# Does Distance Still Matter in Banking? Evidence from Local Credit Markets in Brazil

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**Abstract**

The distance between banks and borrowers can shape the amount and quality of information used in credit decisions. This paper examines how the distance between a bank's headquarters and its operating locations affects credit supply. Using administrative data from the Central Bank of Brazil, we construct a bank-municipality panel for 2011-2022 and exploit within-bank and within-municipality variation over time. We find a negative relationship between distance and local credit: a 100-kilometer increase in distance is associated with a reduction of approximately 4% in credit supply. We also show that this result is attenuated for banks with longer local presence, particularly among private banks, suggesting that accumulated local experience mitigates distance-related informational frictions.

**Keywords:** functional distance, credit supply, banking structure

**JEL Codes:** G21, C23, R12

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# 1 Introduction

The external financing constraints faced by firms and households are less severe in more developed financial systems, a channel widely emphasized in the literature linking financial development to economic growth (Levine, 2005). Although large companies typically have access to capital markets and diversified sources of external finance, small companies and households are primarily dependent on local credit markets. In this context, the development of the local financial system becomes particularly relevant. Empirical evidence indicates that local financial development is associated with higher rates of entrepreneurship, firm entry, innovation, and competition, as well as with improved economic performance (Guiso et al., 2004; Benfratello et al., 2008; Levine, 1997, 2005; Fang and Vlaicu, 2024).

A core function of financial intermediaries is the production of information about investment opportunities, as high fixed costs prevent individual investors from efficiently collecting and processing such information. Although banks have a comparative advantage due to economies of scale, information is often incomplete, generating informational asymmetries. In banking markets, these asymmetries stem from banks' limited ability to observe borrowers' characteristics and actions, making it difficult to distinguish safe from risky borrowers (Stiglitz and Weiss, 1981).

To lend to more opaque borrowers, banks must invest in gathering private information, typically through ongoing lending relationships. Beyond regulatory disclosures, banks gather information through repeated interactions (Boot, 2000). Part of this information is objective, easily codified, stored in reports, and transmitted within the bank's organizational and geographic structure. This type of information is called *hard information*. In contrast, banks also acquire information by observing borrowers' behavior, reliability, and responses to contingencies. This information is inherently subjective, difficult to verify, and costly to codify and transmit. Referred to as *soft information*, it plays a central role in relationship-based lending (Berger and Udell, 2002; Petersen, 2004).

In this paper, we examine the relationship between functional distance — measured as the geographic distance between bank headquarters and local markets — and local credit supply. In hierarchical banking organizations, lending decisions often depend on the transmission of locally generated information from branches to centralized headquarters, making distance a potential source of informational frictions (Alessandrini et al., 2009a). This question is particularly relevant in the context of banking consolidation, branch network downsizing, and the rise of digital banks. We use administrative data from the Central Bank of Brazil (BCB) to construct a bank-municipality panel covering the period from 2011 to 2022. Our empirical approach exploits within-bank and within-municipality variation over time. It incorporates high-dimensional fixed effects to account for unobserved heterogeneity related to local economic conditions and bank-specific factors.

Our results indicate a negative association between functional distance and local credit supply. An increase of 100 kilometers (km) in distance is associated with an approximately 4.1%

reduction of credit supplied in a given municipality. This association is more pronounced for loan portfolios, which are more likely to rely on soft information. In contrast, regulatory provisioning of bank branches — activities that depend less on local client information — does not exhibit statistically significant coefficients. The results are robust across alternative sample definitions, time windows, and different measures of both credit supply and distance.

To shed light on potential mechanisms, we examine a proxy for the accumulation and transmission of soft information: the age of the bank in the municipality. Bank age captures learning and information acquisition through repeated interactions with local borrowers. We find that greater local experience mitigates the negative association between functional distance and credit supply, with this attenuation particularly pronounced for private banks, which tend to rely more on private information in lending decisions.

This paper contributes to the literature on the geography of banking by documenting how functional distance shapes credit allocation. Prior research shows that greater separation between decision-making centers and local markets can reduce the use of soft information and, consequently, limit credit provision. Empirical evidence is mixed: while Di Patti and Gobbi (2001) find a positive correlation between branch distance and credit to small firms in Italian provinces, Avery and Samolyk (2004) find no effect of geographic distance on credit growth to opaque borrowers in the United States. Works focus on functional distance within hierarchical banking organizations, showing that greater distance increases the likelihood of credit rationing—especially for small firms—and reduces relationship lending and innovation financing (Alessandrini et al., 2009a,b). Our results add to this literature by providing new evidence for Brazil using administrative data and municipal-level credit outcomes.

Our findings also contribute to the literature on information production in banking and relationship lending. Seminal work emphasizes that lending to opaque borrowers relies on soft information, which is costly to collect and difficult to transmit within large and hierarchical organizations (Boot, 2000; Stein, 2002; Berger and Udell, 2002). As a result, spatial and organizational distance can hinder banks' ability to incorporate locally generated information into credit decisions (Petersen, 2004; Liberti and Petersen, 2019). Consistent with this framework, we find that the negative association between distance and credit is concentrated among loans that rely more on discretionary screening and relationship-based information.

Finally, this paper relates to the literature on local financial development and bank heterogeneity by highlighting the role of accumulated local experience as a mitigating factor. Prior work shows that local banking development fosters entrepreneurship, firm entry, and economic growth by easing financing constraints (Guiso et al., 2004; Benfratello et al., 2008; Levine, 2005). We add to this literature by documenting that bank age in a municipality, a proxy for learning and relationship building through repeated local interactions, is associated with a weaker negative relationship between functional distance and credit supply, particularly for private banks. This pattern is consistent with models in which organizational form and governance shape the

internal allocation of authority and information (Stein, 2002; Berger, 2011).

