presented in Section 3.3, with all predictions refering to legislative elections. In order to verify the potential gain in reelection terms given by extra seats (P1), the sample comprises all legislative candidates elected in the 2008 election. For the other predictions (P2-P8), regressions are at the municipality level, consequently, sample is composed of 1231 municipalities that lost seats in the 2002 Resolution and, in 2012, had the opportunity to reach the legislative size it have had in the 2000 election. Appendix 3.6 shows a robustness check, considering all municipalities that were able to increase the number of seats by at least 1 chair between 2008 and 2012. Overall, results are similar to those presented in this Section.

This section presents the results for the testable predictions introduced in Section 3.3, all of which relate to legislative elections. To examine the potential reelection benefits associated with an increase in the number of seats (Prediction P1), the analysis focuses on all legislative candidates elected in the 2008 election. For the remaining predictions (P2–P8), the regressions are conducted at the municipality level. The sample includes 1231 municipalities that lost seats due to the 2002 Resolution and, by 2012, had the opportunity to restore the legislative size they held in the 2000 election. Appendix 3.6 provides a robustness check using an alternative sample that includes all municipalities eligible to increase their number of seats by at least one between 2008 and 2012. The overall results are consistent with those presented in this section.

Table 3.1 demonstrates results for P1. Columns 1 to 4 consider all candidates elected in 2008, while column 5 take into account those elected in 2008 and running for reelection in the 2012 poll. Variable $D_m$ is significant in all regressions, indicating that a rise in legislative seats is associated with a jump in the probability of reelection in between 15 to 10 percentage points across all models. This effect is consistent with the fact that incumbent legislators can improve their welfare by approving extra legislative seats because there is an increase in their likelihood of reelection. This is consistent with Acemoglu *et al.* (2021)'s theoretical findings. The control variable $Mandates_{im}$ indicates long time politicians have more probability in being reelected, while variables $Age_{im}$ and $Woman_{im}$ remain consistent with the literature, showing that older and male candidates are more likely to be reelected.

Results from Table 3.1 reinforce Prediction 1. The positive correlation of $D_m$ with reelection probability highlights the strategic behavior of incumbent councilors, who may exploit institutional changes to consolidate power. This suggests that the decision to increase legislative seats is not merely procedural but tied to personal political advantage, as incumbents benefit from higher chances of maintaining office.

Results for predictions P2 and P3 are in Table 3.5. Columns 1 and 2 show that P2 is true if the extra seat goes to the largest mayor coalition. The $LargestCoalition_m$ coefficient is consistently negative. The interaction between $LargestCoalition_m$ and $Mayor_m$ is positive and statistically significant, indicating that when the largest coalition is the same as the mayor's, it can strengthen their ability to expand council size. Columns 3 to 5 present results from P3. In this case, variable $Many_m$ has a negative relation with an increase in legislative chairs during 2008-2012 elections - see column 3. The lack of significance for the interaction between $Many_m \times LargestCoalition_m$, column 4, suggests that simply having a large number of coalitions does not inherently promote legislative expansion. Column 5 demonstrates that a raise in seats is positively correlated with many coalitions in cases where the mayor

Table 3.1: Candidates' increase in reelection probability with additional seats

| | Reelected in 2012 elections | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $D_m$ | 0.152*** | 0.148*** | 0.132*** | 0.109*** | 0.106*** |
| | (0.013) | (0.013) | (0.013) | (0.014) | (0.017) |
| $Mandates_m$ | | 0.134*** | 0.122*** | 0.109*** | 0.276*** |
| | | (0.007) | (0.008) | (0.008) | (0.010) |
| $Age_m$ | | | 0.002*** | 0.002*** | −0.025*** |
| | | | (0.001) | (0.001) | (0.001) |
| $Woman_m$ | | | −0.247*** | −0.262*** | −0.121*** |
| | | | (0.018) | (0.018) | (0.023) |
| Constant | −0.346*** | −0.562*** | −0.542*** | −0.656*** | 0.737*** |
| | (0.007) | (0.014) | (0.029) | (0.065) | (0.080) |
| Education FE | No | No | Yes | Yes | Yes |
| Marital Status FE | No | No | Yes | Yes | Yes |
| State FE | No | No | No | Yes | Yes |
| Observations | 51,940 | 51,940 | 51,929 | 51,929 | 34,461 |

