Investment costs across space: The role of banks' branch network*

Olivia Bordeu† **Gustavo González**‡ **Marcos Sorá**§

November 1, 2024

Preliminary. Please do not cite or circulate.
Click here for the latest version.

Abstract

Using a rich loan-level dataset from Chile, we document substantial geographic disparities in interest rates and provide evidence of two underlying drivers: banks' local market power and cost differences across banks. We embed oligopolistic banks into a quantitative spatial model to study policies aimed at reducing regional interest rate disparities. In a preliminary quantification, we find that an increase in wholesale funding available to banks financed through social security taxes can increase welfare by 7%. The policy works by equalizing the cost of capital across banks and reducing the misallocation of investment across cities.

Key words: banks, local credit markets, capital misallocation.

JEL codes: G21, O16, R12.

*We are grateful to Rodrigo Adão, Milena Almagro, Fernando Cirelli, Jonathan Dingel, Santiago Franco, Esteban Rossi-Hansberg and audiences at the Banco Central de Chile, Católica Lisbon, University of Chicago and the UEA European meetings for helpful comments and suggestions. Esteban Aguilera and Sebastián Andalaft provided superb research assistance. The views and conclusions presented in the paper are exclusively those of the authors and do not necessarily reflect the position of the Central Bank of Chile or of the Board members.

†Princeton, email: ogazmuri@princeton.edu

‡Banco Central de Chile, email: ggonzalezl@bcentral.cl

§Católica Lisbon School of Business & Economics, email: msora@ucp.pt

1 Introduction

Studies in spatial economics often begin when confronting geographic variation in a variable of interest that cannot be assigned to other factors. Disparities in wages, goods prices and rents, notably, have motivated an extensive body of research and policy proposals. In this paper we shift the focus to one of the most important prices for the development of a local economy, the cost of investment. Do interest rates on firm loans differ by city? What drives these differences? Should policy aim at equalizing interest rates across space and, if so, how?

We start with the empirical analysis. Leveraging a rich collection of datasets from Chile where we can control for detailed borrower, loan, and bank characteristics, we document that interest rates vary significantly across cities. Interest rates in cities at the 10th percentile of the distribution are 300 to 600 basis points lower than in cities at the 90th percentile. We explore the factors behind these disparities and find that local bank competition plays a key role—cities with more competition have lower interest rates. The identity of the banks also matters as banks with better access to deposits tend to offer lower rates. To study quantitatively the effects of financial policies aimed at reducing geographic dispersion in the cost of capital, we embed oligopolistic banks into a quantitative spatial model with investment, trade, and migration. We use the estimated model to evaluate the impact of increasing the social security tax from 10% to 15% and allocating these funds to a wholesale market that all banks can borrow from. Preliminary results show that this policy increases workers' aggregate welfare by 7% and has heterogeneous local effects. The policy works by equalizing the cost of funds across banks.

Our evidence on geographic dispersion in interest rates is novel. Most empirical studies on the spatial distribution of banks and their interactions within cities rely on aggregated data on deposits and loans at the city-bank level. This data typically only reports the average interest rate across all outstanding loans or deposits, leading previous studies to abstract from detailed interest rate analysis (Aguirregabiria et al., 2020; Bustos et al., 2020; Oberfield et al., 2024). We overcome this limitation by leveraging detailed loan-level data from Chile, which provides a comprehensive set of borrower and loan characteristics.

Our first finding is that differences in interest rates across cities are substantial. A naive comparison of average interest rates shows that cities in the 10th and 90th percentiles of the distribution differ by approximately 600 basis points. However, this raw difference overlooks variation in loan composition, bank identity, and firm characteristics across cities. To address these issues, we regress loan-specific interest rates on a set of controls, such as bank fixed effects, loan characteristics, and firm characteristics, including the firms' industry and proxies for risk (see Section 3 for details). After accounting for these observable factors, the gap between cities in the 10th and 90th percentiles narrows to around 300 basis points. Even in our more stringent specification, which includes firm fixed effects, geographic differences in interest rates remain substantial. These findings imply that banks charge different rates on similar loans issued to similar firms depending on the city where the firm is located. Furthermore, when we include the local Hirschman-Herfindahl index as a control, we observe a strong negative relationship between local banking concentration and interest rates. This stands in line with theoretical models of bank competition (Aguirregabiria et al., 2020), but the richness of our data allows us to substantiate empirically the role of competition.

The previous result controls for the identity of banks to isolate the effect of geography. In practice, when firms borrow from their local branches the identity of the banks available also plays a role given that, all else equal, some banks charge higher interest rates than others. In line with other studies of banks' branch network, we relate cost differences across banks to the pool of deposits available to each bank (Kashyap et al., 2002; Hanson et al., 2015). If borrowing in the wholesale market is subject to frictions, an increase in the potential pool of deposits that a bank can tap into leads to a reduction in the bank-specific interest rate and an increase in the loans issued. Evidence from Brazil and the United States is consistent with this mechanism (Gilje et al., 2016; Gilje, 2019; Bustos et al., 2020). We provide additional evidence of this mechanism in Chile: following a positive regional shock to deposits, banks exposed to the shock issue more loans elsewhere. This increase in lending occurs in cities that were not exposed to the deposit shock.

For our policy analysis, we develop a model that embeds oligopolistic banks into an otherwise standard quantitative spatial model with investment in physical capital, trade, and migration based on Kleinman et al. (2023). We take the geographic footprint of bank branches as given and focus instead on two key components of the banks' problem: First, we model banks' strategic interactions at the local level, which enables us to replicate our empirical findings regarding the role of local competition. Second, in our model, the balance sheet constraint forces banks to attract deposits or borrow in the wholesale market, which is subject to frictions, when issuing loans. Consequently, banks' equilibrium interest rates depend on the pool of deposits they can tap into, and cities with banks that are better connected to deposits benefit from lower interest rates.

We follow two complementary approaches to estimate the model. First, we estimate firms' elasticity of substitution across banks — a key parameter in the model, as it determines banks' local market power — leveraging the Itaú-Corpbanca merger in 2016 as a natural experiment to local bank competition in cities where the bank's identity changed around the merger. Given that the buying bank, Itaú, charged lower interest rates, competition became stronger in cities that had a Corpbanca branch but no Itaú branch before the merger. We examine how loans issued by other banks responded to the merger in these cities to estimate the elasticity of substitution. For the other parameters of the model, we follow a standard approach in spatial economics and invert the model from observed data on loans, local wages and employment, and interest rates (Redding and Rossi-Hansberg, 2017).

The mechanisms we have highlighted lead to capital misallocation across cities, so a reduction in interest rate disparities can be welfare enhancing. Which policies can address these disparities? A natural — and effective — policy in this setting are city-bank specific subsidies to loans that counterbalance banks' market power. We view city-bank specific subsidies policy as notoriously difficult to implement in practice, and focus instead on a simpler policy that targets the size of the wholesale market funds but does not intervene in banks competition for these funds. In particular, our model incorporates a pension fund that lends in the wholesale market, and the policy we consider is an increase in social security taxes. We find an effect of 7% on workers' welfare. This number should be taken with care as, for reasons discussed in detail in Section 5, the quantification results are preliminary.

The rest of this paper is organized as follows. In the remainder of this section, we discuss our contribution to the literature. In Section 2, we provide context for the Chilean setting and describe the data, while Section 3 presents our empirical analysis. In Section 4, we describe the quantitative spatial model with banks and quantify it in Section 5. In Section 6, we use the quantified model to study our policy counterfactuals and Section 7 concludes.

Related literature. We argue that the bank network influences how much investment takes place in each city, potentially in inefficient ways. Lucas (1990) studies a related question: why does capital not flow from rich to poor countries, where capital is scarcer? In a study of the determinants of within-country spatial inequality, Acemoglu and Dell (2010) minimize the role of capital mobility, arguing that formal impediments for capital mobility within countries are low. However, subsequent empirical studies suggest that banks' internal capital markets can be a source of frictions (Gilje et al., 2016; Bustos et al., 2020). Our analysis of Chilean data supports this view, showing that even without explicit restrictions on capital flows, geographically segmented markets—where firms borrow and households save through local branches—lead to spatial differences in the marginal product of capital. In turn, dispersion in the marginal product of capital across firms has been the focus of the misallocation literature as pioneered by Hsieh and Klenow (2009). Midrigan and Xu (2014) focus on the impact of financial frictions, assuming all firms face the same interest rate, while our empirical evidence suggests that the interest rate they face depends on their location.

Several recent papers focus on the spatial dimensions of banking (Manigi, 2023; Morelli et al., 2024; Oberfield et al., 2024). In Oberfield et al. (2024), the authors endogeneize the bank network while taking local population and investment demand as given; we do the opposite. Manigi (2023) focuses on the short-term spatial effects of deposit reallocation across banks, while our focus is on the steady-state implications of the banking network. A branch of this literature focuses on the relationship between banks' geographic footprint and diversification of risk (Acharya et al., 2010; Morelli et al., 2024), which we abstract from by controlling for risk measures whenever possible. We view the mechanisms we focus on — local market power and banks' cost differences — as working independently of risk. At a broader level, we build on Kleinman et al. (2023) who incorporate capital accumulation into a quantitative spatial model with trade and migration but do not feature banks.

At the heart of our analysis and most of the papers discussed above lies the premise that agents rely disproportionately on bank branches available locally, and *distance still matters* in finance. Petersen and Rajan (2002) showed, using survey evidence from the United States, that information technology allowed borrowers to locate increasingly farther away from their lenders starting in the 1970s. However, Nguyen (2019) analyzes data from 1999-2012 and finds that branch closures lead to substantial and persistent reductions in small-business lending at the census tract level. These results imply that technological change did not eliminate the importance of proximity. The role of distance may be even stronger in less developed economies. Ji et al. (2023) and Fonseca and Matray (2024) study the local economic effects of branch openings in small villages in Thailand and Brazil, respectively, while Burgess and Pande (2005) study the expansion of banks into rural areas in India, and find positive economic effects. These papers focus mostly on unbanked populations getting access to banks, a priority in developing countries. By focusing on Chile, a financially developed country, our study is concerned with countries higher up on the development ladder where the main problem is not reaching unbanked populations but fostering local competition between banks. Along the same line, banks' market power on loans and deposits has been studied in developed countries by researchers in finance and industrial organization (Drechsler et al., 2017; Whited and Zhao, 2021; Aguirregabiria et al., 2020). The richness of our data allows us to substantiate many of the theoretical mechanisms proposed in this literature.

2 Context and Data

2.1 The banking industry and its geographic footprint in Chile

Chile stands out in Latin America for its advanced financial development and the role of banks as providers of credit. Between 2010 and 2018, the level of credit to the private sector was comparable to that in High-Income countries, with banks providing nearly 80% of this credit. Survey data reveals that firms of all sizes rely heavily on banks, and households primarily choose banks as their depository institution.[1] This makes Chile a well-suited application to study the economic effects of the spatial network of banks.

The banking industry is very concentrated. Between 2010 and 2018, the largest bank held a market share of approximately 20% in loans, the top three banks accounted for just under 60%, and the top five banks controlled around 80%. Collectively, the ten largest banks nearly dominated the entire Chilean loan market. The market for deposits exhibits a similar level of concentration.[2] Moreover, as pointed out by Oberfield et al. (2024), given that savers and borrowers rely on local bank branches, national measures may underestimate the relevant concentration level, which, under some extra assumptions, overestimates how competitive the market is. This is indeed the case in Chile. Table 1 reports our main summary statistics on the bank network using city-bank level data (described in more detail in the next section). In Panel A, we compare the national Herfindahl-Hirschmann in the first row with the average index across cities in the second row. Local credit markets are significantly more concentrated than the national market.

Table 1: Bank Network outside the Metropolitan Region

	2013	2015	2017	2019
A. Herfindahl–Hirschman Index				
National	0.16	0.16	0.17	0.17
Average across local indices	0.67	0.69	0.71	0.73
B.				
City-Bank Pairs	558	544	540	510
Cities	172	180	196	203
C. Banks per City				
Mean	3.2	3.0	2.7	2.5
Standard Deviation	3.3	3.1	2.7	2.4
Min	1	1	1	1
25th percentile	1	1	1	1
50th percentile	1	1	1	1
75th percentile	4	4	4	3
Max	13	12	11	10
D. Annualized change between columns				
New city-bank pairs		5	9	10
Disappearing city-bank pairs		10.5	1.5	-

Source and notes: CMF. We count city-bank pairs in which bank branches had outstanding loans. We exclude mergers from the new and disappearing calculations in the last rows of the table.

The geographic distribution of bank branches remained fairly stable throughout the period. Panel B

[1] See Appendix Section A.1 and Section A.2 for a discussion of the empirical results in this paragraph.

[2] See Figure 5 in the Appendix Section A.3.

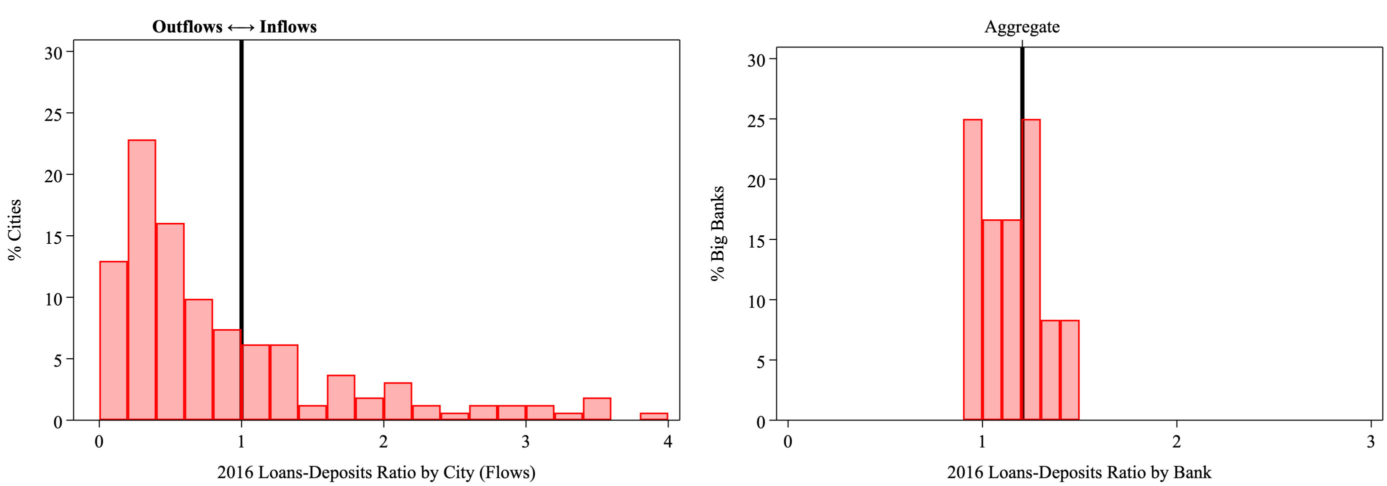
reports the total number of city-bank pairs excluding the metropolitan region, which includes Santiago, the capital. In Panel C, we report summary statistics on the number of banks per city for different years. The average number of banks per city fluctuated around 3; the main reasons it decreased slightly are two mergers: Itaú-Corpbanca in 2016 and Scotiabank-BBVA in 2018. Panel D shows how many new and disappearing city-bank pairs, excluding those attributable to the mergers. Given this stability, we take the bank network as given and do not incorporate branch location decisions in our analysis.

One distinctive feature of the banking sector in Chile is that all bank headquarters are located in Santiago, and branches are dispersed rather than concentrated in specific regions. Following the approach in Conley and Topa (2002), we find no statistically significant geographical correlation between bank presence and market share at various distances. These results are shown in the Appendix Section A.4. This stands in contrast, for example, to the United States, where banks cluster geographically because of a history of regulation in banks' geographic expansion (Oberfield et al., 2024). It also underscores one of this paper's contributions: financial linkages between cities via the bank network are, when branches are not geographically clustered, independent of other geographically driven linkages such as trade and migration connections.