The remainder of the paper is organized as follows. Section 2 provides institutional background on the Brazilian banking system. Section 3 describes the data sources, the construction of the bank–municipality panel, and the main variables of interest. Section 4 outlines the empirical strategy and discusses identification challenges and limitations. Section 5 presents the main results, including heterogeneity analyses and robustness checks. Section 6 examines potential mechanisms, focusing on the role of bank age in the municipality as a mitigating factor. Finally, Section 7 concludes and discusses policy implications.

## 2 Background

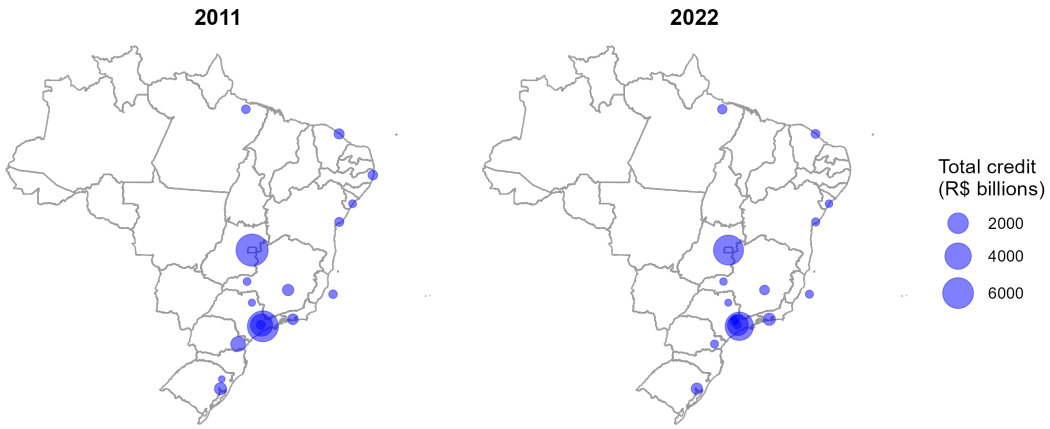
The Brazilian banking system is characterized by high concentration and a heterogeneous institutional structure. It is composed mainly of commercial banks and multiple banks, the latter being allowed to operate simultaneously in several segments, including commercial banking, investment banking, credit, financing, and leasing. A distinctive feature of the Brazilian system is the prominent role of public banks, including federally owned institutions such as Banco do Brasil and Caixa Econômica Federal, as well as state-owned commercial and development banks. Empirical evidence shows that public banks play a central role in credit provision, regional development, and the implementation of public policies, particularly in less developed and peripheral regions (Carvalho, 2014; Bonomo et al., 2018).

Another feature of the Brazilian banking system concerns the geographic concentration of bank headquarters. The vast majority of bank headquarters are located in a small number of large metropolitan areas—most notably São Paulo and Rio de Janeiro, in the Southeast region, and Brasília, in the Center-West region—as illustrated in Figure 1. This spatial concentration implies that strategic decisions, risk assessment, and credit approval processes may be centralized far from the local markets in which banks operate (Carvalho, 2014).

Over the past few decades, the Brazilian banking sector has undergone consolidation. The number of banks operating in the system declined due to mergers, acquisitions, and exits, while market concentration increased (Berger et al., 1999). At the same time, the geographic coverage of bank branch networks contracted, with a growing number of municipalities no longer hosting local branches. Between 2011 and 2021 in Brazil, the number of municipalities with at least one bank branch declined by approximately 12%, while the number of banks operating in the system fell by about 9% (Figure A1 in the Appendix).

Despite the decline in the number of municipalities served by bank branches, the average functional distance between bank headquarters and municipalities does not change substantially over the period from 2011 to 2022, as suggested by Figure 2. This pattern indicates that the observed reduction in local banking presence is not primarily driven by a systematic spatial reallocation of bank branches toward more distant markets. Instead, it is consistent with a

Figure 1: Bank headquarters and total credit




Source: Author's calculations prepared from the Central Bank of Brazil data.
Notes: This figure illustrates the geographic distribution of commercial and multiple bank headquarters and the corresponding volume of credit supplied. Credit values are expressed in 2011 Brazilian reais and deflated using the IPCA price index.

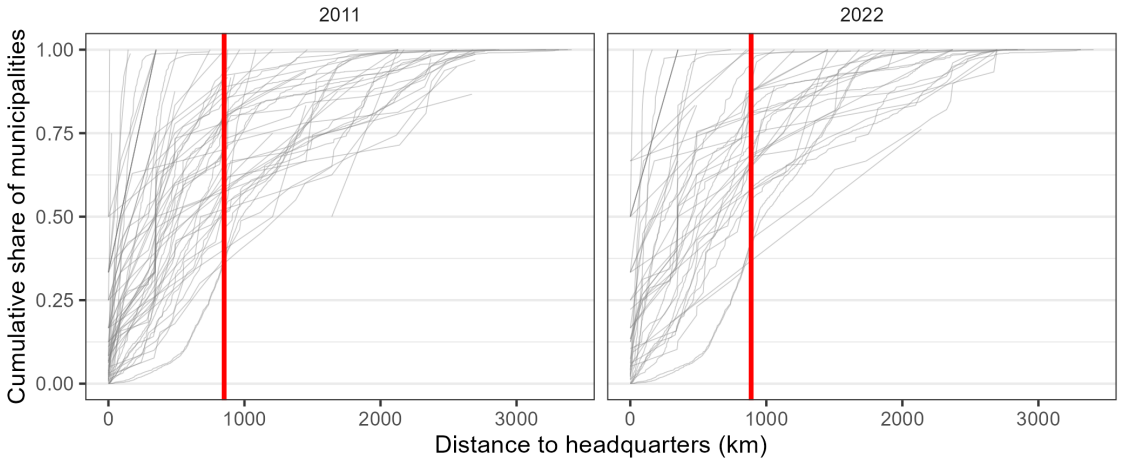
consolidation process that reduces branch coverage while preserving the existing geographic configuration of decision-making centers.