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

**Note:** This table displays regression results for P1 using equation (3.1). The dependent variable assumes 1 when a councilor is reelected in the 2012 elections, $D_m$ indicates if municipality $m$ increased council size, $Mandates_{im}$ is the number of mandates candidate $i$ from municipality $m$ won until the 2008 election, $Age_{im}$ is the candidate age, $Woman_{im}$ is an indicator for whether a candidate is a woman. Standard errors are clustered at the municipality level.

coalition receive the extra seat. These results can demonstrate that a coalition majority is not enough to raise the council size, it is necessary to have the mayor's support because the executive needs to santionate changes in *Lei Orgânica*. Equally, the mayor's support is important to raise the legislative chair when many coalitions run for elections. These results also corroborate with P3, which claims that political competition is negatively correlated with a raise in seats.

These results suggest that Prediction 2 (P2) is not fully supported. P2 posits that a larger coalition is associated with an increase in council size; however, the coefficient is negative. Instead, column 2 of Table 3.5 shows that the correlation becomes statistically significant when the largest coalition is aligned with the mayor. Given the importance of the mayor's coalition, the variable $Mayor_m$ is included in the regressions for Predictions P2 through P6.

Moreover, consistent with Prediction 3 (P3), columns 3 to 5 of Table 3.5 show that a higher number of coalitions is negatively associated with increases in legislative size, except in cases where the mayor's coalition receives the additional seat. This finding underscores the central role of the local executive in shaping legislative decisions regarding council expansion. Appendix 3.6 presents robustness checks using alternative measures of the variable $Many_m$.

Table 3.2: Political factors that can influence the incumbents' decision on rising seats

| | Seats 12-08 | | | | |
|---|---|---|---|---|---|
| | P2 | P2 | P3 | P3 | P3 |
| | (1) | (2) | (3) | (4) | (5) |
| $LargestCoalition_m$ | 0.067 | −0.350 | | 0.014 | |
| | (0.141) | (0.256) | | (0.153) | |
| $Mayor_m$ | | 0.009 | | | −0.018 |
| | | (0.139) | | | (0.127) |
| $Many_m$ | | | −0.357** | −0.369** | −0.469*** |
| | | | (0.148) | (0.152) | (0.157) |
| $LargestCoalition_m \times Mayor_m$ | | 0.562* | | | |
| | | (0.319) | | | |
| $Many_m \times LargestCoalition_m$ | | | | 0.207 | |
| | | | | (0.399) | |
| $Many_m \times Mayor_m$ | | | | | 0.640** |
| | | | | | (0.286) |
| $Diff_m$ | Yes | Yes | Yes | Yes | Yes |
| $UpperLimit_m$ | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 |
| Observations | 1,228 | 1,228 | 1,228 | 1,228 | 1,228 |
| $R^2$ | 0.396 | 0.398 | 0.399 | 0.399 | 0.402 |
| Adjusted $R^2$ | 0.373 | 0.374 | 0.376 | 0.375 | 0.378 |

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

**Note:** This table displays regression results for P2 and P3 using equation (3.2. The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $LargestCoalition_m$ represents one extra seat allocated for the largest coalition by the D'Hondt method, $Mayor_m$ is a dummy indicating an extra seat for the mayor's coalition, $Many_m$ is a dummy that indicates whether a municipality has eight or more coalitions, $Diff_m$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit_m$. Standard errors are reported in brackets.

Table 3.3 reports the results related to Predictions P4–P6. Columns 1 and 2 show that the increase in city council size is not associated with a narrow majority, which supports Prediction 4. Columns 3 and 4 suggest that the presence of small coalitions—measured by the indicator $LessOneThird_m$, which equals one when no coalition controls more than one-third of the seats, is not associated with council expansion. This finding aligns with Prediction 5, which posits that insufficient quorum limits the ability to propose changes to the city council's bylaws. However, columns 5 and 6 indicate that the coefficients for $Qualified_m$ are not statistically significant, implying that even a qualified majority does not ensure an increase in legislative size. The result in column 6 presents a stronger test, while a softer version appears in column 2 of Table 3.6. In that case, the requirement was that the largest coalition held the extra seat, not necessarily two-thirds (qualified majority).