By operating in many cities, banks can fund loans in one city with deposits from another. The importance of banks in allowing capital flows between cities has been shown using data from the United States (Aguirregabiria et al., 2020) and also plays a role in Chile. The left panel in Figure 1 shows all Chilean cities' loans to deposits ratio. Some cities have a surplus, while others have a deficit, with capital moving between them through the banking network. Moreover, although deposits are not the only source through which banks can fund loans, they are the main one. The right panel in Figure 1 displays the loan-deposit ratio for the biggest banks. Most banks rely partly on other sources of funding sources to issue loans. To account for this fact in our model, we allow banks to participate in a wholesale market where banks can borrow from each other and households.

Figure 1: Banks and Capital Flows Across Cities

(a) By City (b) By Bank



Source: CMF. Figure 1a computes the new loans and new deposits in each city between August 2016 and August 2017 and shows the ratio of the two. Figure 1b shows the ratio of the stock of loans and deposits per bank in August 2017. For 1b we keep banks with a stock of loans above one billion Chilean pesos, the 11 biggest in 2017.

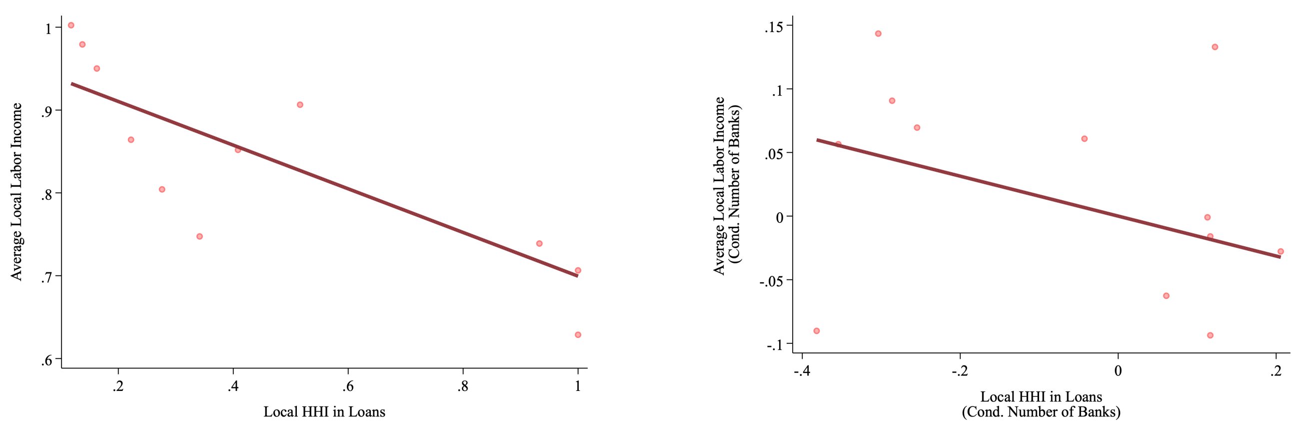
Lastly, another feature of the Chilean context that makes it a well-suited application for our study is that Chile is one of the most unequal countries in Latin America and has high levels of spatial inequality. Leveraging data on the universe of workers in the formal private sector, we compute the average local labor income and normalize it by the national average. For this exercise, we group all the municipalities belonging to Santiago, the capital city, as one. There is substantial inequality in labor income across cities: income at the first decile of cities is less than half the national average, while income at the median city is around 70% of the national average.

The relationship between local bank concentration and local prosperity is a first-order feature of the data. In the two bin-scatters in Figure 2, we compare the local HHI in the loan market in 2017 with the average local labor income in that same year. The first plot shows a strong and statistically significant relationship between the two variables. Reverse causality is a concern: banks could decide not to enter poor cities, increasing local concentration. The right figure shows the same exercise but conditioning on the number of banks in the city. The statistical relationship is still strong and statistically significant. In the rest of the paper, we will analyze the strength of the mechanism going from loan market concentration to local development and analyze policies aimed at making the banking industry more competitive.

Figure 2: Local Bank Competition and Local Income

(a) Unconditional

(b) Conditional on the Number of Banks Locally



Sources: Average local labor income from AFC and local HHI index calculated from CMF data. All data is from 2017.

2.2 Data sources

We use administrative micro and aggregate data from four Chilean sources: the Unemployment Funds Administrator (AFC, in Spanish), the Financial Market Commission (CMF, in Spanish), Electronic Invoices (DTE, in Spanish), and geolocation information about firms and their branches. We also use the Google API.

Google API. We retrieve distances and travel times between each pair of cities in Chile from Google Maps API.

Unemployment Funds Administrator: AFC is the regulated private entity that manages the contributions that every employed formal worker and their employer make to the worker's unemployment insurance fund. Monthly contributions are a defined percentage of the worker's salary. The database contains identifiers for both employers and employees, allowing us to construct a panel of workers across time. Some limitations of this data are that it only covers the private sector (excluding free-lance workers) and contributions are capped. Because contributions are capped, we can not recover actual wages for employees making more than 5,000 USD monthly.

Financial Market Commission: The CMF is the public agency that supervises the correct functioning, development, and stability of Chilean financial markets. The Commission collects detailed data from financial institutions under its regulatory umbrella to achieve its goals. For the part of our analysis relying on micro-data at the loan level, we focus on new loans that private firms take from commercial banks. We impose that these loans have to be denominated in Chilean pesos, not be associated with any public guarantee, and have maturities ranging between 3 days and 10 years. We observe the amount and the associated interest rate of the loan. We also see whether the firm has fallen into indebtedness in the past. We also see the total debt of the firm and whether the firm defaulted on its debt in the last few years. The database contains identifiers both for banks and private firms.

We draw from publicly available data by the CMF to construct aggregate outstanding loans and deposits at the bank-city level. Here, we keep deposits and loans denominated in local currency, inflation-adjusted units, and foreign currency. We sum loans for commercial and mortgage purposes and deposits with different degrees of liquidity.

Electronic Invoices: Every formal transaction between firms must be registered electronically for tax purposes in what is called a DTE. This requirement became mandatory for all large firms in November 2014, while for the rest of firms compulsory adoption was imposed in a staggered way depending on firm size and whether the firm operated in an urban or rural area. By February 2018, coverage became universal. DTEs have information about the selling firm, the purchasing firm, product prices, product quantities, and a short description of every item included in the invoice. The sample only covers transactions between domestically based firms. Information has a daily frequency, but we aggregate it to monthly.

Headquarters and branches geolocation: To assign a municipality to every headquarter and branch reported by a firm, we rely on the legal requirement that, for tax purposes, every firm must report the location of their headquarters and its branches to the tax authority. Firms must also inform the authority of every change in the location of their branches within a 2-month window of any change. However, information is not updated regularly. We use the most recent issue of this database, which corresponds to December 2021.

We impose two additional filters on the sample. We require that firms must be present in the Firms' Directory that Chilean National Accounts use to compile their official statistics and that they have an average of 3 employees over the whole time period. We are thus left with a total of 160,482 firms over the whole sample.

3 Empirical analysis

We document a set of novel facts about the dispersion of interest rates in space, including that interest rates are higher in more concentrated local credit markets. Although our baseline analysis controls for bank fixed effects, part of the variation in the interest rates that firms face is related to the identity of the banks in their city. In the second part of this section, we show indirect evidence that the pool of deposits that a bank can tap into affects the interest rate that the same bank charges on its loans. This highlights the importance of studying the bank network from the perspective both of loans and deposits.

3.1 Geographic dispersion in interest rates

We estimate the following equation,

$$i_{\ell ft} = \delta_0 + \delta_t + \delta_{c(f)} + \gamma_1 \times X_{ft} + \gamma_2 \times X_{\ell t} + \delta_{b(\ell)} + \epsilon_{\ell ft}, \tag{1}$$

using micro-data on the universe of loans extended to firms during 2015-2018. The outcome variable $i_{\ell ft}$ is the net interest rate charged for loan ℓ extended to firm f at period t. We control for quarter fixed effects δ_t, which will absorb variation in credit conditions at the national level. Our second and main fixed of interest, $\delta_c(f)$, is a fixed effect of the municipality of the firm. In our baseline specification, we keep only firms that are present in one city in order to make this link between firm and city unambiguously.

The composition of firms varies geographically. To address this, we control for characteristics of the firm X_{ft}, including the sector of the firm, its size in terms of employment decile, and two measures of risk. The first risk measure is constructed by the bank when a firm borrows from them, based on their own assessment of the borrowing firm. When the borrower is sufficiently large, the bank assesses each firm individually. It assigns the firm to one of 16 categories: A1-A6 for normal risk levels and B1-B4 and C1-C6 for riskier borrowers. When the borrowing firm is small, the risk assessment is done by pooling firms with similar characteristics into the same risk bin. We include one fixed effect for each of the 16 categories. The second risk measure is an indicator variable that takes value one if the firm is behind with its loan payments by at least 90 days. In our more demanding specification, we include firm fixed effects, which are estimated from the special pool of firms borrowing from many banks. We also include characteristics of the loan $X_{\ell t}$, including the amount lent, maturity, and bank fixed effects.

Table 2 shows our results on the geographic dispersion of interest rates in our baseline subsample with single-city firms as we progressively add more controls. In the first column, we only include fixed effects for time and space. The interest rate differential between a city in the 10^{th} and 90^{th} percentile in this specification captures differences in average interest rate within periods and is approximately 600 basis points. As expected, geographic dispersion narrows as we add controls because the composition of firms and loans varies geographically. The interest rate differential between a city in the 10^{th} and 90^{th} percentile narrows to approximately 300 basis points in the third column, half of what a crude comparison of geographic averages would yield.

In the fourth column, we replace city-fixed effects with province-fixed effects and include a measure of local competition between banks. For this reason, in the fourth column, we report the percentile of province FE, not city FE. Our measure of local competition is the Herfindahl-Hirschman Index (HHI). Using $\mathcal{B}^c$ to denote the list of banks active in the city c and s_{cbt} to denote the share of loans originated by bank b at t in city c, the city-level HHI index in the loan market is given by

$$HHI_{ct} = \sum_{b \in \mathcal{B}^c} (s_{cbt})^2.$$

The fourth column shows a positive and statistically significant impact of local concentration on interest rates. Additionally, the R2R2 value for this specification is very similar to that in the third column, indicating that a substantial portion of the variation across cities and within provinces can be attributed to local market concentration. This empirical result informs our model, in which banks compete oligopolistically within a local credit market.

The last column shows the results with our most demanding specification, which includes firm fixed effects. Notice that this comes with some attrition, as firm fixed effects are estimated from firms that borrowed from more than one bank during 2015-2018.

Table 2: Geographic dispersion in interest rates (basis points)

	Interest Rate	**Interest Rate**	**Interest Rate**	**Interest Rate**	**Interest Rate**
City/Province Fixed Effects, normalized percentile					
p10	-248.5	-120.0	-118.3	-49.9	-232.4
p25	-119.6	-49.1	-55.9	-16.9	-110.7
p50	0	0	0	0	0
p75	173.4	77.5	75.7	30.4	148.2
p90	457.1	243.7	242.7	62.4	437.0
Local HHI				60.5***	
				(2.9)	
Quarter FE	✓	✓	✓	✓	✓
Sector and Size of the Firm		✓	✓	✓	✓
Firm Risk		✓	✓	✓	✓
Loan Characteristics		✓	✓	✓	✓
Bank FE			✓	✓	✓
Firm FE					✓
Province FE				✓	
R^2	0.215	0.568	0.598	0.593	0.853
Observations	722,211	717,551	717,550	717,556	705,946
Number of Banks	19	19	18	18	18
Number of Firms	33,670	33,478	33,478	33,484	21,874
Number of Cities	292	292	292	298	291

Outcome variable in basis points. Statistical significance denoted as *p $<$ 0.10, **p $<$ 0.05, ***p $<$ 0.01.

In Table 3, we repeat the analysis excluding the set of firms for which the bank does not report a risk measure, typically because they are small. In the previous table, this was our omitted category when we included the dummy for risk; here, we exclude these firms. The results remain mostly unchanged, except for lower dispersion in the first and fifth columns. Our conclusion about the role of local competition as driving between-city variation in interest rates still holds.

Table 3: Geographic dispersion in interest rates (basis points, only single-city firms, alternative risk measure)

	Interest Rate	**Interest Rate**	**Interest Rate**	**Interest Rate**	**Interest Rate**
City/Province Fixed Effects, normalized percentile					
p10	-168.7	-109.7	-98.8	-60.7	-164.5
p25	-77.0	-59.3	-50.0	-30.3	-83.0
p50	0.0	0.0	0.0	0.0	0.0
p75	91.7	76.9	84.8	30.8	98.8
p90	269.9	227.0	238.7	60.0	267.9
Local HHI				65.6***	
				(2.9)	
Quarter FE	✓	✓	✓	✓	✓
Sector and Size of the Firm		✓	✓	✓	✓
Firm Risk		✓	✓	✓	✓
Loan Characteristics		✓	✓	✓	✓
Bank FE			✓	✓	✓
Firm FE					✓
Province FE				✓	
R^2	0.215	0.568	0.598	0.593	0.853
Observations	722,211	717,551	717,550	717,556	705,946
Number of Banks	19	19	18	18	18
Number of Firms	33,670	33,478	33,478	33,484	21,874
Number of Cities	292	292	292	298	291

Outcome variable in basis points. Statistical significance denoted as *p < 0.10, **p < 0.05, ***p < 0.01.

3.2 Deposits are a key source of funding, shaped by a bank's geographic reach

It is standard to view deposits as the preferred source of banks' funding (Kashyap et al., 2002; Hanson et al., 2015). Compared to issuing bonds or taking loans, deposits are cheaper and more stable, as they provide liquidity services to depositors. In Chile, as in many other countries, deposits are insured by the government up to some limits. Therefore, banks with better access to deposits have a cheaper funding source available.

To empirically gauge the strength of banks' preference for deposits as a source of funding, we exploit banks' differential exposure to deposit shocks and study the effect on their lending. If deposits were not a better source of funding on the margin, banks should not increase their loan issuance (as the ability to raise wholesale funding did not change) at the time of the shock. Building on Gilje et al. (2016), we instrument for deposit shocks to commodity prices. We leverage shocks to the world price of salmon, a large industry in certain regions of Chile to which banks are differentially exposed. We find a positive effect of deposit growth on loan growth at the bank level, which provides indirect evidence that internal capital markets are important for these banks. These results, which echo the findings in Gilje et al. (2016) and Bustos et al. (2020), highlight the importance of studying the bank network both as a source of deposits and loans jointly.

We instrument for deposit shocks at the city-bank level by combining shocks to the world price of salmon and banks' exposure to cities that produce salmon. This shock has several advantages in the Chilean context.

First, the price of salmon moved significantly during our sample. Using data from the IMF Commodity Price series, figure 8 in the Appendix A.5 shows the evolution of the world price of salmon throughout the 2005-2019 period. Second, salmon is an important industry in Chile, accounting for 7.8% of non-copper exports between 2005 and 2019 (12.8% in 2019). Finally, the industry is geographically clustered and most of the salmon firms are headquartered locally. This means that increased profits would be deposited into local bank branches, not shifted to headquarters in Santiago (which would be the case for shocks to mining prices, for example).

To identify which cities specialize in salmon, we calculate employment in the fishing industry as a percentage of local employment using AFC data from 2015. The results, shown in Figure 9 in the Appendix A.5, indicate that cities specializing in fishing cluster in the country's South. We construct an indicator dummy that equals one if the local percentage of employment in the fishing industry is above 4.33% (the 90^{th} percentile). We label these as 'fishing cities' and, below, use $\mathcal{F}$ to denote this set.