More recently, the Brazilian financial system has experienced a rapid expansion of digital and virtual banks. These institutions typically operate with limited or no physical branch networks and rely predominantly on digital platforms to provide financial services (Frost et al., 2019). This business model has contributed to broader access to basic financial products and has increased competition in specific market segments. At the same time, digital banks are characterized by a more centralized organizational structure and a reduced reliance on local presence, which may limit the role of locally generated information in credit allocation decisions (Claessens et al., 2018).

## 3 Data

In this paper, we investigate the relationship between the geographic distance separating bank headquarters and the municipalities they serve and local credit supply. To this end, we build a municipality-bank panel that combines several administrative data sources from the BCB, covering the period from 2011 to 2022. The empirical analysis is restricted to municipalities with fewer than 300,000 inhabitants in 2011 (base year). These municipalities account for 20% of the total credit supplied in 2011. This restriction allows us to focus on local credit markets where soft information and relational banking are more likely to be relevant, and where geographic distance between bank headquarters and branches may be more strongly associated with credit allocation patterns. In addition, we exclude banks operating in a given municipality for fewer

Figure 2: Bank headquarters and average distance to served municipalities




Source: Author's calculations prepared from the Central Bank of Brazil data.

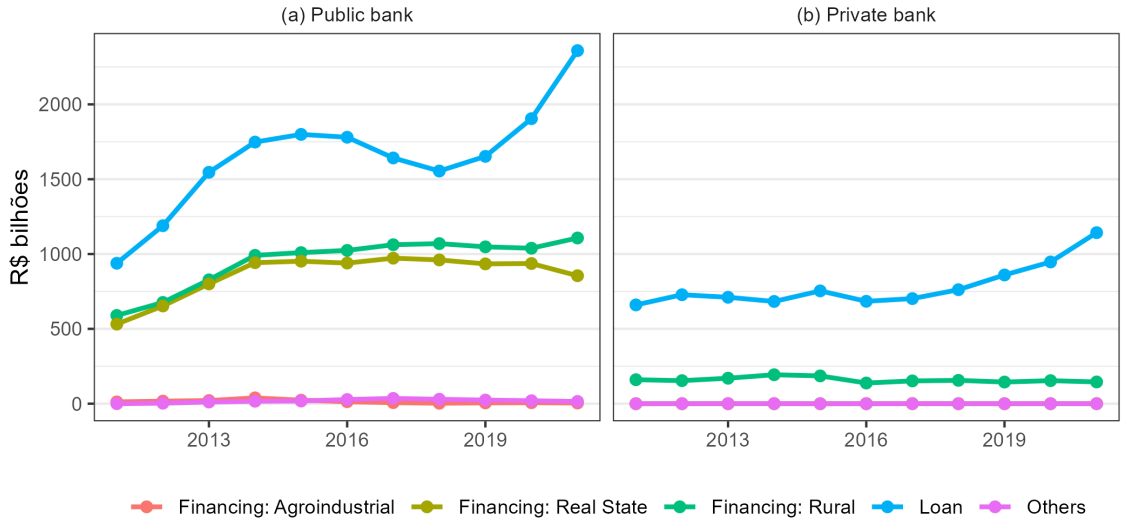
than 12 months to ensure comparability over time. The final sample consists of 33 banks operating in approximately 3,500 municipalities.

We use three datasets from the BCB. The first is the *Estatística Bancária Mensal por Município* (ESTBAN), which reports monthly balance sheet information for bank branches at the municipality level based on the *Plano Contábil das Instituições do Sistema Financeiro Nacional* (Cosif). The second dataset, *Banking Institutions under BCB Supervision*, contains information on bank headquarters, including bank identifiers, institutional segment (commercial or multiple), and geographic location by month. The third dataset provides information on bank branches operating in Brazil under BCB supervision, which reports the opening date of each branch since 2011.

Total credit is the main variable in this study. It is defined as the sum of loans, financing (rural, agroindustrial, and real estate), and other credit operations. Figure 3 presents the evolution of the composition of total credit by type of bank. Loans constitute the largest component of credit for both public and private banks throughout the period. Among financing categories, real estate and rural credit are particularly relevant for public banks, each representing a large and relatively stable share of total credit, though real estate financing shows a slight decline toward the end of the period. For private banks, loans also represent the dominant credit category, but at lower levels compared to public banks. Rural financing is the most important financing category among private banks, while real estate and agroindustrial financing represent comparatively small shares.

We merge the datasets using the bank identifier based on the *Cadastro Nacional da Pessoa Jurídica* (CNPJ) and municipal codes from the Instituto Brasileiro de Geografia e Estatística (IBGE). To mitigate short-term seasonal fluctuations and measurement noise in the monthly

Figure 3: Types of credit in municipalities with populations over 300,000




Source: Author's calculations prepared from the Central Bank of Brazil data.

balance sheet data, we aggregate all variables to the annual level. We then construct an unbalanced municipality–bank panel. We include in this panel data municipality-level demographic and socioeconomic characteristics, including population size and gross domestic product (GDP), both from IBGE.

Based on the merged dataset, we construct several additional variables. First, we compute the geographic distance between each municipality and its corresponding bank headquarters using geographic coordinates, which we call the Functional Distance, following Alessandrini et al. (2009a). Table 1 compares municipalities located closer to and farther from bank headquarters, based on the first and fourth quartiles of the functional distance distribution. Municipalities in the lowest distance group (up to 424 km) exhibit substantially higher levels of total credit on average than those in the highest distance group (at least 1,289 km). In addition, municipalities closer to headquarters are markedly larger in terms of both the economy and demographics. They display higher average GDP and population levels relative to more distant municipalities.

Second, we construct a Herfindahl–Hirschman Index (HHI) to measure local banking market concentration, calculated from the distribution of bank branches across institutions within each municipality. Using the CNPJ identifier, we classify banks as public or private. We also define large banks as those that jointly account for up to 75% of total credit supplied in Brazil in 2011. Finally, using the bank branch opening date, we compute the age of each bank in a given municipality.