Table 3.3: Institutional factors that can influence the incumbents' decision on rising seats

| | Seats 12-08 | | | | | |
|---|---|---|---|---|---|---|
| | P4 | P4 | P5 | P5 | P6 | P6 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Narrow_m$ | 0.128 | 0.178 | | | | |
| | (0.227) | (0.349) | | | | |
| $Mayor_m$ | | 0.151 | | 0.083 | | 0.126 |
| | | (0.436) | | (0.132) | | (0.119) |
| $LessOneThird_m$ | | | 0.185 | 0.156 | | |
| | | | (0.123) | (0.135) | | |
| $Qualified_m$ | | | | | −0.164 | −0.240 |
| | | | | | (0.235) | (0.371) |
| $Narrow_m \times Mayor_m$ | | −0.025 | | | | |
| | | (0.450) | | | | |
| $LessOneThird_m \times Mayor_m$ | | | | 0.147 | | |
| | | | | (0.261) | | |
| $Qualified_m \times Mayor_m$ | | | | | | 0.062 |
| | | | | | | (0.471) |
| $Diff_m$ | Yes | Yes | Yes | Yes | Yes | Yes |
| $UpperLimit_m$ | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 |
| Observations | 1,228 | 1,228 | 1,228 | 1,228 | 1,228 | 1,228 |
| $R^2$ | 0.397 | 0.397 | 0.398 | 0.398 | 0.397 | 0.397 |
| Adjusted $R^2$ | 0.373 | 0.373 | 0.374 | 0.374 | 0.373 | 0.373 |

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

**Note:** This table displays regression results for P4 - P6 using equation (3.3). The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $Narrow_m$ is an indicator for municipalities with the largest coalition having a maximum of 56% of the council share, $LessOneThird_m$ indicates municipalities that do not have a coalition with more than one-third of the council share, $Qualified_m$ indicates when the largest coalition in 2008 comprehends at least two-thirds of the legislative, $Mayor_m$ is a dummy indicating an extra seat for the mayor's coalition, $Diff_m$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit_m$ represents the council size upper bound for 2012 elections. Standard errors are reported in brackets.

Results for corruption are in Table 3.4. Columns 1 and 2 indicate that P7 is not totally true because the corruption variables' parameters are negative but not significant. Columns 3 and 4 test Prediction 8 and they show it is not entirely true. The perception of corruption associated with the additional seat going to opposition is positively correlated with and increase of number of council but it is not significant. In this case, it is not possible to confirm Britto & Fiorin (2020)'s findings.

Results related to corruption are presented in Table 3.4. Columns 1 and 2 suggest that Prediction 7 is not fully supported: the coefficients for the corruption variables are negative, as expected, but statistically insignificant. Columns 3 and 4 test Prediction 8 and likewise show that the evidence is inconclusive. When the additional seat is allocated to the opposition, the perception of corruption is positively correlated with an increase in the number of council seats, but it is statistically insignificant. Therefore, it is not possible to confirm the findings reported by Britto & Fiorin (2020).

To summarize, the results presented in this section provide robust evidence in favor of several testable predictions while refining others. Prediction 1 is strongly supported, with the addition of legislative seats significantly associated with incumbent councilors' reelection probabilities. This highlights the strategic incentives for incumbents to manipulate institutional structures for personal political gain. Predictions 2 is partially validated, as the results underscore the importance of the mayor's coalition in driving legislative expansion, while merely having a large number of coalitions or a broad majority is insufficient. These results highlight the importance of executive support in enabling such changes. P3 - P5 highlights that political competition may bring uncertainty to the political decision, so it could be better not increase the number of seats. P6 indicates that even qualified majorities are insufficient without additional political alignment. Finally, predictions relating to corruption are unclear it is better not to do a strong proposition. Together, these findings highlight the interplay between institutional persistence, political incentives, and governance dynamics in shaping legislative decision-making.