The analysis in this section is done at the semester level because the outstanding stock of deposits or loans was reported every February and August from 2005 to 2019 and only started to be reported monthly in 2012. To measure banks' exposure to movements in the price of salmon, we compute the share of deposits each bank received from 'fishing cities' during 1998-2001. We measure banks' presence in these cities before the price started to pick up (as seen in Figure 8 in the Appendix A.5) to avoid endogeneity in banks' entry to these regions as a response of increasing salmon prices. Our instrument for the deposits into bank b at time t, Z_{bt}, is

$$Z_{bt} = p_{t-1}^{salmon} \times \frac{\sum_{c \in \mathcal{F}} D_{bc1998-2001}}{\sum_c D_{bc1998-2001}}.$$

Notice that we lag the price of salmon one semester. This captures the potential adjustment time needed for wages and dividends to adjust following an increase in price. In our first stage, we estimate

$$Deposits_t^b = \beta_0 + \beta_1 Deposits_{t-1}^b + \beta_2 p_t^{salmon} + \beta_3 Z_{bt} + \gamma X_t^b + \epsilon_t^b.$$

Our control variables include the lagged value of deposits, bank fixed effects, and an interaction between the bank fixed effect and a dummy for the years 2008 and 2009 to control for the effects of the Global Financial Crisis (GFC). The results are shown in the first column of Table 4. There is a statistically significant and economically large relationship between the world price of salmon and deposits. If a bank's deposits came fully from Fishing cities, a one percent increase in the world price of salmon would translate into a 4.62% increase in the bank's total deposits. To have as a benchmark, deposits grew at an average (median) rate of 2.92% (3.43%) during the period.

For the second stage, we use aggregate loan data at the city-bank level, denoted by n and b, respectively. To avoid reverse causality concerns related to investment in the fishing industry responding to the price of salmon, we exclude 'fishing cities' from the sample. We estimate

$$Loans_{nt}^b = \beta_0 + \beta_1 Deposits_t^b + \beta_2 Deposits_{t-1}^b + \beta_3 Loans_{nt-1}^b + \gamma X_{nt}^b + \epsilon_t^b \ \ \forall n \notin \mathcal{F}.$$

Our control variables include the lagged value of loans in the city-bank pair, city-bank fixed effects, city-semester fixed effects, and the interaction between bank fixed effects and the GFC period. The second column in Table 4 shows the results of the OLS estimation, and the third column shows the results when

Table 4: Deposit Shocks and Loan Growth

	Bank Deposits (Logs) OLS	**City-Bank Loans (Logs)** OLS	**City-Bank Loans (Logs)** IV
Log Deposits$_t$		-0.056	2.825*
		(0.070)	(1.459)
Log Deposits$_{t-1}$	0.255***	0.044	-1.449**
	(0.034)	(0.037)	(0.626)
Log Loans$_{t-1}$		0.041	-0.006
		(0.043)	(0.040)
Log Price of Salmon$_{t-1}$	1.163***		
	(0.319)		
Z_{bt}	4.629***		
	(1.245)		
Controls included			
Bank FE	✓		
Bank FE × GFC Dummy	✓	✓	✓
Bank × City FE		✓	✓
Semester × City FE		✓	✓
Within R-squared	0.669	0.069	
Cragg-Donald Wald F-statistic			32.2
Observations	222	12102	9643
Number of Banks	10	14	10

Statistical significance denoted as * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the bank level.

instrumenting contemporaneous deposits with our instrument Z_{bt}. When we instrument for deposits, we find a strong and statistically significant effect on loans. A bank with a reliance on fishing cities of 0.25 would have issued around 0.7% more loans in each branch following a 1% increase in the price of salmon. To serve as a benchmark, during the period, loans at the city-bank level grew at an average (median) rate of 0.77% (-0.13%).

4 Model

The general equilibrium model we build in this section allows us to analyze the effects of interest rate disparities on endogenous objects like local employment, wages, and investment. The estimated version of the model allows us to analyze bank-sector policies quantitatively. Our modeling choices capture features described in the previous two sections: firms' and households' reliance on local branches, local competition between banks, and banks' preference for deposits as a source of funding. Our setup includes endogenous investment decisions by local firms, endogenous deposit supply by capitalists, trade, and migration.

4.1 Setup

The economy is comprised of N cities, indexed by n. Time is discrete. There are three types of agents: workers, capitalists, and bank owners. Workers are homogeneous, live hand-to-mouth, and can move freely between cities. Immobile capitalists are attached to their city and own local, immobile physical capital. They are restricted to borrow and save using the bank branches available in the city where they reside. We denote the set of banks with branches in city n as $\mathcal{B}^n$.

The economy has B banks. Each bank operates in a set of cities $\mathcal{C}^b$, assumed to be fixed.[3] Every period, the bank owner in charge of each bank sets city-specific nominal interest rates for deposits and loans, r^b_{nt} and $\tilde{r}^b_{nt}$, respectively, to maximize national profits. Banks face city-specific demand for loans and city-specific supply of savings and compete oilgopolistically with other banks in the city. Deposits and loans are assumed to be one-period risk-free instruments and are settled using money that is costlessly transferable between branches. Banks can also tap into the wholesale market, which is subject to frictions. Banks are also subject to a balance sheet constraint: total assets must equal total liabilities at the bank level, period by period.

We proceed by first analyzing the problem of the worker, which is the simplest. Then we derive the supply of savings and demand for loans from the problem of capitalists. Finally, we analyze the problem of banks.

4.1.1 Production and trade

Each location produces a differentiated good. The representative firm in location n hires labor, ℓ_{nt}, and capital,k_{nt}, from workers and capitalists, respectively, and makes production decisions in a perfectly competitive environment. The firm has access to a constant-returns Cobb-Douglas technology given by

$$y_{nt} = z_n \left(\frac{\ell_{nt}}{\mu}\right)^{\mu} \left(\frac{k_{nt}}{1-\mu}\right)^{1-\mu},$$

where z_n denotes productivity. Trade is costly. For one unit to arrive in location n, $\tau_{ni} \geq 1$ units must be shipped from location i. In this framework, the price of a good of variety i for a consumer located in n is given by

$$p_{nit} = \tau_{nit} p_{iit} = \frac{\tau_{ni} w^{\mu}_{it} r^{1-\mu}_{it}}{z_{it}},$$

where p_{iit} denotes the free-on-board dollar price for the good produced in city i.

4.1.2 Workers

There is a unit mass of identical and infinitely-lived workers. They cannot access savings or investment instruments and live 'hand-to-mouth,' as in Kleinman et al. (2023). At period t, a worker located in city n decides how much to consume of each of the N goods in the economy, where the consumption basket aggregates goods from all origins with a constant elasticity of substitution,

$$C^w_{nt} = \left(\sum_{i=1}^{N} c_{it}^{\frac{\sigma_c - 1}{\sigma_c}}\right)^{\frac{\sigma_c}{\sigma_c - 1}}.$$

[3]See Oberfield et al. (2024) for an analysis of the evolution of the bank network in space.

The consumption price index in city n, P_{nt}, and the fraction of expenditure of city n in goods from city i, π_{nit}, are given by

$$P_{nt} \equiv \Big(\sum_j (\tau_{ni} p_{iit})^{1-\sigma_c} \Big)^{\frac{1}{1-\sigma_c}} \quad \text{and} \quad \pi_{nit} = \Big(\frac{\tau_{ni} p_{iit}}{P_{nt}} \Big)^{1-\sigma_c}. \tag{2}$$

The budget constraint of a worker is given by

$$P_{nt} C^w_{nt} = w_{nt}(1-\tau^{ss}) + T^w_{nt}$$

where τ^{ss} is a social security tax and T^w_t is the transfer that the worker receives from the government and we describe in detail later.

After consuming in period t, the worker faces idiosyncratic utility shocks of moving to each destination city d, ϵ_{dt}, and decides whether to move and where. The value of living in city n at t combines an amenity value b_n, the utility coming from consumption, and the continuation value after moving

$$V^w_{nt} = \log(b_n C^w_{nt}) + \max_d \{\beta \mathbb{E}_t [V^w_{dt+1}] + \rho \epsilon_{dt}\}. \tag{3}$$

We assume that idiosyncratic shocks ϵ are drawn from an extreme value distribution, $F(\epsilon) = e^{-(\epsilon - \bar{\gamma})}$. The parameter ρ captures the relative importance of idiosyncratic reasons for migration that are not captured by amenities or real income in a city. The expectation is taken with respect to future realizations of the idiosyncratic shocks ϵ_{dt+1}.

4.1.3 Capitalists

There is one capitalist per city who lives indefinitely and cannot move to other cities. The capitalist owns the local stock of physical capital and rents it to the producers of the final good. To transfer resources inter-temporally, the capitalist can invest in physical capital or save using deposits in the bank branches available locally.

We assume that to finance investments in physical capital, the capitalist needs to borrow from local banks. Moreover, loans from different banks are imperfect substitutes when funding new investments. This assumption is intended to capture, in a parsimonious way, heterogeneity between banks, which are specialized in funding different types of businesses. The elasticity of substitution between banks is a key parameter in the model, as it will determine banks' local market power in interest rate setting.

The problem solved by the capitalist living in n can be divided into two stages. In the first stage, she decides how much to borrow from each bank to finance a given level of investment, i_{nt}, at the lowest cost. In the second stage, she maximizes her welfare by deciding how much to consume, save in deposits, and invest, taking the cost of investment $\mathcal{C}_{nt}(i_{nt})$ as given. Following Morelli et al. (2024), we assume that capitalists derive utility from consumption and deposits, where α controls the utility derived from deposits relative to consumption. Using C^c_{nt} to denote a consumption basket for capitalists, analogous to the one for workers in equation (4.1.2), the problem of a capitalist at the second stage can be written as

$$
\begin{aligned}
\max_{\{C^c_{nt}, D^b_{nt+1}, k_{nt+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \Big[\log C^c_t + \alpha \log D_{nt+1} \Big] & \\
\underline{s.t:}\ C^c_{nt} + \sum_b \frac{D^b_{nt+1}}{P_{nt}} + \frac{\mathcal{C}_{nt}(i_{nt-1})}{P_{nt}} &= \frac{\hat{r}_{nt}}{P_{nt}} k_{nt} + \sum_b (1+\tilde{r}^b_{nt}) \frac{D^b_{nt}}{P_{nt}} + T_{nt} \qquad (4) \\
k_{nt} &= k_{nt-1}(1-\delta) + i_{nt-1} \\
D_{nt+1} &= \Big[\sum_b {D^b_{nt+1}}^{1-\frac{1}{\eta}} \Big]^{\frac{\eta}{\eta-1}} \qquad (5) \\
k_{n0}, \{D^b_{n0}, L^b_{n0}\}_b &
\end{aligned}
$$

where the budget constraint equation (4) is expressed in real terms: the capitalist spends income from renting out capital at rental rate $\hat{r}$, the payout of her $t-1$ deposits and a lump-sum transfer from the governmnet T_{nt} (which we specify below) to finance consumption, new deposits and re-paying loans maturing at t. The function $\mathcal{C}_{nt}(i_{nt-1})$ comes from solving the minimization problem

$$
\begin{aligned}
\mathcal{C}_{nt}(i_{nt-1}) &= \min_{\{L^b_{nt}\}_b} \sum_{b \in \mathcal{B}} L^b_{nt}(1 + r^b_{nt-1}) \\
s.t: \Big[\sum_{b \in \mathcal{B}} (\gamma^b \tfrac{L^b_{nt}}{P_{nt-1}})^{\frac{\sigma-1}{\sigma}} \Big]^{\frac{\sigma}{\sigma-1}} &= i_{nt-1}
\end{aligned}
\tag{6}
$$

in the first stage. The parameter σ captures the elasticity of substitution between loans from different banks. As stated above, this elasticity is intended to capture heterogeneity between banks in their ability to fund other types of businesses. In what follows, we drop subscript n for clarity when referring to the problem of immobile capitalists. Manipulating the first-order conditions, we can express the equilibrium loans from bank b as

$$
\frac{L^b_t}{P_{t-1}} = \Big(\frac{R_{t-1}}{1 + r^b_{t-1}} \Big)^{\sigma} i_{t-1} (\gamma^b)^{\sigma-1} \text{ where } R_{t-1} \equiv \Big[\sum_{b \in \mathcal{B}} (\tfrac{1+r^b_{t-1}}{\gamma^b})^{1-\sigma} \Big]^{\frac{1}{1-\sigma}}. \tag{7}
$$

From equation (6) and equation (7) it follows that

$$
\mathcal{C}_t(i_{t-1}) = i_{t-1} R_{t-1} P_{t-1}. \tag{8}
$$

Plugging this functional form for $\mathcal{C}_t(i_{t-1})$ into the budget constraint and manipulating first-order conditions, the demand for deposits into bank b will be

$$
D^b_{t+1} = D_{t+1} \left(\frac{Q_t}{q^b_t} \right)^{\eta}, \tag{9}
$$

where

$$
q^b_t \equiv 1 - \underbrace{\Big(1 + \tilde{r}^b_t\Big)}_{\text{Return on deposits}} / \underbrace{\left(\frac{(1-\delta) R_t P_t}{R_{t-1} P_{t-1} - \hat{r}_t} \right)}_{\text{Return on investment}} \text{ and } Q_t \equiv \left(\sum_b (q^b_t)^{1-\eta} \right)^{\frac{1}{1-\eta}}. \tag{10}
$$

The key price of a deposit with bank b is q_t^b. This cost captures the dollar that the capitalists gives up in the present net of the interest income accruing tomorrow. The pecuniary cost is adjusted by the marginal rate of substitution between periods, where the latter can be equated with the rate at which resources can be transferred between periods through investing in physical capital. Therefore, the return on investment deflates the pecuniary benefit of a deposits in the definition of q_t^b.

The total demand for deposits and consumption is given by

$$D_{t+1} = \frac{\alpha M_t}{Q_t + \alpha Q_t^{\eta} \tilde{Q}_t} \tag{11}$$

$$P_t C_t^c = \frac{Q_t M_t}{Q_t + \alpha Q_t^{\eta} \tilde{Q}_t}. \tag{12}$$

where we have defined total income as $M_t \equiv \hat{r}_t k_t + \sum_b (1 + \tilde{r}_t^b) D_t^b - (k_t - (1-\delta) k_{t-1}) R_{t-1} P_{t-1}$ and $\tilde{Q}_t$ is an alternative index of q_t^b, defined in the appendix.

From equation (7), equation (9) and equation (11) the bank-specific demand for deposits and loans are described by

$$D_{t+1}^b = \frac{\alpha M_t}{Q_t + \alpha Q_t^{\eta} \tilde{Q}_t} \left(\frac{Q_t}{q_t^b} \right)^{\eta} \tag{13}$$

$$L_{t+1}^b = i_t P_t \Big(\frac{R_t}{1 + r_t^b} \Big)^{\sigma} (\gamma^b)^{\sigma - 1}. \tag{14}$$

By increasing the interest rate on deposits $\tilde{r}_t^b$ (which translates into a decrease in q_t^b), the supply of deposits into bank b will increase. By increasing the interest rate on loans r_t^b, the demand for loans from bank b will decrease. We now turn to the problem of setting interest rates by banks, who take these two functions as given.