Table 2 presents summary statistics for the main variables used in the study. Total credit exhibits substantial dispersion across municipality-bank pairs. The average distance between

Table 1: Summary statistics by functional distance group

| | $\leq$ 424 km | | $\geq$ 1,289 km | |
|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev |
| Total Credit (billion R$) | 5,323.88 | 70,970.90 | 1,030.81 | 4,44.39 |
| Functional distance (km) | 217.58 | 129.64 | 1,758.45 | 385.66 |
| Municipal GDP (thousand R$) | 1,9312.39 | 76,575.36 | 3,077.62 | 18,219.53 |
| Population (thousand) | 575.3502 | 2,133.40 | 165.91 | 596.75 |

Notes: This table reports summary statistics for municipalities in the first quartile (Q1) and fourth quartile (Q4) of the distribution of functional distance. Q1 includes municipalities within 424 km of their corresponding bank headquarters, while Q4 includes those at least 1,289 km away. All values refer to 2011.

a municipality and its corresponding bank headquarters is 895 km, with a median of 787 km, suggesting that many lending relationships span considerable geographic distances.

Table 2: Summary statistics of key variables

| | Mean | Std.Dev | Min | Median | Max | Obs. |
|---|---|---|---|---|---|---|
| Total Credit (billion R$) | 525.52 | 1,361.99 | 0.00 | 187.97 | 76,880.02 | 98,387 |
| Loan | 271.86 | 917.50 | 0.00 | 124.50 | 97,463.05 | 98,387 |
| Financing: Rural | 123.96 | 409.43 | 0.00 | 5.94 | 17,831.79 | 98,387 |
| Financing: Agroindustrial | 1.56 | 21.23 | 0.00 | 0.00 | 2,388.28 | 98,387 |
| Financing: Real State | 96.33 | 413.59 | 0.00 | 0.00 | 15,052.21 | 98,387 |
| Functional distance (km) | 895.22 | 593.91 | 0.00 | 786.61 | 3,404.92 | 98,387 |
| Local bank age | 27.50 | 20.39 | 0.00 | 26.00 | 132.00 | 98,387 |
| Bank branches | 1.23 | 0.83 | 1.00 | 1.00 | 21.00 | 98,387 |
| Hirfindahl-Hirschman Index (HHI) | 0.37 | 0.25 | 0.11 | 0.25 | 1.00 | 98,387 |
| Municipal GDP (thousand R$) | 1,088.96 | 2,135.39 | 16.23 | 410.61 | 40,058.74 | 98,387 |
| Population (thousand) | 53.95 | 59.81 | 0.81 | 31.60 | 436.59 | 98,387 |

Notes: This table reports summary statistics for the main variables used in the analysis. All values refer to the period from 2011 to 2022. *Distance* measures the geographic distance between a bank's headquarters and the municipality served by that bank. The Herfindahl–Hirschman Index (HHI) is computed based on the distribution of bank branches across banks within each municipality. Monetary variables are expressed in constant 2011 prices and deflated using the IPCA consumer price index from the Brazilian Institute of Geography and Statistics (IBGE).

# 4 Empirical Strategy

This section presents the empirical strategy to examine the relationship between distance and local credit supply. We exploit variation in the geographic distance between bank headquarters and the municipalities in which banks operate to assess how spatial frictions shape local lending outcomes.

Our approach relies on a panel at the bank–municipality level. It focuses on within-municipality and within-bank variation over time, while flexibly controlling for unobserved heterogeneity at both the bank and municipal levels. By incorporating high-dimensional fixed effects, we aim to isolate the association between functional distance and credit supply from confounding factors related to local economic conditions, bank-specific shocks, and time-varying institutional characteristics. Our baseline specification is given by:

$$\ln C_{bit} = \beta \, \text{Dist}_{bit} + \mu_{bt} + \mu_{it} + \varepsilon_{bit}, \tag{1}$$

where $\ln C_{bit}$ denotes the natural logarithm of credit supplied by bank $b$ in municipality $i$ at year $t$, $\text{Dist}_{bi}$ is the distance between the municipality $i$ and the bank headquarters $b$ at year $t$ (functional distance), $\mu_{bt}$ are bank-by-year fixed effects, and $\mu_{it}$ are municipality-by-year fixed effects.

Equation (1) is estimated by ordinary least squares (OLS). Standard errors are computed using a two-way bootstrap procedure at the bank and municipality levels. This approach accounts for potential correlation in the error term across observations associated with the same bank or municipality over time.

In this study, we use the intermediation approach of the banking literature. This approach is grounded in the traditional role of banks as financial intermediaries that transform assets. From this perspective, banking activity is measured by the volume of credit supplied, with financial capital—such as deposits collected by bank branches and funds raised in capital markets—serving as the main input (Freixas and Rochet, 2008). Because our objective is to assess banks' aggregate lending behavior across municipalities, the volume of credit supplied constitutes the most appropriate measure of local banking activity in this study.

Following Alessandrini et al. (2009a), functional distance is interpreted as a proxy for the amount of local information available at bank headquarters. When lending decisions are centralized at headquarters, a greater distance from local markets introduces frictions in the transmission of soft information. As a result, bank headquarters are expected to possess less detailed and timely information about local borrowers than branch-level units.

Moreover, as shown by Stein (2002), when banks do not delegate decision-making authority to local agents, incentives to produce soft information are weaker, further reducing the stock of information available at headquarters. In this context, functional distance captures not only geographic separation but also organizational frictions within the bank.

### 4.1 Identification

Identification in our empirical framework stems from cross-sectional variation in the functional distance between bank headquarters and the municipalities in which banks operate, combined with rich fixed-effects structures that absorb a wide range of confounding factors. By including bank-by-year and municipality-by-year fixed effects, we exploit within-bank and

within-municipality variation over time, isolating differences in credit supply across banks that operate in the same municipality and across municipalities served by the same bank in a given year. As a result, the estimated coefficient on functional distance reflects differences in lending behavior that are orthogonal to time-varying bank-level shocks and local economic conditions.