Table 3.4: Corruption and the incumbents' decision on rising seats

| | Seats 12-08 | | | |
|---|---|---|---|---|
| | P7 | P7 | P8 | P8 |
| | (1) | (2) | (3) | (4) |
| $Corruption1_m$ | $-0.346$ | | $-0.941$ | |
| | (0.405) | | (0.654) | |
| $Corruption2_m$ | | $-0.175$ | | $-0.573$ |
| | | (0.594) | | (0.932) |
| $Opposition_m$ | | | $-0.631^{*}$ | $-0.433$ |
| | | | (0.377) | (0.346) |
| $Corruption1_m \times Opposition_m$ | | | 0.878 | |
| | | | (0.754) | |
| $Corruption2_m \times Opposition_m$ | | | | 0.572 |
| | | | | (1.115) |
| $Diff_m$ | Yes | Yes | Yes | Yes |
| $UpperLimit_m$ | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.78 | 2.78 | 2.78 | 2.78 |
| Observations | 230 | 230 | 230 | 230 |
| $R^2$ | 0.624 | 0.623 | 0.630 | 0.627 |
| Adjusted $R^2$ | 0.535 | 0.534 | 0.537 | 0.533 |

$^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

**Note:** This table displays regression results for P7 - P8 using equation (3.4). The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $Corruption1_m$ is the broader sense of corruption, $Corruption2_m$ is the weighted measure of corruption, $Opposition_m$ indicates whether the additional seat is allocated to coalitions different from the mayor's one, $Diff_m$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit_m$ represents the council size upper bound for 2012 elections. Standard errors are reported in brackets.

## 3.6 Conclusion

Institutions play a critical role in shaping the long-term evolution of society. Understanding how institutions are built, and why they persist, is essential for analyzing broader political and economic outcomes. This paper investigates the persistence of legislature size as an institution in Brazil, examining its implications for political power and governance.

Brazil presents a unique case study due to two successive laws: one that restricted, and another that restored, local politicians' authority over determining city council size. The country's socioeconomic diversity provides an ideal setting for studying how different municipalities respond to changes in institutional rules. Using an algorithm designed to simulate seat allocation in the 2008 election, this paper analyzes how the anticipation of adding seats to city councils affects political dynamics.

Results indicate there is a personal advantage for incumbent councilors in rising legislative chairs but certain circumstances are necessary to materialize a jump in the city council's size. The personal benefit is linked to an increase in the reelection probability of being elected for another term. In fact, to make this true the alignment between the largest coalition and the mayor's coalition is crucial. When the majority is narrow or fails to reach one-third of the legislative body, there is a negative relationship in increasing seats diminishes.

This study sheds light on the interplay between institutional design, political incentives, and governance. The findings underscore how institutional persistence can serve the strategic interests of incumbents, reinforcing power structures and perpetuating political advantage. However, the results also reveal how legal and procedural constraints, such as coalition strength act as checks on the extent to which incumbents can manipulate institutional rules for personal or partisan gain.

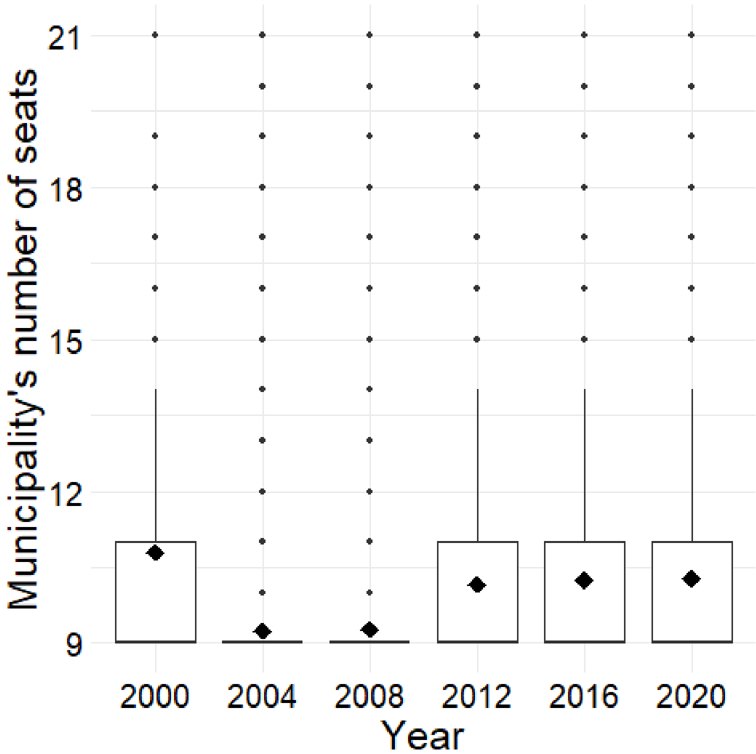
Backing from the original question: "How do institutions persist over time?" this paper offers a possible answer based in its results. Institutions persist over time because individuals that can decide over them have private benefits but it is also necessary to have an organized group with the same objectives and a leader deriving gains from the institutions. And if there are many groups competing, institutions may not persist.