4.1.4 Banks

Banks set active and passive interest rates in each city where they operate to maximize profits. They take the supply of deposits and demand for loans from local capitalists, equation (13) and equation (14), as given. To issue loans while meeting balance sheet requirements, banks can attract deposits and use wholesale funding. They can either borrow from or lend to the wholesale market, but this market faces frictions. These frictions are an increasing function of the ratio of wholesale funding to deposits, as in (Oberfield et al., 2024). Among other forces, this captures that banks that are more reliant on external funding seen as riskier by other banks or regulators since wholesale funds lack government insurance. Omitting super-script b for clarity in this section, the problem of a bank at $t = 0$ is

$$\max_{\{\{r_{nt},\tilde{r}_{nt}\},F_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty}\beta^t\Big(\Pi_t - \tau\left(\frac{F_t}{\sum_n D_{nt}}\right)(1+r^F_{t-1})F_t\Big)$$

$$\underline{s.t:}\ [\lambda_t]\ \sum_n L_{nt+1} = \sum_n D_{nt+1} + F_{t+1}\quad \forall t.$$

$$\Pi_t \equiv \sum_n L_{nt}(1+r_{nt-1}) + D_{nt+1} - L_{nt+1} - D_{nt}(1+\tilde{r}_{nt-1}) - (1+r^F_{t-1})F_t$$

The value of the bank is the maximized discounted sum of per-period cash flows, Π_t. The amount of wholesale funding is represented by F_t. At each t, inflows come from maturing loans either from firms or the wholesale market (if $F_t < 0$), and new deposits captures. Outflows consist of new loans extended to firms or other banks and maturing deposits that need to be repaid.

A positive F_t indicates that the bank is borrowing in the wholesale market, while a negative F_t means the bank is lending in the wholesale market. The wholesale equilibrium interest rate is denoted by r^F_t, and the friction function $\tau(\cdot)$ satisfies $\tau' > 0$ and $\tau(0) = 0$. These conditions imply that for banks borrowing from the wholesale market, the total cost is higher than the pecuniary cost while for those lending to the wholesale market, the total benefit is lower than the pecuniary benefit. In what follows, we assume

$$\tau\Big(\frac{F_{t+1}}{D_{t+1}}\Big) = exp\Big(\frac{\phi F_{t+1}}{D_{t+1}}\Big) - 1,$$

where ϕ measures how costly it is to access wholesale funding. Manipulating the first-order conditions with respect to active and passive interest rates, and wholesale funding, we get

$$r^*_{nt} = \frac{\varepsilon^L_n}{\varepsilon^L_n - 1}\tilde{\mu}_t \text{ and} \tag{15}$$

$$\tilde{r}^*_{nt} = \frac{\varepsilon^D_n}{\varepsilon^D_n + 1}\left[\tilde{\mu}_t + \frac{\partial\tau(F_{t+1}/D_{t+1})}{\partial D_{t+1}}(1+r^F_t)F_{t+1}\right], \tag{16}$$

where $\varepsilon^L_n = -\frac{\partial L^b_n}{\partial r^b_n}\frac{r^b_n}{L^b_n}$ and $\epsilon^D_n = \frac{\partial D^b_n}{\partial \tilde{r}^b_n}\frac{\tilde{r}^b_n}{D^b_n}$ denote the city-specific elasticities of loan demand and deposit supply with respect to an individual bank's interest rates. The variable $\tilde{\mu}_t \equiv \left[\frac{1}{\beta} + \mu_t - 1\right]$ represents the total marginal cost of issuing a loan which includes the dollar the bank needs to give up from its cash flows today net of that it received tomorrow, and the balance sheet space used to issue a loan. In the case of deposits the interpretation is flipped: $\tilde{\mu}_t$ represents the marginal benefit of receiving a deposit today, including the dollar today new of the dollar that needs to be returned tomorrow, and the increased space in the balance sheet constraint. Deposits also include an additional marginal cost compared to loans, as expanding the deposit base reduces wholesale funding frictions.

Equation (15) and equation (16) describe the city-specific markups that banks charge for their loans, and the markdowns they charge on depositors. City-specific derivatives which play a key role in determining markups and markdowns, can be decomposed as direct and indirect effects. For example, in the case of loans

$$\frac{\partial L_n^b}{\partial r_n^b} = \underbrace{-\sigma \frac{L_n^b}{1+r_n^b}}_{\text{direct effect}} + \underbrace{\sigma \frac{(L_n^b)^2}{i_n R_n P_n}}_{\text{indirect effect through } R_n} + \underbrace{\left(\frac{L_n^b}{i_n}\right)\frac{\partial i_n}{\partial r_n^b}}_{\text{indirect effect through } i_n}$$

Banks do not set uniform markups and markdowns across cities because they internalize their influence on local interest rate indices, aggregate investment, and deposits at the city level. This mechanism allows us to capture the importance of local banking market structures: cities with more competition will experience lower markups and markdowns on interest rates. Moreover, our framework also captures cost differences across banks as a source of differences in the cost of capital across cities. To see this, equation (17) shows the value of μ_t in equilibrium. Because all banks can intervene as lender or borrower in the inter-bank market, it equals

$$\mu_t = \tau\left(\frac{F_{t+1}}{D_{t+1}}\right)(1+r^F) + \frac{\partial \tau(F_{t+1}/D_{t+1})}{\partial F_{t+1}}(1+r_t^F)F_{t+1}, \tag{17}$$

which increases in F.

4.1.5 Government

The government plays two roles in the model. First, it taxes workers at rate τ^{ss} and invests the funds in the wholesale market, from which banks are allowed to borrow. This assumption is intended to capture the quantitatively important role of pension funds in domestic financial systems. From this role of the government it follows that transfers to workers are given by

$$T_{nt}^w = w_{nt-1}\tau^{ss}(1+r_{t-1}^F).$$

The second role of the government is to tax banks and rebate the profits back to capitalists in a way that completely undoes city-specific profits made by the banking industry. We assume

$$T_{nt} = \sum_{b\in\mathcal{B}^n} L_{nt}^b r_{nt-1}^b - D_{nt}^b \tilde{r}_{nt-1}^b.$$

This assumption means that, in a steady state, banks make no profits in the aggregate and takes care of where (in what city) to locate the profits of the banking industry.

4.2 Steady state

Our analysis will focus on comparing steady state outcomes. In each steady state the productivity and amenity values, $\{z_n, b_n\}_{n\in N}$, together with the set of cities in which each bank is present, $\{\mathcal{C}^b\}_{b\in B}$, are constant. A steady state consists of a vector of quantities $\{\ell_n, k_n, y_n, C_n, C_n^c, k_n\{L_n^b, D_n^b\}_{b\in B}\}_{n\in N}, \{F^b\}_{b\in B}$ and prices $\{\{w_n, p_n, \{r_n^b, \tilde{r}_n^b\}_{b\in B}\}_{n\in N}, , r_t^F$ such that

- Workers' consumption and migration decisions maximize their lifetime utility, equation (2)-equation (3).

From optimal migration decisions, it follows that steady-state labor shares reflect flow utility,

$$\ell_n = \frac{\left(\frac{b_n w_n}{P_n}\right)^{\frac{\beta}{\rho}}}{\sum_{i=1}^{N}\left(\frac{b_i w_i}{P_i}\right)^{\frac{\beta}{\rho}}}. \tag{18}$$

- Capitalists' consumption, saving and borrowing decisions maximize their lifetime utility, equation (12)-equation (13)-equation (14).
- Bank-specific interest rates set optimally, equation (78)-equation (79) in the Appendix.
- The wholesale market clears and the bank's profits are rebated to consumers in the form of transfers

$$\sum_b F^b = \tau \sum_n \ell_n w_n \text{ and } T_n = \sum_{b \in \mathcal{B}^n} L_n^b r_n^b - D_n^b \tilde{r}_n^b. \tag{19}$$

- Labor markets clear at the national level

$$\sum_n \ell_n = 1. \tag{20}$$

- Final good revenue in city n, equal to total cost, equals expenditure by workers and capitalists (for consumption and investment purposes) in all other cities in that same good:

$$w_n \ell_n + \hat{r} k_n = \sum_{i=1}^{N} \pi_{ni}(P_i C_i^w + P_i C_i^c + \sum_{b \in \mathcal{B}^i} L_i^b) \tag{21}$$

4.3 An economy with symmetric banks

To proceed with the analysis in closed form and gain intuition on the mechanisms, suppose that banks were symmetric: $\mu^b = \mu \, \forall \, b$ and $\gamma_n^b = \gamma_n \, \forall b$. As a consequence, $r_n^b = r_n^{b'} \, \forall n, \forall b, b'$. The aggregate interest rate R_n becomes

$$R_n = \Big[\sum_{b \in \mathcal{B}} (\tfrac{1+r_n^b}{\gamma^b})^{1-\sigma}\Big]^{\frac{1}{1-\sigma}} = \frac{B^{\frac{1}{1-\sigma}}(1+r_n)}{\gamma_n}, \tag{22}$$

where we use B_n to denote the number of banks in city n. Because interest rates are symmetric, $L_n \equiv L_n^b = L_n^{b'} \forall n, \forall b, b'$. Plugging this into equation (6),

$$P_n i_n = B_n^{\frac{\sigma}{\sigma-1}} \gamma_n L_n. \tag{23}$$

In the appendix Section C.1 we show that these assumption lead to

$$\varepsilon_n^L|_{SS} = \sigma \frac{r_n}{1+r_n}\Big(1 - \frac{1}{B_n}\Big) + \frac{\partial i_n}{\partial r_n}\frac{\partial r_n}{i_n}|_{SS} \tag{24}$$

The first term in equation (24) captures that when a bank raises interest rates, firms substitute away to other banks. When each bank commands a bigger share of the local loan market, this response is muted. This captures the intuition that markups go down when there is more competition in a city, which was one of the main conclusion in the empirical analysis (in particular, Table 2).

5 Estimation

We quantify the model using data from Chile between 2013 and 2018, but focusing on 2017 as our main target. Once we clean the data and keep cities for which we observe all variables, we are left with around 178 cities (excluding the capital, Santiago, from the analysis). Currently, we report a **preliminary quantification** with the 20 largest cities. A quantification with the whole 178 cities is in progress.

We follow two complementary approaches to estimate the model. To estimate σ, the elasticity of substitution between banks for loans, we exploit the merger of Itaú and Corpbanca in April 2016 and compare cities where the merge had an impact on competition versus those were neither bank was present in a difference-in-differences design. Secondly, as it is standard in the literature, we estimate productivity and amenities by matching the joint distribution of employment and wages. Intuitively, cities with a high population despite low wages are rationalized through better amenities through the lens of the model and high wages indicate productivity is high. Finally, the values of γ_n^b are chosen so as to rationalize the observed loans in each city-bank. To estimate transport costs τ_{ij} we assume they are a function of the travel times between these cities, which we obtain from the Google API. We borrow from Redding and Rossi-Hansberg (2017) and assume that ice-berg costs can be written as $\tau_{ni} = t_{ni}^{0.375}$. All other parameters are calibrated externally from other sources. Table 5 summarizes how we estimate each set of parameters.

Table 5: Estimation

	Description	Value	Source or Objective
		Externally calibrated	
μ	Capital share	0.30	Standard
δ	Rate of depreciation	0.04	Standard
β	Discount factor	0.96	Standard
η	Elasticity of substitution (deposits)	1.2	See main text
σ_c	Elasticity of substitution (consumption)	4	Redding and Rossi-Hansberg (2017)
τ^{ss}	Social Security	0.1	Social Security Taxes in Chile
$\{\tau_{nj}\}_{n,j=1,..,N}$	Trade costs as a function of travel times	$t_{ij}^{0.375}$	Redding and Rossi-Hansberg (2017)
		Internally estimated	
σ	Elasticity of substitution (loans)	5.9	Itaú-Corpbanca merger
α	Deposits in the utility function	4.5	Size of wholesale market
ϕ	Cost of wholesale funding	4.3	Dispersion in banks' wholesale funding
$\{z_n\}_{n=1}^N$	Productivities		Geographic distribution of employment
$\{b_n\}_{n=1}^N$	Amenities		Geographic distribution of wages
$\{\{\gamma_n^b\}_{b=1}^B\}_{n=1}^N$	Bank-city match		Loans

5.1 Itaú-Corpbanca merger: reduced-form evidence of substitution between banks

In January 2014, the authorities of Itaú, a Brazilian bank, announced that the bank would buy the Chilean bank Corpbanca. At the time, both banks were important players in the Chilean loan market. This was the biggest transaction in Chile's financial history at the time, and it was motivated by factors exogenous to Chile. According to Reuters, *Itaú is contending with slowing economic growth and rising household debt in Brazil, where it trails state-run lender Banco do Brasil SA.*[4] The merger was made effective in April 2016. We use the merger as an exogenous shock to competition in certain cities.

We follow a differences-in-differences design comparing cities in which Corpbanca was still present by 2015 (treated cities, $\mathcal{T}$) to cities in which neither of the two banks was present by 2015 (control cities, $\mathcal{C}$). Because Itaú charged a lower interest rate than Corpbanca, the merger induced a decrease in the interest rate charged by the merged bank in treated cities. The speed at which new loans issued by other banks responded informs us about the elasticity of substitution for loans from the perspective of firms.

For this analysis we use aggregate city-bank data from the CMF. The data reports the the stock of outstanding loans and the flow of maturing loans at a monthly frequency. In principle, differencing the value of the stock of outstanding loans and adding the maturing loans equals the new loans issued. However, this procedure yield negative values in around 10% of the observations. We treat negative values as missing in the data and interpolate across months with positive values.

Treatment takes place on the second quarter of 2016, when the merger became effective. In order to avoid issued related to seasonality and noise in the monthly data we aggregate four consecutive quarter of

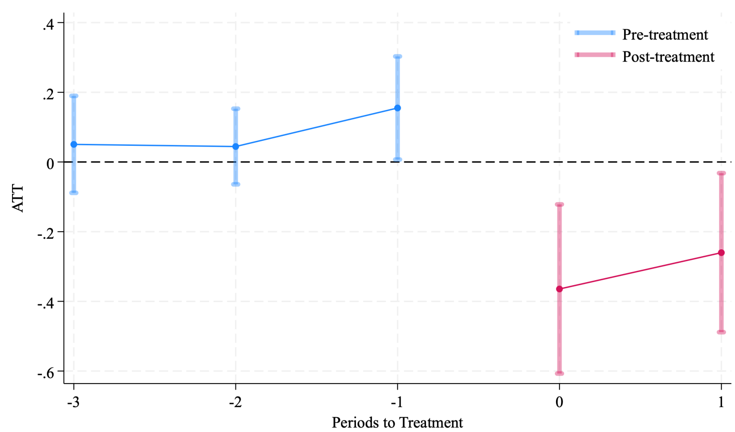
[4]This quote and the description of the merge come from https://www.reuters.com/article/corpbanca-chile-itauunibanco/update-4-ita-to-expand-in-chile-and-colombia-with-corpbanca-deal-idUSL2N0L30LL20140129.

data. We deflate monthly new loans values using the consumer price index and then sum the new loans for each period. Once we have yearly data, we estimate the coefficients in the following equation,

$$Loans^b_{nt} = \eta^b_n + \theta_b \times Year_t + \sum_{t=1}^{5} \alpha_t D_{nt} + \epsilon^b_{nt}. \tag{25}$$

Our outcome variable of interest, $Loans^b_{nt}$ are the new loans issued by bank b in city n and year t (in logs). We include a fixed effect for the city-bank pair and bank-specific trends. D_{nt} is a dummy that takes value one if city n is treated and the time period is t. We estimate equation (25) over a balanced panel of the city-bank pairs nb that we observe throughout the whole 2013Q2-2017Q1 period and, as we have been doing throughout, we exclude the state bank and the metropolitan region from the analysis. We also restrict our sample to cities that belong to either $\mathcal{T}$ or $\mathcal{C}$. Our coefficient of interest, α_t, captures the differential growth of loans issued in treated cities. Figure 3 shows the estimation results.