It is important to emphasize that our empirical strategy is non-experimental. We do not rely on a clearly exogenous shock to functional distance, nor do we exploit a policy reform or institutional change that would generate plausibly random variation in the location of bank headquarters. Instead, our approach leverages observational data and controls extensively for observable and unobservable heterogeneity through high-dimensional fixed effects. Consequently, the estimates should be interpreted as conditional correlation rather than causal effects derived from experimental or quasi-experimental design. It can be argued that, depending on the assumptions, non-experimental methods can replicate experimental results, as demonstrated by Imbens and Xu (2025).

Accordingly, our estimates are subject to the limitations inherent in observational studies. In particular, unobserved factors correlated with both functional distance and lending behavior—such as long-run strategic positioning of banks, historical market segmentation, or persistent differences in management practices—may still bias the estimated coefficients. We therefore interpret the results as capturing the average relationship between functional distance and local credit supply among banks that choose to operate in a given municipality, rather than the causal effect of an exogenous change in distance. However, to validate our results, we assess their robustness by estimating alternative model specifications, varying sample definitions, and conducting placebo tests.

# 5 Results

## 5.1 Functional distance and local credit

Table 3 reports the main results. The dependent variable is the logarithm of total credit supplied by a given bank in a municipality. Functional distance is measured in units of 100 km. Column (1) presents a baseline specification without controls or fixed effects. Column (2) introduces year, bank, and municipality fixed effects. Column (3) further augments the specification by including additional control variables: municipal GDP (in logs) and population (in logs). Finally, Column (4) reports our preferred and most restrictive specification, as described in Equation 1, which includes bank-by-year and municipality-by-year fixed effects.

The functional distance is negatively associated with the total credit supply in all specifications. The coefficient becomes statistically significant once fixed effects are included, suggesting that unobserved bank- and municipality-level heterogeneity is an important source of confounding in less restrictive specifications. The inclusion of additional controls and more restrictive fixed effects does not significantly alter the estimated coefficient.

Table 3: Functional distance and local credit

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.028 | -0.042*** | -0.043*** | -0.041*** |
| | (0.042) | (0.011) | (0.011) | (0.011) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.008 | 0.841 | 0.842 | 0.876 |
| R2 Within | | 0.024 | 0.029 | 0.027 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank × Year | | | | X |
| FE: Municipality × Year | | | | X |

Notes: Control variables include municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Our preferred specification, reported in Column (4), indicates that an increase of 100 km in functional distance is associated with a reduction in local credit supply by approximately 4.1%. This result implies that the bank headquarters are not spatially neutral. Municipalities farther from the banks' main decision-making centers receive less credit. As discussed earlier, when lending decisions are centralized and rely on soft information, headquarters are likely to be less informed about distant local markets, which constrains credit provision.

Table 4 reports the association between functional distance and different components of local credit supply. Column (1) presents the results for total credit, while Column (2) reports loans. Columns (3) to (5) further decompose financing activities into rural credit, agroindustrial credit, and real estate credit, respectively. Column (6) reports the estimates for loan loss provisions.

The negative association between functional distance and credit is evident for total credit and loans. In particular, Column (2) shows that a one-unit increase in functional distance is associated with a 4.9% reduction in loans. The effect is also statistically significant and substantially larger in magnitude for rural credit (Column 3), suggesting that this segment is especially sensitive to distance. By contrast, the coefficients for agroindustrial credit are not statistically significant, while those for real estate credit are positive and statistically significant.

These results indicate that the relationship between functional distance and credit supply varies across credit segments. The stronger negative association observed for loans and rural credit is consistent with the view that these activities rely more intensively on borrower-specific and locally generated information. In contrast, agroindustrial and real estate credit may depend more heavily on standardized contracts, collateral valuation, or sector-specific programs, which

Table 4: Functional distance and other balance-sheet components

| | | | Financing | | | |
|---|---|---|---|---|---|---|
| | Total | Loan | Rural | Agroindustrial | Real Estate | Provision |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance | -0.041*** | -0.049*** | -0.318*** | 0.067 | 0.066** | -0.005 |
| | (0.011) | (0.007) | (0.030) | (0.043) | (0.024) | (0.009) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.875 | 0.867 | 0.770 | 0.773 | 0.977 | 0.996 |
| R2 Within | 0.027 | 0.045 | 0.042 | 0.005 | 0.017 | 0.001 |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

can be assessed using more formalized procedures and are therefore less affected by spatial separation between branches and headquarters.

It is also worth noting that provisions—defined (Column 6) as accounting reserves set aside to cover expected credit losses— present a small parameter and do not exhibit statistically significant coefficients, as expected. Since provisions are largely driven by regulatory requirements and portfolio-level risk assessments rather than local screening decisions, they should be relatively insensitive to functional distance. These null results, therefore, serve as a placebo test, reinforcing the interpretation that the negative relationship between functional distance and credit supply reflects informational frictions, rather than other confounding factors affecting local banking activity.

### 5.2 Heterogeneous effects

Our dataset allows us to explore heterogeneity in the effects of functional distance. Table 5 reports the results of this analysis. Column (1) presents the benchmark specification. Column (2) introduces an interaction between functional distance and an indicator for large banks, defined as those that account for more than 75% of total credit supply in the baseline year (2011). The coefficient on distance remains negative and statistically significant, whereas the interaction term is not. This result suggests that the negative effect of functional distance on local credit supply does not differ systematically between large and small banks, indicating that scale alone does not mitigate the informational frictions associated with distance.