Future research could explore the broader implications of legislative seat adjustments on municipal service delivery, budget allocations, and voter perceptions of representation.

## Appendix C

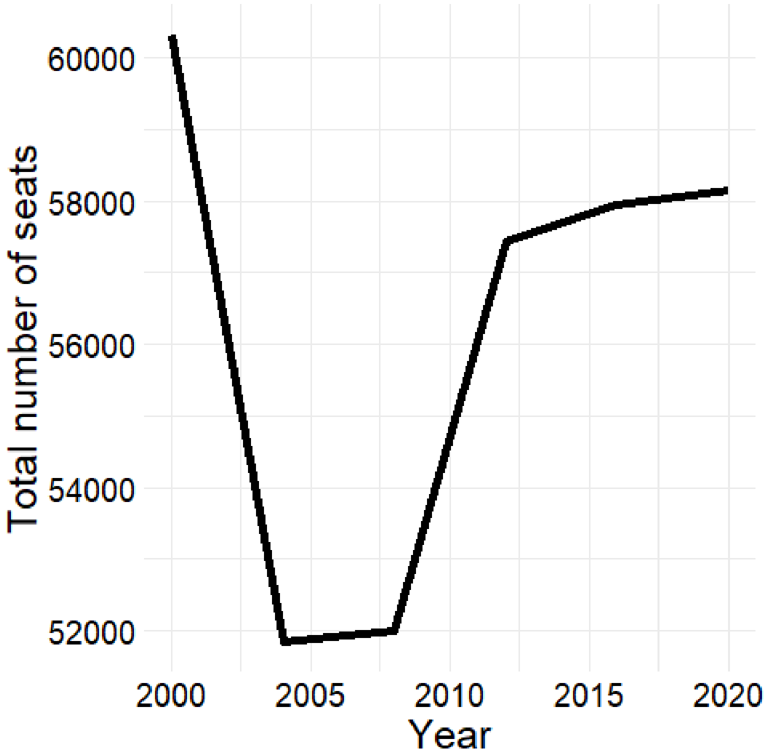
### Additional figures

Figure 3.4: Boxplot of the municipality's number of seats from 2000 to 2020




**Note:** This figure displays how the number of council seats varies across municipalities over each municipality election year starting from 2000. The lower bound of legislature size (9) is the median for all years and is either the 75th percentile point for 2004 and 2008. When local legislators are more free to choose the city council size (2000, 2012, 2016, and 2020) the 75th percentile point of boxplots is 11. For all those election years, the municipality's legislature size mean (⧫) is higher from 10.2 seats, contrasting with the elections of 2004 and 2008, when the mean is 9.3 councilors. The dots (•) are observations of the municipality's number of seats above the 75th percentile.

Figure 3.5: Total number of local legislators




**Note:** This figure shows the total number of local legislators elected in the period 2000 to 2020. In 2004, the number of legislators fell from 61.3 thousand to 51.8 thousand. Since the 2012 election, the number of legislators has jumped above 57.4 thousand.

### Robustness check

This section presents several robustness checks. First, I re-examine Prediction P3 using alternative definitions of the variable $Many_m$. Then, I test Predictions P2 through P8 using a different sample of municipalities.