Figure 3: Loan substitution after the merger



Loans in treated and control groups grow in parallel between 2013Q2 and 2015Q1, which makes the parallel trend assumption at the time of treatment more plausible. The slight increase in the loans issued by other banks immediately before the merger took place may be related to Corpbanca branches stopping loan issuance before the merger, something that cannot be explained by our model. The most important result, however, is the decrease in loans issued by other banks after the merger takes place and a bank with lower interest rates starts competing with them. The coefficients for both 2016Q2-2017Q1 and 2017Q2-2018Q1 are economically large and statistically significant.

Our estimated effects can be mapped to σ. To see this, start by taing logs in equation (14),

$$\log\left(\frac{L_{nt}}{P_{nt}}\right) = \log(i_{nt}) + (\sigma - 1)\log(\gamma^b_n) + \sigma\log(R_{nt}) - \sigma\log(1 + r^b_{nt}).$$

Intuitively, the city-bank fixed effects and the bank-specific trends capture, respectively, γ^b_n and movements in r^b_{nt} related to changes in the marginal cost for each bank that are common across cities. In the Appendix C.1, we show that around a symmetric equilibrium, this means that changes in $\log(1 + r^b_{nt})$ will be small for banks competing with Itaú. Therefore, through the lens of the model the effect of the merger on loan issuance by other bank is the sum of tighter competition (a decrease in R_{nt}) and countervailing changes in city-level investment (higher i_{nt}). This boils down to a system of equations in which σ is one of the unknowns. We back out a value of $\sigma = 5.9$.

5.2 Productivity, amenity, and city-bank complementarities

We can invert the model using data on wages, employment, loans, and interest rates. For these steps we rely on aggregate data on loans by city-bank pairs and interest rates from the CMF and average wage and total employment from AFC. In the case of interest rates, we only observe the aggregate rate at the bank level so we assume they are the same in all cities. All data is from 2017. All steps that follow are restricted to the 20 largest cities in terms of employment in 2017.

The inversion proceeds as follows.

1. Using data on new loans and the average interest rate we calculate

$$\mathcal{C}(i_n) = \sum_{b \in \mathcal{B}^n} (1 + r_n^b) L_n^b.$$

2. Using that $\mathcal{C}(i_n) = i_n R_n P_n$, we use equation (7) to write down a system of $\tilde{N}$ equations

$$L_n^b = \mathcal{C}(i_n) \frac{R_n^{\sigma-1}}{(1 + r_n^b)^\sigma} (\gamma_n^b)^{\sigma-1}$$

   in $\tilde{N}$ unknowns, the vector of γ_n^b. These parameters rationalize the observed level of loans perfectly.

3. Having estimated γ_n^b we use the definition of investment, equation (6), to calculate $P_n k_n$. Then, we recover $\frac{P_n}{\hat{r}_n}$ from $\hat{r}_n k_n$, which appears in firms' optimality conditions, and using data on the wage bill $w_n \ell_n$.

4. We estimate $\{z_n\}$ as the vector that guarantees the market clearing conditions hold and $\frac{P}{\hat{r}}$ equals the value we obtained before.

5. We back out amenities $\{b_n\}$ that perfectly rationalize workers' location decisions.

Finally, we calibrate α, the relative utility of deposits, and ϕ, which affects the non-pecuniary costs of banks' wholesale funding, to match two moments related to banks' use of wholesale funding. First, we target the average loan-deposits ratio of banks of 1.2, shown in Figure 1b. Second, we target the standard deviation in this ratio across of all banks, 0.19.

6 Pro-competitive policies in the banking sector

We use the quantified model to measure the welfare and output effects of banks' branch networks. First, we consider a pro-competitive policy in which the government completely undoes banks' local market power. We focus on the effect on labor productivity and workers' welfare. Welfare in the steady state among workers living in the city n can be written as

$$V_n \propto \log(\tfrac{b_n w_n}{P_n})(1 + \beta) - \rho \ell_n. \tag{26}$$

The value of living in city n is the sum of flow utility and a continuation value. In equation (26) we have used the property of the extreme value distribution according to which the expected value of moving to other cities can be linked to the value conditional on choosing to stay in that city in the future. A correction term involving the probability that the worker actually chooses this action needs to be included. In our setting, the probability of choosing an action is the same as the share of people in that location, which leads to the last term.

6.1 City-bank subsidies

In this regime, the government imposes a subsidy on loans (deposits) equal to $1 + s_n^b$ $(1 + \tilde{s}_n^b)$, given by

$$1 + s_n^b = \frac{\varepsilon^L - 1}{\varepsilon^L} \text{ and } 1 + \tilde{s}_n^b = \frac{\varepsilon^D + 1}{\varepsilon^D}. \tag{27}$$

We view this policy analysis as setting up a benchmark, given that city-bank specific subsidies to loan issuance would be hard to implement in practice.

6.2 Indirect policy: expanding the wholesale market

We consider a much simpler policy in which the government raises the taxes on social security from $\tau^{ss} = 0.1$ to $\tau^{ss\prime} = 0.15$.

Table 6: Policy analysis

	City-bank subsidies	Increase in the size of wholesale market
Workers' welfare	+10%	+7%
Productivity	+6%	+2%

In the preliminary quantification, we find that the second policy, despite being significantly simpler to implement, can attain a large part of the welfare gains of loan subsidies tailored to each city-bank pair.

7 Conclusion

There are substantial disparities in income within countries. In Latin America, for example, differences in labor income between cities are about double the size of those between countries (Acemoglu and Dell, 2010). In this paper, we provided evidence of a novel mechanism underlying spatial inequality: differences in investment costs across cities. Leveraging rich credit registry data from Chile, we show that the difference in investment costs is substantial and cannot be explained by observable characteristics of the firm, the bank, or the loan. We highlight two drivers of interest rate differentials: local competition between banks and the identity of the banks in that city. In line with other studies, we focus on the pool of deposits a bank can tap into as a determinant of the interest rate a bank will charge for its loans in all the cities where it is present.

To understand the potential benefits in terms of income and welfare of policies that equalize the cost of capital across cities, we developed a quantitative model that includes banks, investment, trade, and migration. We used the estimated model to study city-bank level subsidies that correct for banks' market power and a more easily implementable policy of increasing the size of the wholesale funds available to banks financed through social security taxes. In the quantification, preliminary for reasons discussed in the main text, we find positive effects on the aggregate welfare of both policies. Despite its simplicity, the second policy can attain a large portion of the gains of the first policy. We are currently improving the quantification step before delving deeper into the mechanisms at play.

References

Acemoglu, D. and Dell, M. (2010). Productivity differences between and within countries. American Economic Journal: Macroeconomics, 2(1):169–88.

Acharya, V. V., Imbs, J., and Sturgess, J. (2010). Finance and Efficiency: Do Bank Branching Regulations Matter?*. Review of Finance, 15(1):135–172.

Aguirregabiria, V., Clark, o., and Wang, H. (2020). The geographic flow of bank funding and access to credit: Branchh networks, local synergies and competition. Technical report, Working Paper.

Bronnenberg, B. J., Dhar, S. K., and Dubé, J.-P. (2007). Consumer packaged goods in the united states: National brands, local branding.

Burgess, R. and Pande, R. (2005). Do rural banks matter? evidence from the indian social banking experiment. American Economic Review, 95(3):780–795.

Bustos, P., Garber, G., and Ponticelli, J. (2020). Capital Accumulation and Structural Transformation*. The Quarterly Journal of Economics, 135(2):1037–1094.

Conley, T. G. and Topa, G. (2002). Socio-economic distance and spatial patterns in unemployment. Journal of Applied Econometrics, 17(4):303–327.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The deposits channel of monetary policy. The Quarterly Journal of Economics, 132(4):1819–1876.

Fonseca, J. and Matray, A. (2024). Financial inclusion, economic development, and inequality: Evidence from brazil. Journal of Financial Economics, 156:103854.

Gilje, E. P. (2019). Does local access to finance matter? evidence from u.s. oil and natural gas shale booms. Management Science, 65(1):1–18.

Gilje, E. P., Loutskina, E., and Strahan, P. E. (2016). Exporting liquidity: Branch banking and financial integration. The Journal of Finance, 71(3):1159–1184.

Hanson, S. G., Shleifer, A., Stein, J. C., and Vishny, R. W. (2015). Banks as patient fixed-income investors. Journal of Financial Economics, 117(3):449–469.

Hsieh, C.-T. and Klenow, P. J. (2009). Misallocation and manufacturing tfp in china and india. The Quarterly Journal of Economics, 124(4):1403–1448.

Ji, Y., Teng, S., and Townsend, R. M. (2023). Dynamic bank expansion: Spatial growth, financial access, and inequality. Journal of Political Economy, 131(8):2209–2275.

Kashyap, A. K., Rajan, R., and Stein, J. C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. The Journal of Finance, 57(1):33–73.

Kleinman, B., Liu, E., and Redding, S. J. (2023). Dynamic spatial general equilibrium. Econometrica, 91(2):385–424.

Lucas, R. E. (1990). Why doesn't capital flow from rich to poor countries? The American Economic Review, 80(2):92–96.

Manigi, Q. (2023). Regional banks, aggregate effects. Working paper.

Midrigan, V. and Xu, D. Y. (2014). Finance and misallocation: Evidence from plant-level data. American Economic Review, 104(2):422–58.

Morelli, J., Moretti, M., and Venkateswaran, V. (2024). Geographical diversification in banking: A structural evaluation. Working paper.

Nguyen, H.-L. Q. (2019). Are credit markets still local? evidence from bank branch closings. American Economic Journal: Applied Economics, 11(1):1–32.

Oberfield, E., Rossi-Hansberg, E., Trachter, N., and Wenning, D. (2024). Banks in space. Technical report, Working Paper.

Petersen, M. A. and Rajan, R. G. (2002). Does distance still matter? the information revolution in small business lending. The Journal of Finance, 57(6):2533–2570.

Redding, S. J. and Rossi-Hansberg, E. (2017). Quantitative spatial economics. Annual Review of Economics, 9(1):21–58.

Whited, T. M. and Zhao, J. (2021). The misallocation of finance. The Journal of Finance, 76(5):2359–2407.

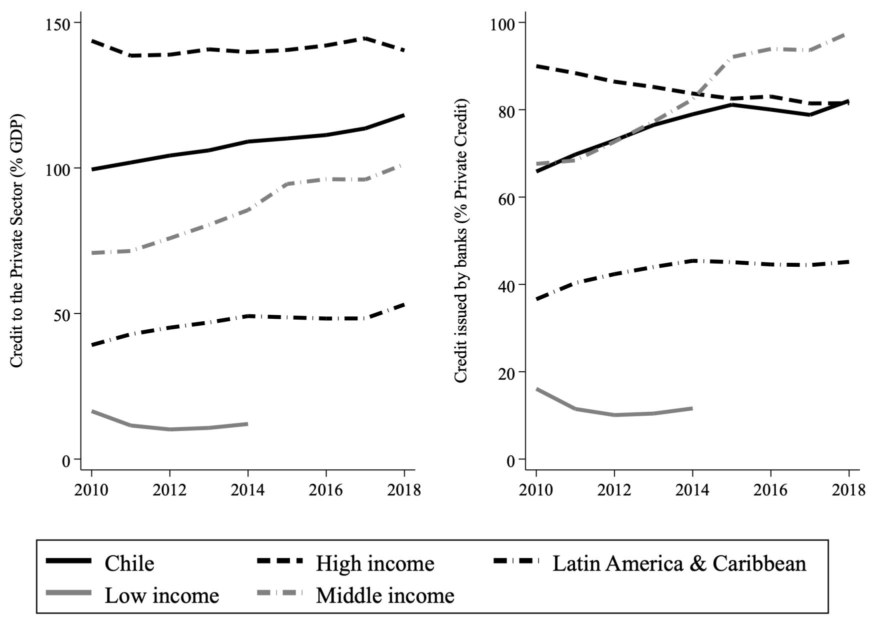
Appendix

A Empirical appendix

A.1 Chile's financial development

We use data publicly accessed from the World Banks' website on June 2024. Figure 4 below shows the two facts mentioned in the main text.

Figure 4: Financial development



The importance of banks in other developing regions during 2007-2017 was even higher: 93% in Latin America and the Caribbean, 95.6% in Middle-Income countries, and 97.1% among Lower-Middle income countries.

A.2 The importance of banks for domestic credit in Chile: Survey evidence

Firms and households rely mostly on banks for financial services and local branches play a significant role.

Firms. To delve deeper into the importance of banks for private firms in Chile, we rely on firm-level data from the 2015 *Encuesta longitudinal de empresas* (ELE), a nationally representative survey that includes a module on firms' sources of credit. We calculate the percentage of private firms that borrow from banks and the percentage of firms for which banks constitute the main source of credit. We exclude Santiago, the capital city and home to approximately 29% of the population and bigger firms, to show that Santiago does not drive the results. The first two columns of Table 7 show that banks stand out as the main source of credit for large private firms outside the capital area.

Households. In 2007 and 2017, the *Encuesta financiera de hogares* (EFH), a nationally representative survey of households' financial behavior, included modules on the financial assets held by households; using these modules, we first document that households rely significantly on banks to purchase financial assets (compared to other institutions) and, secondly, that Internet banking remains limited.

In the EFH we separately observe the total amount invested by an individual household in stocks, mutual funds, fixed income, saving accounts, and other instruments. The survey contains information on the financial institution through which these assets were purchased. Panel A in Table 8 shows — for the sub-sample of

Table 7: Credit sources for firms (excluding Santiago)

Firm size	2015 ELE		
	% borrows from banks	% biggest loan comes from banks	% private employment
Micro	57.1	16.7	7.7
Small	66.4	29.6	39.3
Medium	77.7	42.1	21.9
Large	80.5	50.4	30.1

respondents with positive financial assets — what percentage of savings were allocated to each asset and the percentage of respondents who used banks to purchase that asset. Banks are the primary institutions used by households to invest in mutual funds and fixed-income assets and to open savings accounts. These represent around half the total investment in financial assets in 2007 and 2017.

The main concern regarding reliance on local branches is the expansion of Internet banking, which makes it easier to save and borrow from geographically distant banks. The EFH includes a question on the use of Internet banking, where people are asked whether they used the Internet to carry out a variety of financial transactions. Panel B in Table 8 shows the share of respondents who used the Internet to purchase financial assets or get new loans. In both cases, we calculate the percentage over the total number of respondents who either purchase assets or get new loans. Internet was used more intensively to purchase new financial assets than to get loans. Although there was an increase in both uses between 2007 and 2017, a majority of the transactions still happen in physical branches. Moreover, the survey does not distinguish between new transactions and the first transaction with a bank, therefore representing an upper bound on the reliance on the Internet to start new financial relationships with an institution.

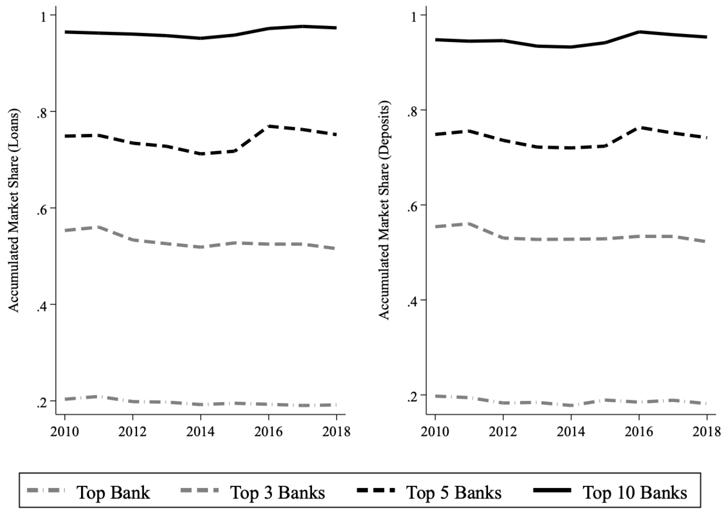
Table 8: Households' savings behavior

A. Asset types	2007 EFH		2017 EFH	
	% of assets	% purchased through banks	% of assets	% purchased through banks
Stock	19.1	36.1	15.1	44.2
Mutual Fund	30.8	80.4	24.3	83.7
Fixed-income	9.4	82.9	21.3	90.0
Saving Account	7.0	91.6	7.3	72.3
Other	33.6	-	31.7	-
B. Used the internet to...	% respondents in 2007		% respondents in 2017	
purchase financial assets	6.5		21.0	
get a loan	0.3		2.1	

A.3 Concentration in banking industry

We calculate the market share for top banks using aggregate data from the CMF. Results are shown in Figure 5.