The specification associated with Column (3) includes an interaction between functional distance and an indicator for multiple banks. The interaction term is negative and statistically significant, indicating that the adverse effect of distance on credit supply is stronger for multiple banks than for commercial banks, by approximately 2%. This result is consistent with the view that multiple banks tend to exhibit more complex organizational structures and more

Table 5: Heterogeneous effects of functional distance by bank characteristics

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.041*** | -0.045** | -0.020* | -0.008 |
| | (0.011) | (0.018) | (0.010) | (0.017) |
| Distance × Large bank | | 0.005 | | |
| | | (0.019) | | |
| Distance × Multiple bank | | | -0.022** | |
| | | | (0.011) | |
| Distance × Private bank | | | | -0.040*** |
| | | | | (0.009) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.876 | 0.876 | 0.876 | 0.878 |
| R2 Within | 0.027 | 0.027 | 0.027 | 0.041 |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

centralized decision-making processes, which may amplify informational frictions and hinder the transmission of soft information from local branches to headquarters.

Column (4) explores heterogeneity by ownership by interacting functional distance with an indicator for private banks. The interaction coefficient is negative, large in magnitude, and highly statistically significant, indicating a reduction of approximately 4% in credit supply relative to public banks. At the same time, the main effect of distance becomes small and is not statistically significant. This pattern suggests that private banks almost entirely drive the negative relationship between functional distance and credit supply, whereas public banks exhibit substantially lower sensitivity to distance.

A plausible explanation is that public banks operate under distinct institutional objectives and governance structures that mitigate the relevance of informational frictions. Unlike private banks, public banks typically pursue policy-oriented goals, such as promoting regional development, financial inclusion, or counter-cyclical lending, which reduces their reliance on soft information and discretionary screening at the branch level (Micco et al., 2007). Moreover, public banks often rely more heavily on standardized credit programs, centralized allocation rules, and government guarantees, which further weaken the link between local information and lending decisions (Sapienza, 2004). As a result, credit supply by public banks tends to be less sensitive to functional distance between branches and headquarters.

Table 6 explores whether the association between functional distance and local credit supply varies with characteristics of the local banking market. Column (1) reports the baseline specification. Column (2) interacts functional distance with the number of branches operating in the municipality, a proxy for local banking presence and network density. In this specification,

the interaction term is small and is not statistically significant, indicating that a denser branch network does not meaningfully attenuate the negative association between distance and credit supply. This result suggests that physical presence alone is insufficient to offset informational frictions.

Table 6: Heterogeneous effects of functional distance by local market characteristic

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.041*** | -0.040*** | -0.037 | -0.025** |
| | (0.011) | (0.006) | (0.026) | (0.012) |
| Distance × Branches | | -0.000 | | |
| | | (0.001) | | |
| Distance × HHI | | | -0.015 | |
| | | | (0.064) | |
| Distance × Private Bank Rate | | | | -0.036 |
| | | | | (0.045) |
| Num.Obs. | 98387 | 98387 | 98387 | 98387 |
| R2 | 0.875 | 0.875 | 0.875 | 0.875 |
| R2 Within | 0.027 | 0.027 | 0.027 | 0.028 |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

In Column (3), we allow the effect of distance to vary with local market concentration, measured by the HHI. The interaction coefficient is negative but imprecisely estimated and statistically insignificant. This finding indicates that the sensitivity of credit supply to functional distance does not differ systematically across more or less concentrated local banking markets, suggesting that market structure per se does not play a first-order role in shaping the distance–credit relationship.

Finally, Column (4) introduces an interaction between functional distance and the share of private banks in local credit supply. While the interaction term is negative, it is not statistically significant. The main effect of distance remains negative and significant, indicating that variation in local bank ownership composition does not substantially alter the association between distance and credit. Taken together, the results in Table 6 suggest that the negative correlation between functional distance and local credit supply is remarkably stable across different local market environments, reinforcing the interpretation that functional distance captures a pervasive informational channel rather than context-specific market conditions.

### 5.3 Robustness Checks

This section presents a set of robustness checks to assess the stability of our main findings. We consider alternative samples, different subperiods, non-linear specifications of the distance

measure, and alternative measures of credit supply. Overall, the results consistently support our main conclusion that functional distance is negatively associated with local credit provision. All robustness results are reported in the Appendix.

**Sample selection.** To assess whether our results are sensitive to sample selection, we re-estimate our baseline model using the full sample of bank–municipality observations, that is, including all municipalities with at least one bank branch, regardless of population size. The coefficient on functional distance remains negative and statistically significant across specifications. However, the magnitude of the estimated effect increases relative to our benchmark sample. Considering this sample, an increase of 100 km in functional distance is associated with a reduction of approximately 7.9% in total credit. Second, we examine whether extreme values in the credit distribution drive our findings by excluding the top 5% of credit observations. The results remain qualitatively unchanged: the estimated coefficient on functional distance remains negative and statistically significant, and its magnitude is very similar to that in the baseline specification.

**Subperiods.** Our results may vary across periods marked by major shocks to the Brazilian banking sector. We examine whether the effect of functional distance changes after 2016 — when banking consolidation and digitalization intensified — and after 2020, which coincides with the COVID-19 shock and the rapid expansion of digital financial services. We do so by interacting functional distance with indicators for years greater than or equal to each reference year. In our most restrictive specification, the interaction terms are small and statistically not significant, indicating that the negative association between functional distance and local credit supply remains stable over time and is not meaningfully altered by these structural and macroeconomic shocks.

**Distance non linearity.** We further assess whether the association between functional distance and local credit supply exhibits non-linear patterns by augmenting our baseline specification with a quadratic term in distance. We find a quadratic term small and not statistically different from zero across all specifications. The linear distance coefficient also turns negative and remains stable. These results indicate that there is no robust evidence of non-linearities in the relationship between functional distance and credit supply. Instead, the association appears approximately linear over the relevant range of distances.

**Alternative measure of credit supply.** To ensure that our results are not driven by differences in bank size or balance-sheet scale, we re-estimate our main specifications using credit normalized by bank assets as an alternative measure of local credit supply. Across specifications with increasingly stringent fixed effects, the coefficient on functional distance is consistently negative and statistically significant once unobserved bank, municipality, and time heterogeneity

are accounted for. In our most restrictive specification, a 100 km increase in functional distance is associated with a reduction of approximately 2.1% in local credit. The similarity in sign relative to our baseline results suggests that the negative association between functional distance and credit supply is not driven by the specific definition of the credit variable, reinforcing the stability of our main findings.