### Alternative Definitions of $Many_m$

To assess the robustness of Prediction P3, I construct alternative thresholds for defining when a municipality has "many" party coalitions. The baseline specification classifies a municipality as having many coalitions if it has eight or more. I test alternative thresholds using cutoffs at five, six, and seven coalitions, as well as a continuous measure based on the Herfindahl-Hirschman Index (HHI) of coalition concentration. The results indicate that the variable $Many_m$ remains statistically significant when the threshold is set at seven or more coalitions.

Table 3.5: Political factors that can influence the incumbents' decision on rising seats

| | Seats 12-08 | | | | |
|---|---|---|---|---|---|
| | P3 | P3 | P3 | P3 | P3 |
| | (1) | (2) | (3) | (4) | (5) |
| $Many_m$ | $-0.357^{**}$ | | | | |
| | (0.148) | | | | |
| $Many5_m$ | | 0.072 | | | |
| | | (0.134) | | | |
| $Many6_m$ | | | $-0.032$ | | |
| | | | (0.126) | | |
| $Many7_m$ | | | | $-0.268^{**}$ | |
| | | | | (0.132) | |
| $ColigationHHI_m$ | | | | | $-0.111$ |
| | | | | | (0.089) |
| $Diff_m$ | Yes | Yes | Yes | Yes | Yes |
| $UpperLimit_m$ | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 |
| Observations | 1,228 | 1,228 | 1,228 | 1,228 | 1,228 |
| $R^2$ | 0.399 | 0.397 | 0.396 | 0.398 | 0.397 |
| Adjusted $R^2$ | 0.376 | 0.373 | 0.373 | 0.375 | 0.374 |

$^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

**Note:** This table displays regression results for P3 using equation (3.2. The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $Many_m$ is a dummy that indicates whether a municipality has eight or more coalitions, $Many5_m$ is a dummy that indicates whether a municipality has five or more coalitions, $Many6_m$ is a dummy that indicates whether a municipality has six or more coalitions, $Many7_m$ is a dummy that indicates whether a municipality has seven or more coalitions, $ColigationHHI_m$ is the Herfindahl-Hirschman Index (HHI) of coalition concentration, $Diff_m$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit_m$. Standard errors are reported in brackets.

### Alternative Sample

Next, I test Predictions P2 through P8, as discussed in Section 3.3, using a wider sample composed of municipalities that were eligible to increase their number of legislative seats by at least one between 2008 and 2012. This sample includes 2,152 municipalities. The findings based on this subsample are very similar to those reported in Section 3.5, lending further support to the main conclusions of the paper.

Table 3.6: Political factors that can influence the incumbents' decision on rising seats

| | Seats 12-08 | | | | |
|---|---|---|---|---|---|
| | P2 | P2 | P3 | P3 | P3 |
| | (1) | (2) | (3) | (4) | (5) |
| $LargestCoalition_m$ | $-0.038$ | $-0.333^{*}$ | | $-0.014$ | |
| | (0.097) | (0.189) | | (0.103) | |
| $Mayor$ | | $-0.078$ | | | $-0.097$ |
| | | (0.097) | | | (0.086) |
| $Many$ | | | $-0.216^{**}$ | $-0.199^{*}$ | $-0.304^{***}$ |
| | | | (0.105) | (0.107) | (0.112) |
| $LargestCoalition_m \times Mayor$ | | $0.441^{*}$ | | | |
| | | (0.230) | | | |
| $Many \times LargestCoalition_m$ | | | | $-0.353$ | |
| | | | | (0.306) | |
| $Many \times Mayor$ | | | | | $0.469^{**}$ |
| | | | | | (0.211) |
| $Diff$ | Yes | Yes | Yes | Yes | Yes |
| $UpperLimit$ | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.49 | 2.49 | 2.49 | 2.49 | 2.49 |
| Observations | 2,152 | 2,152 | 2,152 | 2,152 | 2,152 |
| $R^2$ | 0.389 | 0.390 | 0.390 | 0.390 | 0.391 |
| Adjusted $R^2$ | 0.375 | 0.376 | 0.376 | 0.376 | 0.377 |

$^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

**Note:** This table displays regression results for P2 and P3 using regression 3.2. The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $LargestCoalition_m$ represents one extra seat allocated for the largest coalition by the D'Hondt method, $Mayor$ is a dummy indicating an extra seat for the mayor's coalition, $Many$ is a dummy that indicates whether a municipality has eight or more coalitions, $Diff$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit$. Standard errors are reported in brackets.