Figure 5: Concentration in the Banking Industry



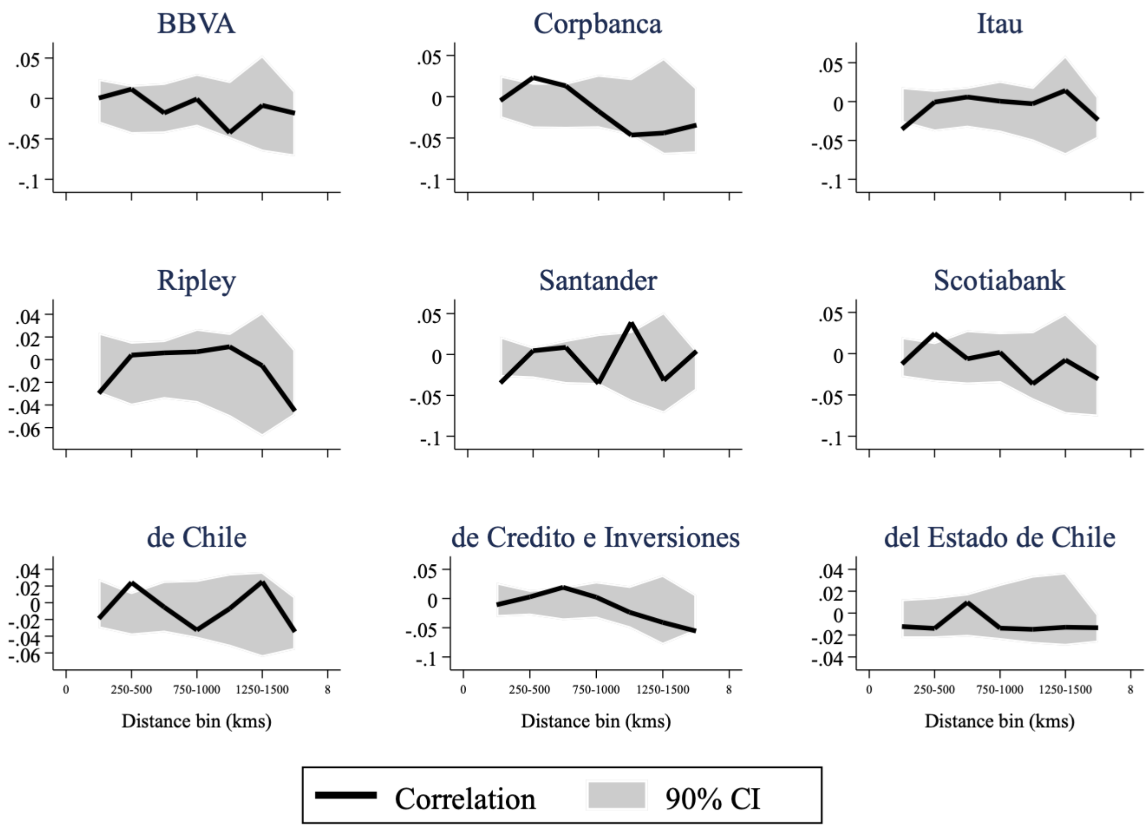
A.4 Spatial Clustering of Banks

To determine whether banks' economic activity is geographically clustered we follow the approach in Conley and Topa (2002), who study the degree of spatial correlation in unemployment between neighborhoods. More closely related to our setting, the approach has been used to study the degree of geographical concentration in market shares for a variety of consumer goods in Bronnenberg et al. (2007). For this exercise, we use aggregate data from the year 2015 (publicly available through the CMF) and focus exclusively on banks present in at least ten cities in 2015. These banks explained 96.8% of all the outstanding loans in that year. We exclude the metropolitan area around Santiago.

Extensive margin. First, we define the dummy variable X_{ib}, which takes the value 1 if bank b gave any loans in city i. We are interested in the correlation of X_{ib} between pairs of cities i, j as the distance between i and j changes. Figure 6 shows these correlations for each individual bank, where we have defined bins of 250 kilometers in size.

A correlation close to zero suggests that banks' presence is independent across cities. To determine how close to zero the observed measures of correlation would be if the X_{ib} were independent we follow the bootstrap approach in Conley and Topa (2002). We create 100 samples in which we randomize the identity of the cities in which each bank is present by drawing (with replacement) from the observed distribution of that particular bank. The two dashed lines in each figure show the 90% confidence interval across bootstrapped samples. For almost all banks and all distance bins we cannot reject that the observed correlations are different than what we would observe if banks' presence was independent across cities.

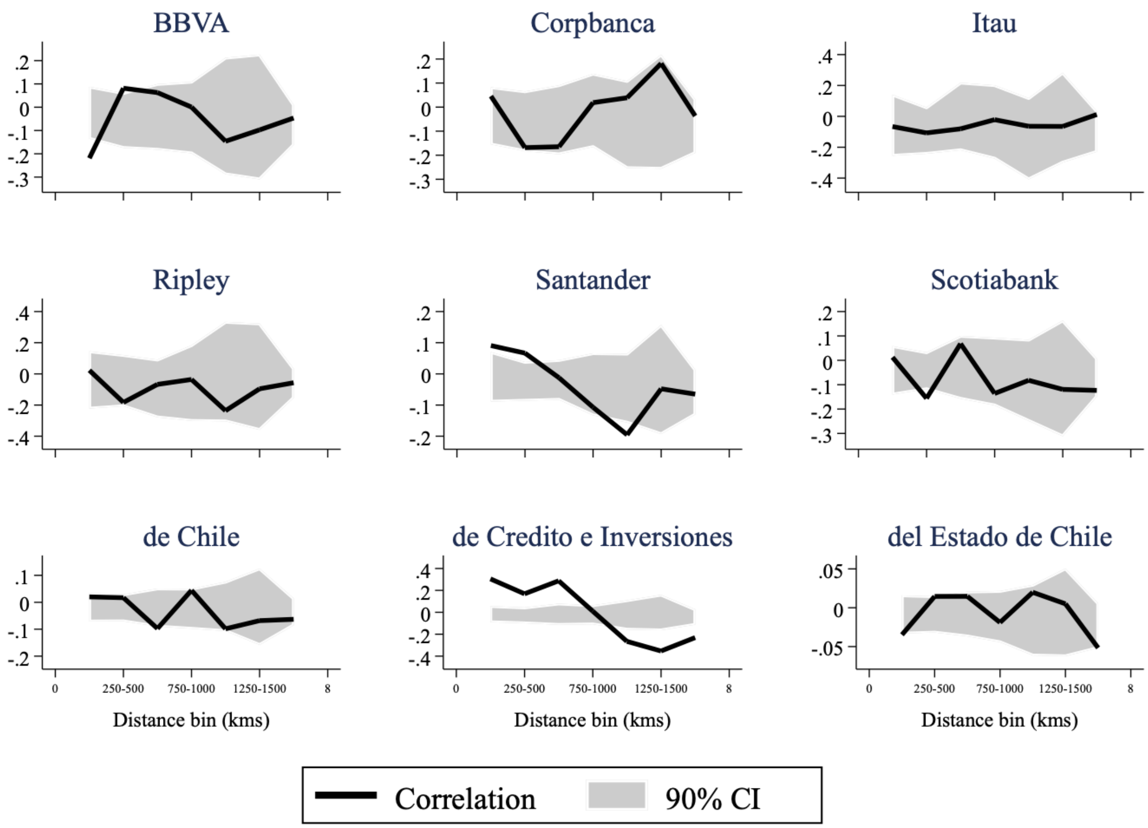
Figure 6: Spatial Correlation in Bank's Presence (Extensive Margin)



Intensive margin. To complement the previous analysis, we study whether there is spatial correlation in market shares (conditional on banks' presence). The approach is analogous to the one described above except that, in this case, the outcome variable is defined as the share of outstanding loans in city i issued by bank b in 2015. When we construct the confidence intervals, we randomize the particular market share of a bank in a city without changing the cities in which a bank is present, therefore focusing exclusively on the intensive margin.

Figure 7 shows the results. The conclusion is similar to the one before, albeit less clear-cut. *Banco de Crédito e Inversiones* and *Banco Santander* exhibit patterns of geographical clustering in market shares.

Figure 7: Spatial Correlation in Loan Market Shares (Intensive Margin)



A.5 Details on the Shift-Share design

The world price of salmon fluctuated during the period we analyzed. Figure 8 shows the world price of salmon.

Figure 8: World Price of Salmon

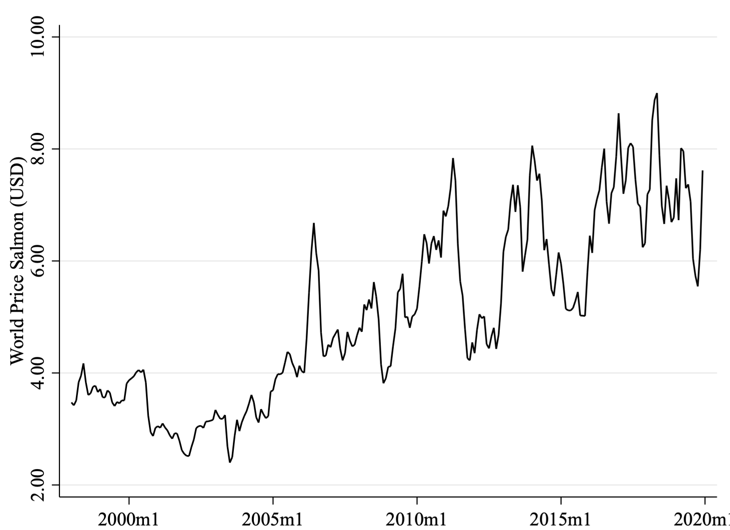
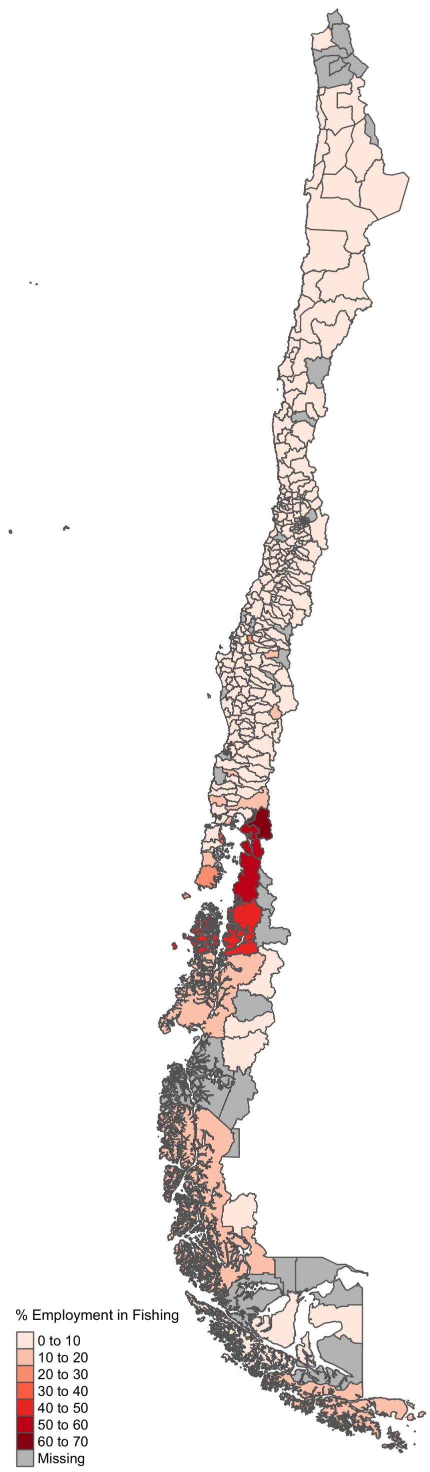


Figure 9 shows the share of local employment in the Fishing industry. The industry is mostly present in the Southern region.

Figure 9: Share of local employment in the fishing industry



B Mathematical appendix

B.1 Capitalist' problem

Throughout the description of the capitalist's problem in the appendix we drop n from the sub-indices for clarity, as the problem is identical for all capitalists. This problem can be divided in two stages. In a first stage, the capitalist decides from which banks to borrow in order to finance a level of investment i_t at the lowest cost. In a second stage she maximizes her welfare by deciding how much investment to make taking the cost of investment, $\mathcal{C}_t(i_t)$, as given. The problem at the second stage an be written as

$$\max_{\{C_t^c, D_{t+1}^b, k_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \Big[\log C_t^c + \alpha \log D_{t+1} \Big] \tag{28}$$

$$\underline{s.t:}\ C_t^c + \sum_b \frac{D_{t+1}^b}{P_t} + \frac{\mathcal{C}_t(i_{t-1})}{P_t} = \frac{\hat{r}_t}{P_t} k_t + \sum_b (1+\tilde{r}_t^b) \frac{D_t^b}{P_t} + \frac{T_{nt}}{P_{nt}} \tag{29}$$

$$k_t = k_{t-1}(1-\delta) + i_{t-1} \tag{30}$$

$$D_{t+1} = \Big[\sum_b {D_{t+1}^b}^{1-\frac{1}{\eta}} \Big]^{\frac{\eta}{\eta-1}} \tag{31}$$

$$k_0, \{D_0^b, L_0^b\}_b \tag{32}$$

and $\mathcal{C}_t(i_{t-1})$ comes from solving the minimization problem

$$\mathcal{C}_t(i_{t-1}) = \min_{\{L_t^b\}_b} \sum_{b \in \mathcal{B}} L_t^b (1 + r_{t-1}^b)$$

$$s.t: \Big[\sum_{b\in\mathcal{B}} (\gamma^b \tfrac{L_t^b}{P_{t-1}})^{\frac{\sigma-1}{\sigma}} \Big]^{\frac{\sigma}{\sigma-1}} = i_{t-1}. \tag{33}$$

We start with deriving $\mathcal{C}_t$. From the first order condition with respect to an arbitrary L_t^b,

$$\mu (\tfrac{\gamma^b}{P_{t-1}})^{\frac{\sigma-1}{\sigma}} \Big(\frac{i_{t-1}}{L_t^b} \Big)^{\frac{1}{\sigma}} = (1 + r_{t-1}^b), \tag{34}$$

where μ is the multiplier associated with the constraint in equation (33). Taking the ratio of equation (34) for two banks b, b'

$$\frac{L_t^{b'}}{L_t^b} = \Big[\frac{(1+r_{t-1}^b)}{(1+r_{t-1}^{b'})} \Big]^{\sigma} \Big[\frac{\gamma^{b'}}{\gamma^b} \Big]^{\sigma-1}. \tag{35}$$

From here, picking an arbitrary b':

$$i_{t-1} = \Big(\sum_{b\in\mathcal{B}} (\gamma^b \tfrac{L_t^b}{P_{t-1}})^{\frac{\sigma-1}{\sigma}} \Big)^{\frac{\sigma}{\sigma-1}} = (1+r_{t-1}^{b'})^{\sigma} (\gamma^{b'})^{1-\sigma} \tfrac{L_t^{b'}}{P_{t-1}} \Big[\sum_{b\in\mathcal{B}} (\tfrac{1+r_{t-1}^b}{\gamma^b})^{1-\sigma} \Big]^{-\frac{\sigma}{1-\sigma}}. \tag{36}$$