# 6 Potential mechanism

In this section, we explore potential mechanisms linking functional distance to local credit supply, with particular emphasis on the length of time a bank has operated in a given municipality. Importantly, this analysis does not aim to identify a causal effect of functional distance. Instead, it provides suggestive evidence on whether the patterns documented in the baseline results are consistent with informational channels emphasized in the literature.

The duration of a bank in a municipality may be related to its ability to acquire, process, and transmit soft information. Bank age reflects the accumulation of local knowledge through repeated interactions with borrowers over time, capturing learning processes and relationship building at the local level. A longer local presence may therefore mitigate informational frictions associated with the spatial separation between branches and headquarters.

To empirically assess these potential mechanisms, we extend our baseline specification by allowing the effect of functional distance on local credit supply to vary with proxies for banks' informational capacity. Specifically, we interact functional distance with a measure of bank age at the municipal level. This approach allows us to examine whether learning through repeated local interactions moderates the association between distance and credit provision.

Accordingly, we estimate the following specification:

$$\ln C_{bit} = \beta_1 \text{Dist}_{bi} + \beta_2 Z_{bit} + \beta_3 \text{Dist}_{bi} \times Z_{bit} + \mu_{bt} + \mu_{it} + \varepsilon_{bit}, \tag{2}$$

where $Z_{bit}$ denotes either the age of bank $b$ in municipality $i$ or the number of branches operated by the bank in that municipality. The coefficient $\beta_3$ captures whether the association between functional distance and local credit supply varies systematically with banks' capacity to accumulate soft information. We expect $\beta_3 > 0$. If functional distance negatively affects local credit supply ($\beta_1 < 0$), greater local presence should attenuate this effect.

Table 3 reports the results. Columns (1) to (3) are estimated using our baseline sample. Column (1) presents the baseline specification. Column (2) augments the model by including bank age at the municipal level (measured in decades). Column (3) further extends the specification by interacting functional distance with bank age, allowing the association between distance and credit supply to vary with the length of the bank's local presence. Columns (4) to (6) re-estimate the specification in Column (3) separately for multiple banks, public banks, and private banks, respectively. Estimating these subsamples is important to assess whether the

proposed informational mechanism operates differently across institutional types.

Table 7: Local credit, functional distance and bank age,

| | Total | | | Multiple | Public | Private |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance (100 km) | -0.041*** | -0.031*** | -0.038*** | -0.040*** | -0.017 | -0.139*** |
| | (0.011) | (0.007) | (0.008) | (0.008) | (0.023) | (0.028) |
| Age (10 years) | | 0.194*** | 0.171*** | 0.174*** | 0.268*** | 0.126*** |
| | | (0.020) | (0.022) | (0.022) | (0.025) | (0.030) |
| Distance × Age | | | 0.003 | 0.003 | -0.006** | 0.008*** |
| | | | (0.002) | (0.002) | (0.002) | (0.002) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 97,304 | 53,183 | 44,121 |
| R2 | 0.876 | 0.892 | 0.892 | 0.894 | 0.869 | 0.924 |
| R2 Within | 0.027 | 0.147 | 0.149 | 0.153 | 0.155 | 0.125 |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

The results indicate that bank age is positively associated with credit provision. A 10-year increase in a bank's local presence is associated with a 17.1% expansion in credit in our preferred specification, with estimates ranging from 12.6% to 26.8% across bank types, with public banks exhibiting the largest effects.

The interaction between functional distance and bank age reveals important heterogeneity. The interaction effect is generally small or statistically insignificant across most specifications, except for private banks. In contrast, private banks (Column 6) display the strongest sensitivity to distance: a 100 km increase in functional distance is associated with a 13.9% reduction in credit, more than three times the baseline effect. Bank age significantly increases credit for private banks (12.6% per decade), and the interaction term is positive and statistically significant, indicating that each additional decade of local presence reduces the distance penalty by approximately 0.8 percentage points.

This pattern is consistent with relationship lending models in which private banks rely more heavily on soft information, making accumulated local experience an effective mechanism for mitigating informational frictions, as suggested by Berger and Udell (1995); Petersen (2004).

Overall, these results suggest that bank age operates as a mitigating mechanism primarily for private banks. Local experience partially offsets the negative association between functional distance and credit supply, reinforcing the interpretation that informational frictions—rather than purely geographic factors—underlie the main findings.

# 7 Conclusion

This paper examines the relationship between the functional distance between bank headquarters and local credit supply in Brazil, using a municipality-bank-year panel covering the period from 2011 to 2022. The results indicate a negative association between functional distance and credit provision at the local level. This pattern is primarily driven by loans, which are more sensitive to informational frictions, whereas financing and provisions do not display a statistically significant relationship with distance. These results are consistent with the interpretation that functional distance captures the informational constraints banks face when operating far from their headquarters. While the empirical strategy does not allow for a fully causal interpretation, the consistency of the estimates across placebo tests and robustness checks supports the relevance of this channel.

To shed light on potential mechanisms, we interact functional distance with bank age at the municipal level. Longer local presence is positively associated with credit supply and attenuates the negative association between distance and lending, particularly among private banks. This pattern is consistent with relationship-lending frameworks in which accumulated soft information mitigates informational frictions. Taken together, the evidence suggests that informational channels play a central role in shaping the observed relationship between functional distance and credit provision.

From a policy perspective, the results suggest that the spatial organization of the banking sector matters for local credit outcomes. The concentration of bank headquarters and the consolidation of branch networks may contribute to uneven access to credit across regions, particularly in smaller and more remote municipalities. Policies aimed at strengthening local banking presence or improving the flow of local information within banks may help reduce these disparities. While digital banking can broaden access to basic financial services, it is unlikely to fully replace local intermediation in credit markets where lending decisions depend on soft information. Understanding the role of functional distance is therefore relevant for discussions on financial inclusion and regional development in Brazil.