Table 3.7: Institutional factors that can influence the incumbents' decision on rising seats

| | Seats 12-08 | | | | | |
|---|---|---|---|---|---|---|
| | P4 | P4 | P5 | P5 | P6 | P6 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Narrow$ | 0.205 | 0.133 | | | | |
| | (0.142) | (0.206) | | | | |
| $Mayor$ | | −0.125 | | −0.036 | | −0.022 |
| | | (0.264) | | (0.089) | | (0.082) |
| $LessOneThird$ | | | 0.128 | 0.104 | | |
| | | | (0.087) | (0.097) | | |
| $Qualified$ | | | | | −0.168 | −0.278 |
| | | | | | (0.148) | (0.214) |
| $Narrow \times Mayor$ | | 0.136 | | | | |
| | | (0.276) | | | | |
| $LessOneThird \times Mayor$ | | | | 0.104 | | |
| | | | | (0.187) | | |
| $Qualified \times Mayor$ | | | | | | 0.206 |
| | | | | | | (0.286) |
| $Diff$ | Yes | Yes | Yes | Yes | Yes | Yes |
| $UpperLimit$ | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.49 | 2.49 | 2.49 | 2.49 | 2.49 | 2.49 |
| Observations | 2,152 | 2,152 | 2,152 | 2,152 | 2,152 | 2,152 |
| $R^2$ | 0.389 | 0.389 | 0.389 | 0.389 | 0.389 | 0.389 |
| Adjusted $R^2$ | 0.376 | 0.375 | 0.376 | 0.375 | 0.376 | 0.375 |

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

**Note:** This table displays regression results for P4 - P6 using regression 3.3. The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $Narrow$ is an indicator for municipalities with the largest coalition having a maximum of 56% of the council share, $LessOneThird$ indicates municipalities that do not have a coalition with more than one-third of the council share, $Qualified$ indicates when the largest coalition in 2008 comprehends at least two-thirds of the legislative, $Mayor$ is a dummy indicating an extra seat for the mayor's coalition, $Diff$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit$ represents the council size upper bound for 2012 elections. Standard errors are reported in brackets.

Table 3.8: Corruption and the incumbents' decision on rising seats

| | Seats 12-08 | | | |
|---|---|---|---|---|
| | P7 | P7 | P8 | P8 |
| | (1) | (2) | (3) | (4) |
| $Corruption1$ | −0.339 | | −0.852* | |
| | (0.289) | | (0.478) | |
| $Corruption2$ | | −0.343 | | −0.899 |
| | | (0.445) | | (0.731) |
| $Opposition$ | | | −0.230 | −0.115 |
| | | | (0.267) | (0.240) |
| $Corruption1 \times Opposition$ | | | 0.732 | |
| | | | (0.543) | |
| $Corruption2 \times Opposition$ | | | | 0.811 |
| | | | | (0.845) |
| $Diff_m$ | Yes | Yes | Yes | Yes |
| $UpperLimit_m$ | Yes | Yes | Yes | Yes |
| Additional Controls | Yes | Yes | Yes | Yes |
| Dep. var mean | 2.49 | 2.49 | 2.49 | 2.49 |
| Observations | 408 | 408 | 408 | 408 |
| $R^2$ | 0.537 | 0.536 | 0.539 | 0.537 |
| Adjusted $R^2$ | 0.478 | 0.476 | 0.477 | 0.475 |

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

**Note:** This table displays regression results for P7 - P8 using equation (3.4). The dependent variable is the absolute difference in legislative size between the 2012 and 2008 elections, $Corruption1$ is the broader sense of corruption, $Corruption2$ is the weighted measure of corruption, $Opposition$ indicates whether the additional seat is allocated to coalitions different from the mayor's one, $Diff$ is the absolute difference in chairs between elections 2000 and 2004, and $UpperLimit$ represents the council size upper bound for 2012 elections. Standard errors are reported in brackets.

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