Defining $R_{t-1} \equiv \Big[\sum_{b\in\mathcal{B}} (\frac{1+r_{t-1}^b}{\gamma^b})^{1-\sigma} \Big]^{\frac{1}{1-\sigma}}$, the previous equation can be written as

$$i_{t-1} R_{t-1}^{\sigma} = (1+r_{t-1}^b)^{\sigma} (\gamma^b)^{1-\sigma} \tfrac{L_t^b}{P_{t-1}} \tag{37}$$

and from here we can express the equilibrium loans from bank b as

$$\frac{L_t^b}{P_{t-1}} = \left(\frac{R_{t-1}}{1+r_{t-1}^b}\right)^{\sigma} i_{t-1}(\gamma^b)^{\sigma-1}. \tag{38}$$

as in the main text. From equation (38) and the definition of $\mathcal{C}_t(i_{t-1})$,

$$\mathcal{C}_t(i_{t-1}) = \sum_{b\in\mathcal{B}} L_t^b(1+r_{t-1}^b) = i_{t-1}R_{t-1}P_{t-1}. \tag{39}$$

Plugging $\mathcal{C}_t(i_{t-1})$ into the budget constraint equation (29) and law of motion for capital equation (30), the problem of the capitalist becomes

$$\max_{\{C_t^c, D_{t+1}^b, k_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \Big[\log C_t^c + \alpha \log D_{t+1}\Big] \tag{40}$$

$$\underline{s.t:}\ C_t^c + \sum_b \frac{D_{t+1}^b}{P_t} = (\frac{\hat{r}_t - R_{t-1}P_{t-1}}{P_t})k_t + \frac{(1-\delta)R_{t-1}P_{t-1}}{P_t}k_{t-1} + \sum_b R_t^b \frac{D_t^b}{P_t} + \frac{T_{nt}}{P_{nt}} \tag{41}$$

$$D_{t+1} = \Big[\sum_b {D_{t+1}^b}^{1-\frac{1}{\eta}}\Big]^{\frac{\eta}{\eta-1}} \tag{42}$$

$$k_0, \{D_0^b, L_0^b\}_b \tag{43}$$

First-order conditions with respect to k_t, C_t^c and D_{t+1}^b yield

$$\lambda_t \frac{\hat{r}_t}{P_t} + \lambda_{t+1}\frac{(1-\delta)R_tP_t}{P_{t+1}} = \lambda_t \frac{R_{t-1}P_{t-1}}{P_t} \tag{44}$$

$$\frac{\beta^t}{C_t^c} = \lambda_t \tag{45}$$

$$\beta^t \alpha D_{t+1}^{\frac{1-\eta}{\eta}} (D_{t+1}^b)^{-\frac{1}{\eta}} + \lambda_{t+1}\frac{1+\tilde{r}_t^b}{P_{t+1}} = \frac{\lambda_t}{P_t} \tag{46}$$

Equation (44) captures that the capitalist equates the marginal benefit of an extra unit of capital in period t, which consists of the per-period rental rate and the extra capital she would carry to period $t+1$, to its cost, which is the sum of loan repayment in period t. The first order condition with respect to consumption, equation (45), is standard. The first order condition with respect to deposits in a specific bank, equation (46), reflects the dual role of deposits in the model: they increase utility and transfer resources between periods.

Capitalist's demand for deposits. By combining equation (44) and equation (45) we derive the following Euler equation,

$$\frac{P_{t+1}C_{t+1}}{P_tC_t} = \beta(1-\delta)\frac{R_tP_t}{R_{t-1}P_{t-1} - \hat{r}_t}. \tag{47}$$

Replacing equation (45) into equation (46), and then replacing $C_{t+1}P_{t+1}$ from the Euler equation above, we get

$$\frac{\alpha}{D_{t+1}}\left(\frac{D_{t+1}}{D_{t+1}^b}\right)^{\frac{1}{\eta}} = \frac{1}{P_tC_t}\left[1 - \frac{(1+\tilde{r}_t^b)(R_{t-1}P_{t-1} - \hat{r}_t)}{(1-\delta)R_tP_t}\right].$$

Dividing this equation for two banks, b and b', we get

$$\frac{D^b_{t+1}}{D^{b'}_{t+1}} = \left(\frac{q^b_t}{q^{b'}_t}\right)^{-\eta}, \tag{48}$$

where we defined q^b_t as

$$q^b_t \equiv 1 - \left(1 + \tilde{r}^b_t\right) / \left(\frac{(1-\delta)R_t P_t}{R_{t-1}P_{t-1} - \hat{r}_t}\right). \tag{49}$$

Let us define the deposit price index as

$$Q_t \equiv \left(\sum_b (q^b_t)^{1-\eta}\right)^{\frac{1}{1-\eta}}. \tag{50}$$

It follows from equation (48) and the definition of D_{t+1} that the supply of deposits to bank b is given by

$$D^b_{t+1} = D_{t+1}\left(\frac{Q_t}{q^b_t}\right)^{\eta}. \tag{51}$$

Replacing this back into equation (46) we get the usual equalization of expenditure on the two 'goods' available to the consumer

$$D_{t+1}Q_t = \alpha P_t C_t. \tag{52}$$

The nominal value invested on deposits at t is given by

$$\sum_b D^b_{t+1} = \sum_b D_{t+1}(\tfrac{Q_t}{q^b_t})^{\eta} = D_{t+1}Q^{\eta}_t \overbrace{\sum_b (q^b_t)^{-\eta}}^{\equiv \tilde{Q}_t}. \tag{53}$$

Then, plugging this into the budget constraint equation (41), using equation (52) and defining M_t to be the real income for capitalists at t we get

$$M_t \equiv \hat{r}_t k_t + \sum_b (1+\tilde{r}^b_{t-1})D^b_t - (k_t - (1-\delta)k_{t-1})R_{t-1}P_{t-1} + T_{nt} \tag{54}$$

$$\frac{Q_t D_{t+1}}{\alpha} + D_{t+1}Q^{\eta}_t\tilde{Q}_t = M_t \to D_{t+1} = \frac{\alpha M_t}{Q_t + \alpha Q^{\eta}_t \tilde{Q}_t} \tag{55}$$

$$\text{and } P_t C^c_t = \frac{Q_t M_t}{Q_t + \alpha Q^{\eta}_t \tilde{Q}_t}. \tag{56}$$

Furthermore, notice that given our specification of transfers $T_{nt} = \sum_b L^b_t r^b_{t-1} - \sum_b D^b_t \tilde{r}^b_{t-1}$,

$$M_t \equiv \hat{r}_t k_t + \sum_b D^b_t + \sum_b r^b_{t-1}L^b_t - (k_t - (1-\delta)k_{t-1})R_{t-1}P_{t-1} \tag{57}$$

$$= \hat{r}_t k_t + \sum_b D^b_t + \sum_b r^b_{t-1}L^b_t - i_t R_t P_t \tag{58}$$

$$= \hat{r}_t k_t + \sum_b D^b_t - \sum_b L^b_t \tag{59}$$

Plugging equation (53) into our previous equation,

$$M_t \equiv \hat{r}_t k_t + \frac{\alpha M_t Q_{t-1}^{\eta}\tilde{Q}_{t-1}}{Q_{t-1}+\alpha Q_{t-1}^{\eta}\tilde{Q}_{t-1}} - \sum_b L_t^b \implies M_t = (1+\alpha Q_{t-1}^{\eta-1}\tilde{Q}_{t-1})(\hat{r}_t k_t - \sum_b L_t^b) \tag{60}$$

Plugging this into equation (56),

$$P_t C_t = \overbrace{\frac{1+\alpha Q_{t-1}^{\eta-1}\tilde{Q}_{t-1}}{1+\alpha Q_t^{\eta-1}\tilde{Q}_t}}^{\gamma_t^Q}\Big(\hat{r}_t k_t - \sum_b L_t^b\Big). \tag{61}$$

The intuition for this equation is that changes in the deposit interest rate have different effects when they happened in the past or when they happen in the present. Higher past deposit rates increase current income and consumption, while higher current interest rates induce less consumption and more savings. The Euler equation becomes,

$$\frac{\gamma_{t+1}^Q}{\gamma_t^Q}\frac{\hat{r}_{t+1}k_{t+1}-\sum_b L_{t+1}^b}{\hat{r}_t k_t - \sum_b L_t^b} = \frac{\beta(1-\delta)R_t P_t}{R_{t-1}P_{t-1}-\hat{r}_t} \tag{62}$$

$$\hat{r}_{t+1}i_t + \hat{r}_{t+1}k_t(1-\delta) - R_t^{\sigma}P_t i_t \sum_b (\gamma^b)^{\sigma-1}(1+r_n)^{-\sigma} = \frac{\gamma_T^Q}{\gamma_{t+1}^Q}\frac{(\hat{r}_t k_t - \sum_b L_t^b)\beta(1-\delta)R_t P_t}{R_{t-1}P_{t-1}-\hat{r}_t} \tag{63}$$

$$\hat{r}_{t+1}i_t - R_t^{\sigma}P_t i_t = \frac{\gamma_T^Q}{\gamma_{t+1}^Q}\frac{(\hat{r}_t k_t - \sum_b L_t^b)\beta(1-\delta)R_t P_t}{R_{t-1}P_{t-1}-\hat{r}_t} - \hat{r}_{t+1}k_t(1-\delta) \tag{64}$$

From where, defining $\tilde{R}_t \equiv \sum_b (\gamma^b)^{\sigma-1}(1+r_n)^{-\sigma}$

$$i_t = \Big\{\frac{\gamma_T^Q}{\gamma_{t+1}^Q}\frac{(\hat{r}_t k_t - \sum_b L_t^b)\beta(1-\delta)R_t P_t}{R_{t-1}P_{t-1}-\hat{r}_t} - \hat{r}_{t+1}k_t(1-\delta)\Big\}\Big\{\frac{1}{\hat{r}_{t+1}-R_t^{\sigma}P_t\tilde{R}_t}\Big\} \tag{65}$$

Derivatives. We collect the derivatives of deposits and loans with respect to the interest rate of individual banks. From the definition of Q and $\tilde{Q}$,

$$\frac{\partial Q_t}{\partial q_t^b} = \Big(\frac{Q_t}{q_t^b}\Big)^{\eta} \text{ and } \frac{\partial \tilde{Q}_t}{\partial q_t^b} = -\eta(q_t^b)^{-(1+\eta)}. \tag{66}$$

Then, the derivative of D_n^b with respect to the cost q becomes

$$\frac{\partial D_n^b}{\partial q_n^b} = \underbrace{\eta\frac{D_n^b}{Q_n}\Big(\frac{Q_n}{q_n^b}\Big)^{\eta}}_{\frac{\partial D_n^b}{\partial Q_n}\frac{\partial Q_n}{\partial q_n^b}} \underbrace{-\eta\frac{D_n^b}{q_n^b}}_{\frac{\partial D_n^b}{\partial q_n^b}} - \underbrace{\frac{D_n^b}{D_n}}_{\frac{\partial D_n^b}{\partial D_n}}\underbrace{\frac{D_n}{Q_n+\alpha Q_n^{\eta}\tilde{Q}_n}\Big(\frac{Q_n}{q_n^b}\Big)^{\eta}\Big(1+\alpha\eta Q_n^{\eta-1}\tilde{Q}_n - \alpha\frac{\eta}{q_n^b}\Big)}_{\frac{\partial D_n}{\partial q_n^b}}$$

To recover the derivative with respect to $\tilde{r}$, we note that

$$\frac{\partial D_n^b}{\partial \tilde{r}_n^b} = \frac{\partial D_n^b}{\partial q_n^b}\frac{\partial q_t^b}{\partial \tilde{r}_t^b} = -\frac{\partial D_n^b}{\partial q_n^b}\frac{R_{t-1}P_{t-1}-\hat{r}_t}{(1-\delta)R_t P_t} \overbrace{=}^{\text{in SS}} -\beta\frac{\partial D_n^b}{\partial q_n^b} \tag{67}$$

where the last equality holds only in steady state.

The derivative of an individual city-bank pair's loans with respect to the interest rate is

$$\frac{\partial L_n^b}{\partial r_n^b} = \underbrace{\sigma \frac{(L_n^b)^2}{i_n R_n P_n}}_{\frac{\partial L_n^b}{\partial R_n}\frac{\partial R_n}{\partial r_n}} \underbrace{-\sigma \frac{L_n^b}{1+r_n^b}}_{\frac{\partial L_n^b}{\partial r_n^b}} + \left(\frac{L_n^b}{i_n}\right)\frac{\partial i_n}{\partial r_n^b}$$

which follows from $\frac{\partial R_n}{\partial r_n} = \frac{L_n^b}{i_n P_n}$. To solve for $\frac{\partial i_n}{\partial r_n}$ start from taking the derivative in equation (65),

$$\frac{\partial i_n}{\partial r_n^b} = \frac{\partial i_n}{\partial R_n}\frac{\partial R_n}{\partial r_n^b} + \frac{\partial i_n}{\partial \tilde{R}_n}\frac{\partial \tilde{R}_n}{\partial r_n^b} \tag{68}$$

Start by taking derivatives of each type of index,

$$\frac{\partial R_n}{\partial r_n^b} = \left(\frac{R_n}{1+r_n^b}\right)^{\sigma}(\gamma^b)^{\sigma-1} \text{ and } \frac{\partial \tilde{R}_n}{\partial r_n^b} = \frac{-\sigma\gamma^{\sigma-1}}{(1+r)^{\sigma+1}} \tag{69}$$

Putting all together an dropping time indices (as we focus on the steady state value)

$$\frac{\partial i_n}{\partial r_n^b} = i_n\Big\{\Big(1+\frac{\sigma R_n^{\sigma} P_n \tilde{R}_n}{\hat{r}_n^b - R_n^{\sigma} P_n \tilde{R}_n}\Big)\frac{(R_n\gamma^b)^{\sigma-1}}{(1+r_n)^{\sigma}} - \frac{R_n^{\sigma} P_n}{\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n}\frac{\sigma\gamma^{\sigma-1}}{(1+r_n^b)^{\sigma+1}} + \frac{\hat{r}_n\delta(1-\delta)}{\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n}\Big(\frac{R_n}{1+r_n^b}\Big)^{\sigma}(\gamma^b)^{\sigma-1}\Big\} \tag{70}$$

$$= L_n^b\Big\{\Big(1+\frac{\sigma R_n^{\sigma} P_n \tilde{R}_n}{\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n}\Big)\frac{1}{R_n P_n} - \frac{\sigma}{(\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n)(1+r_n^b)}\Big\} + \frac{\hat{r}_n k_n(1-\delta)}{\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n}\Big(\frac{R_n}{1+r_n^b}\Big)^{\sigma}(\gamma^b)^{\sigma-1} \tag{71}$$

$$= \frac{L_n^b}{\hat{r}_n - R_n^{\sigma} P_n \tilde{R}_n}\Big\{\frac{\hat{r}_n + (\sigma-1)R_n^{\sigma} P_n \tilde{R}_n}{R_n P_n} - \frac{\sigma}{1+r_n^b} + \frac{\hat{r}_n(1-\delta)}{\delta}\Big\} \tag{72}$$

B.1.1 Steady state with symmetric banks.

In a steady state $\frac{R_n P_n}{R_n P_n - \hat{r}_n} = \frac{1}{\beta(1-\delta)}$.