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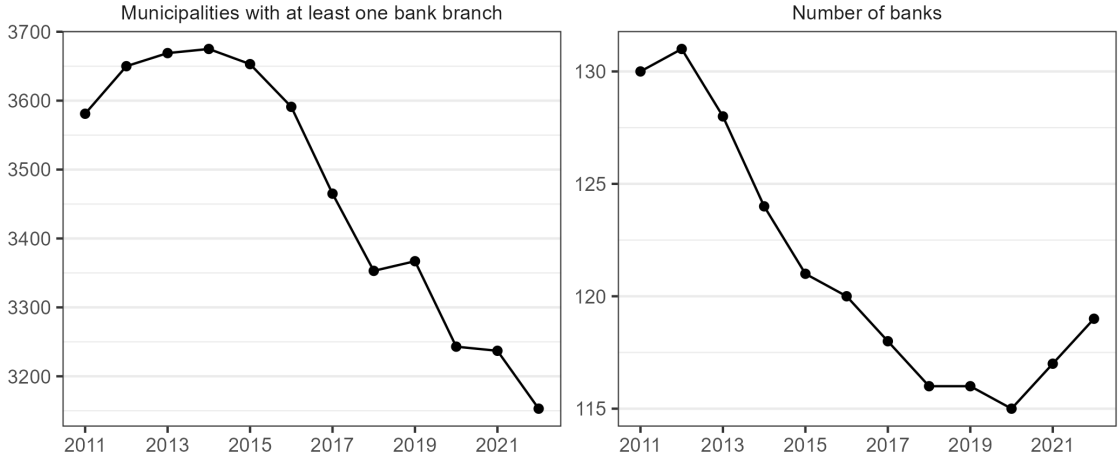
# Appendix. Supplementary figures and tables

Figure A1: Number of commercial and multiple banks, and municipalities with bank branches




Source: Author's calculations prepared from the Central Bank of Brazil data.

Table A1: Robustness check: full sample of bank–municipality observations

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.044 | -0.081*** | -0.082*** | -0.079*** |
| | (0.039) | (0.022) | (0.022) | (0.022) |
| Num.Obs. | 113,567 | 113,567 | 113,565 | 11,3565 |
| R2 | 0.008 | 0.724 | 0.725 | 0.801 |
| R2 Within | | 0.022 | 0.026 | 0.028 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank × Year | | | | X |
| FE: Municipality × Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table A2: Robustness check: excluding top 5% of credit observations

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.029 | -0.044*** | -0.044*** | -0.042*** |
| | (0.046) | (0.008) | (0.008) | (0.008) |
| Num.Obs. | 73314 | 73314 | 73314 | 73314 |
| R2 | 0.011 | 0.813 | 0.814 | 0.856 |
| R2 Within | | 0.024 | 0.031 | 0.028 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank × Year | | | | X |
| FE: Municipality × Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table A3: Robustness check: post-2016

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.030 | -0.046*** | -0.047*** | -0.038*** |
| | (0.040) | (0.011) | (0.011) | (0.010) |
| I[Year $\geq$ 2016] | -0.211* | | | |
| | (0.111) | | | |
| Distance $\times$ I[Year $\geq$ 2016] | 0.002 | 0.007* | 0.007** | -0.005 |
| | (0.006) | (0.004) | (0.004) | (0.004) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.011 | 0.839 | 0.840 | 0.875 |
| R2 Within | | 0.025 | 0.031 | 0.027 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank $\times$ Year | | | | X |
| FE: Municipality $\times$ Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table A4: Robustness check: post-2020

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.029 | -0.043*** | -0.044*** | -0.041*** |
| | (0.042) | (0.011) | (0.011) | (0.010) |
| I[Year $\geq$ 2020] | -0.027 | | | |
| | (0.089) | | | |
| Distance $\times$ I[Year $\geq$ 2020] | 0.000 | 0.005** | 0.005*** | 0.002 |
| | (0.004) | (0.002) | (0.002) | (0.004) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.008 | 0.839 | 0.840 | 0.875 |
| R2 Within | | 0.024 | 0.030 | 0.027 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank $\times$ Year | | | | X |
| FE: Municipality $\times$ Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table A5: Robustness check: nonlinear effects of distance

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | 0.251*** | -0.043 | -0.043 | -0.042 |
| | (0.071) | (0.040) | (0.040) | (0.040) |
| Distance$^2$ | -0.012*** | 0.000 | 0.000 | 0.000 |
| | (0.003) | (0.002) | (0.002) | (0.002) |
| Num.Obs. | 98,387 | 98,387 | 98,387 | 98,387 |
| R2 | 0.097 | 0.839 | 0.839 | 0.875 |
| R2 Within | | 0.024 | 0.025 | 0.027 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank × Year | | | | X |
| FE: Municipality × Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table A6: Robustness check: total credit per total assets

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Distance | -0.004 | -0.024* | -0.024* | -0.021* |
| | (0.030) | (0.013) | (0.013) | (0.012) |
| Num.Obs. | 98387 | 98387 | 98387 | 98387 |
| R2 | 0.000 | 0.767 | 0.767 | 0.833 |
| R2 Within | | 0.013 | 0.013 | 0.013 |
| Controls | | | X | |
| FE: Year | | X | X | |
| FE: Bank | | X | X | |
| FE: Municipality | | X | X | |
| FE: Bank × Year | | | | X |
| FE: Municipality × Year | | | | X |

Notes: All specifications include bank-by-year and municipality-by-year fixed effects. Covariates include the municipal GDP (log) and population (log). Standard errors are clustered at the bank and municipality levels. Significance levels are denoted by *** at the 1% level, ** at the 5% level, and * at the 10% level.