B.2 Bank's problem - Wholesale funding

The problem of the bank at $t = 0$ is

$$\begin{aligned}
&\max_{\{\{r_{nt},\tilde{r}_{nt}\},W_t\}_{t=0}^{\infty}} && \sum_{t=0}^{\infty}\beta^t \sum_n L_{nt}(1+r_{nt-1}) + D_{nt+1} - L_{nt+1} - D_{nt}(1+\tilde{r}_{nt-1}) \\
& && -\tau\left(\frac{W_t}{\sum_n D_{nt}}\right)(1+r_{t-1}^W)W_t \\
&\underline{s.t:}\ [\lambda_t^b] && \sum_n L_{nt+1} = \sum_n D_{nt+1} + W_{t+1} \quad \forall t \\
&[\bar{\lambda}_t] && W_{t+1} \geq 0 \quad \forall t
\end{aligned}$$

Where profits reflect the discounted sum of per-period cash flows. At each t, inflows come from maturing loans issued to firms and other banks and new deposits borrowed from capitalists or other banks. Outflows come from extending new loans to firms or other banks and maturing deposits borrowed from capitalists and other banks.

The wholesale cost is the equilibrium interest rate on repayments (that clear the wholesale market), and in addition, there is an increasing function, $\tau(\cdot)$, of the ratio of wholesale funding to deposits. This function τ captures that the more reliable on wholesale funding a bank is, the more risky their operations (?) The first-order conditions with respect to active and passive interest rates are, respectively,

$$\frac{\partial L_{nt+1}}{\partial r_{nt}}[-\beta^t + \beta^{t+1}(1+r_{nt}) - \lambda_t] + L_{nt+1}\beta^{t+1} = 0,$$
$$\frac{\partial D_{nt+1}}{\partial \tilde{r}_{nt}}[-\beta^t + \beta^{t+1}(1+\tilde{r}_{nt}) - \beta^{t+1}\tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}^2}{D_{t+1}^2} - \lambda_t] + D_{nt+1}\beta^{t+1} = 0,$$
$$\beta^{t+1}\tau\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W) + \beta^{t+1}\tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}}{D_{t+1}} - \lambda_t = 0.$$

where $D_t \equiv \sum_n D_{nt}$
Dividing by β^t and normalizing the multipliers as $\mu_t = \frac{\lambda_t}{\beta^{t+1}}$, after some manipulation we obtain

$$\frac{\partial L_{nt+1}}{\partial r_{nt}}\left[\frac{1}{\beta} - (1+r_{nt}) + \mu_t\right] = L_{nt+1}, \tag{73}$$
$$\frac{\partial D_{nt+1}}{\partial \tilde{r}_{nt}}\left[\frac{1}{\beta} - (1+\tilde{r}_{nt}) + \tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}^2}{D_{t+1}^2} + \mu_t\right] = D_{nt+1}, \tag{74}$$
$$\tau\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W) + \tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}}{D_{t+1}} = \mu_t \tag{75}$$

Let us write this in terms of elasticities. First, let us define:

$$\varepsilon_L \equiv -\frac{\partial L_{nt+1}}{\partial r_{nt}}\frac{1+r_{nt}}{L_{nt+1}} \tag{76}$$
$$\varepsilon_D \equiv \frac{\partial D_{nt+1}}{\partial \tilde{r}_{nt}}\frac{1+\tilde{r}_{nt}}{D_{nt}} \tag{77}$$

$$(1+r_{nt})^* = \frac{\varepsilon_L}{\varepsilon_L - 1}\left[\frac{1}{\beta} + \tau\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W) + \tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}}{D_{t+1}}\right], \tag{78}$$
$$(1+\tilde{r}_{nt})^* = \frac{\varepsilon_D}{\varepsilon_D + 1}\left[\frac{1}{\beta} + \tau\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W) + \tau'\left(\frac{W_{t+1}}{D_{t+1}}\right)(1+r_t^W)\frac{W_{t+1}}{D_{t+1}}\frac{D_{t+1}+W_{t+1}}{D_{t+1}}\right] \tag{79}$$

B.3 Symmetric banks

$$L_n^b = \frac{P_n i_n B_n^{\frac{\sigma}{1-\sigma}}}{\gamma_n} \tag{80}$$
$$R_n = B_n^{\frac{1}{1-\sigma}}\frac{1+r_n^b}{\gamma_n} \tag{81}$$
$$\tag{82}$$

Let's unpack that en el symmetric case:

$$\sum_b L = i_n \gamma_n^{\sigma-1} R_n^{\sigma} P_n B(1+r_n)^{-\sigma} \tag{83}$$

$$= i_n \gamma_n^{\sigma-1} \gamma_n^{-\sigma} B^{\frac{\sigma}{1-\sigma}} (1+r)^{\sigma} P_n B(1+r_n)^{-\sigma} \tag{84}$$

$$= \frac{i_n B^{\frac{1}{1-\sigma}} P_n}{\gamma} \tag{85}$$

Putting all together, in the steady state with symmetric banks

$$M_n \equiv \hat{r}_n k_n + \frac{\alpha M_n Q_n^{\eta} \tilde{Q}_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} - \frac{i_n B^{\frac{1}{1-\sigma}} P_n}{\gamma} \implies M_n = \frac{Q_n k_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} \left(\hat{r}_n - \frac{\delta B^{\frac{1}{1-\sigma}} P_n}{\gamma} \right) \tag{86}$$

So that the derivative of interest becomes,

$$\frac{\partial i_n}{R_n} \frac{1}{i_n} = -\frac{P_n}{R_n P_n \hat{r}_n} \left[i_t + \beta(1-\delta) \frac{M_n}{R_n P_n - \hat{r}_n} \right] \tag{87}$$

$$= -\frac{1}{R_n \beta(1-\delta)} \left[1 + \frac{M_n}{\delta k_n R_n P_n} \right] \tag{88}$$

$$= -\frac{1}{R_n \beta(1-\delta)} \left[1 + \frac{1}{R_n P_n} \frac{Q_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} \left(\frac{\hat{r}_n}{\delta} - \frac{B_n^{\frac{1}{1-\sigma}} P_n}{\gamma} \right) \right] \tag{89}$$

$$= -\frac{1}{R_n \beta(1-\delta)} \left[1 + \frac{Q_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} \left(\frac{(1-\beta(1-\delta))}{\delta} - \frac{B_n^{\frac{1}{1-\sigma}}}{R_n \gamma} \right) \right] \tag{90}$$

But our key object of interest is

$$\frac{L_n}{i_n P_n}(1+r_n) \frac{\partial i_n}{R_n} \frac{1}{i_n} = -\frac{L_n}{i_n P_n}(1+r_n) \frac{1}{R_n \beta(1-\delta)} \left[1 + \frac{Q_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} \left(\frac{(1-\beta(1-\delta))}{\delta} - \frac{B_n^{\frac{1}{1-\sigma}}}{R_n \gamma} \right) \right] \tag{91}$$

$$= -\frac{1+r}{B_n^{\frac{\sigma}{\sigma-1}} \gamma} \frac{1}{R_n \beta(1-\delta)} \left[1 + \frac{Q_n}{Q_n + \alpha Q_n^{\eta} \tilde{Q}_n} \left(\frac{(1-\beta(1-\delta))}{\delta} - \frac{B_n^{\frac{1}{1-\sigma}}}{R_n \gamma} \right) \right] \tag{92}$$

$$= -\frac{1}{B_n} \frac{1}{\beta(1-\delta)} \left[1 + \frac{1}{1 + \alpha Q_n^{\eta-1} \tilde{Q}_n} \left(\frac{(1-\beta(1-\delta))}{\delta} - \frac{1}{1+r_n} \right) \right] \tag{93}$$

For $\beta(1-\delta) \approx 1$, this becomes

$$\approx -\frac{1}{B_n} \left(1 - \frac{1}{(1 + \alpha Q_n^{\eta-1} \tilde{Q}_n)(1+r_n)} \right) \tag{94}$$

When banks are offering high interest rates on deposits in a city (meaning that Q is small), then the last term is large. This means that the big parenthesis is closer to 0. Which I guess means that there is little investment being done in the city and people prefer to use deposits.

C Estimation appendix

C.1 Mapping the differences-in-differences result to σ

Our outcome variable is the log of real loans issued by bank b in city n at t. Using $\tilde{L}$ to denote real loans,

$$\log\left(\tilde{L}^b_{nt}\right) = \log(i^b_n) + \gamma^b_n + \sigma\Big[\log R_{nt} - \log(1 + r^b_{nt})\Big] \tag{95}$$

Around the symmetric case, and assuming that the last term in the equation for ^{L} remains fairly constant in time,

$$\log(1 + r^b_{nt}) \approx \log(\sigma) + \log(1 - \tfrac{1}{B_{nt}}) + \beta_n + \log(\mu^b_t), \tag{96}$$

where B_{nt} is the number of banks competing in city n and period t. Because the number of banks does not change in treated cities around the time of the merger, the last term boils down to changes in the marginal cost of bank b. Our inclusion of period-bank fixed effects addresses these changes. Then, differencing our previous equation

$$\Delta\log(L) = (1 + \Delta^L) = \Delta\log(i) + \sigma\Delta\log(R) \tag{97}$$

Start by taking logs in the defition of R,

$$\log(R) = \frac{\log(\sum_b \frac{1+r}{\gamma}^{1-\sigma})}{1-\sigma}. \tag{98}$$

Under the symmetric banks assumption,

$$\Delta\log(R) = \frac{1}{1-\sigma}\log\Big(1 + \frac{(1 + r^{1-\sigma}_{b'}) - (1 + r_b)^{1-\sigma}}{B_{t_0}(1 + r_b)^{1-\sigma}}\Big) \tag{99}$$

$$\approx \frac{1}{B_{t_0}(1-\sigma)}\Big(\Big(\frac{1 + r_{b'}}{1 + r_b}\Big)^{1-\sigma} - 1\Big) \tag{100}$$

Where we have used that interest rates for banks $b \neq b'$ do not change differentially in treated and control cities. Focusing on investment,

$$\log(i_n) = \frac{\sigma}{\sigma-1}\log\Big(\gamma_n\sum_b L_n^{\frac{\sigma-1}{\sigma}}\Big) \tag{101}$$

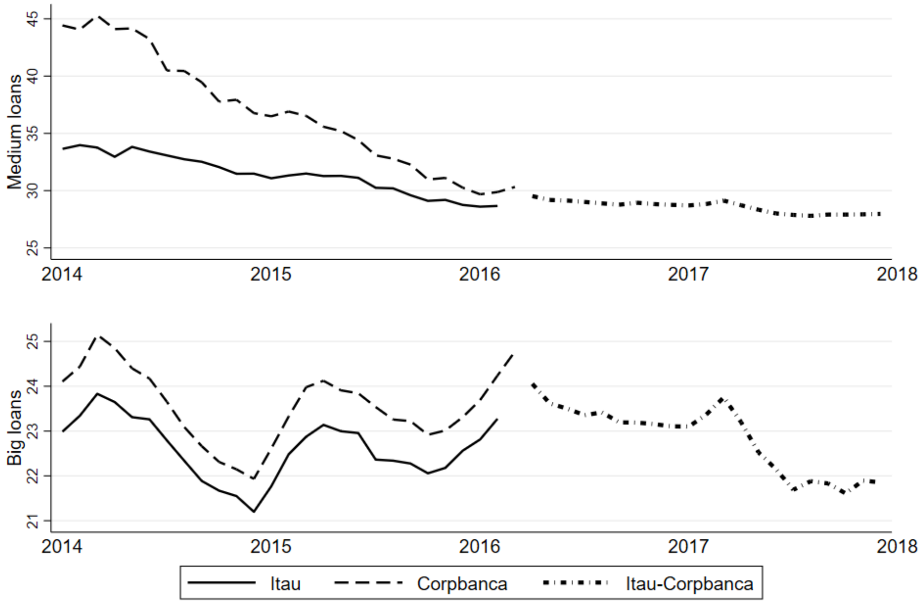
$$\rightarrow \Delta\log(i_n) = \frac{\sigma}{\sigma-1}\log\Big(\frac{\sum_b L_n^{\frac{\sigma-1}{\sigma}}}{\sum_b L_n^{\frac{\sigma-1}{\sigma}}}\Big) \tag{102}$$

$$= \frac{\sigma}{\sigma-1}\log\Big((1 + \Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1 + \Delta^{L'})^{\frac{\sigma}{\sigma-1}} - (1 + \Delta^L)^{\frac{\sigma}{\sigma-1}}}{B}\Big) \tag{103}$$

$$\approx \frac{\sigma}{\sigma-1}\Big[(1 + \Delta^L)^{\frac{\sigma-1}{\sigma}}\Big(1 - \frac{1}{B}\Big) + \frac{(1 + \Delta^{L'})^{\frac{\sigma}{\sigma-1}}}{B} - 1\Big] \tag{104}$$

Where $(1 + \Delta^L)$ is the growth in loans for all banks except for Itaú, which is captured by $(1 + \Delta^{L'})$. This can be written as

Figure 10: Interes Rates around the time of the Merger



Source: CMF. Medium loans: 2000-9000 USD. Big loans: 9000-220000 USD.

$$(1+\Delta^{L'}) = \Delta\log(i_n) - \sigma\Delta\log(1+r_{b'}) \tag{105}$$

Plugging the expression for $\Delta log(i_n)$ into $\Delta^{L\prime}$ and Δ^L,

$$(1+\Delta^L) \approx \frac{\sigma}{\sigma-1}\left[(1+\Delta^L)^{\frac{\sigma-1}{\sigma}}\left(1-\frac{1}{B}\right)+\frac{(1+\Delta^{L'})^{\frac{\sigma}{\sigma-1}}}{B}-1\right]+\sigma\frac{1}{B_{t_0}(1-\sigma)}\left(\left(\frac{1+r_{b'}}{1+r_b}\right)^{1-\sigma}-1\right) \tag{106}$$

$$(1+\Delta^{L'}) \approx \frac{\sigma}{\sigma-1}\left[(1+\Delta^L)^{\frac{\sigma-1}{\sigma}}\left(1-\frac{1}{B}\right)+\frac{(1+\Delta^{L'})^{\frac{\sigma}{\sigma-1}}}{B}-1\right]-\sigma\Delta\log(1+r_{b'}). \tag{107}$$

Incorporating observable interest rate changes and the DID estimate. The CMF reports aggregate interest rates on loans, disaggregated by the amount of the loan. Figure 10 shows the evolution of interest rates for Itaú and Corpbanca before and after the merger, for medium and big loans.

We will keep the interest rate for big loans, in which case

$$\left(\frac{1+r_{b'}}{1+r_b}\right)^{1-\sigma} = 0.986^{1-\sigma} \text{ and } \log\left(\frac{1+r'}{1+r}\right) = -0.005 \tag{108}$$

Then, our two equations of interest become

$$(1+\Delta^L) \approx \frac{\sigma}{\sigma-1}\left[(1+\Delta^L)^{\frac{\sigma-1}{\sigma}}\left(1-\frac{1}{B}\right)+\frac{(1+\Delta^{L'})^{\frac{\sigma}{\sigma-1}}}{B}-1\right]+\sigma\frac{0.986^{1-\sigma}-1}{B(1-\sigma)} \tag{109}$$

$$(1+\Delta^{L'}) \approx \frac{\sigma}{\sigma-1}\left[(1+\Delta^L)^{\frac{\sigma-1}{\sigma}}\left(1-\frac{1}{B}\right)+\frac{(1+\Delta^{L'})^{\frac{\sigma}{\sigma-1}}}{B}-1\right]+0.005\sigma. \tag{110}$$

$$1+\Delta^L \tag{111}$$

Our difference-in-differences estimate is the average Δ^L. The average number of banks in the treated cities is 5. Plugging in these values, we end up with a system of two equations into two unknowns, $(1+\Delta^{L'})$ and σ.