Investment Costs across Space: The Role of Banks' Branch Network*

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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 the welfare and productivity costs induced by regional interest rate disparities. We find that eliminating local market power would lead to 19% gains in productivity, while financial sector policies that equalize the cost of funds across banks would can lead to gains of productivity of around 3%.

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

JEL codes: G21, O16, R12.

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1 Introduction

Studies in spatial economics often begin when confronting purely geographic variation in a variable of interest. Spatial disparities in wages, goods prices, and rents have motivated a large body of research and policy proposals. In this paper, we shift the focus to an important determinant of local development: the cost of investment. We address several questions: Do the interest rates firms pay on their loans differ between cities? What drives these differences? What are the local and aggregate costs of such disparities?

We start with an empirical analysis of the first two questions. Using loan-level data covering the universe of bank loans in Chile, where we observe detailed characteristics of the borrower and the loan, we document that interest rates vary significantly between cities. Interest rates in cities at the 25th percentile of the distribution are approximately 220 basis points lower than in cities at the 75th percentile. Regarding the drivers of interest rate differences, we first document that cities with stronger competition have lower interest rates. We then show that better access to deposits leads banks to decrease interest rates on their loans. Therefore, local interest rates tend to be lower when local banks are connected to a larger pool of deposits throughout the country.

Our evidence on geographic dispersion in interest rates is novel. Most empirical studies on the spatial dimensions of banking rely on aggregated data on deposits and loans at the city-bank level. Typically, these data only report the average interest rate in all outstanding loans or deposits, which led previous studies to abstract the detailed interest rate analysis (Aguirregabiria et al., 2024; Bustos et al., 2020; Oberfield et al., 2024). We overcome this limitation by using detailed loan-level data from Chile, which provides the loan interest rate and a comprehensive set of borrower and loan characteristics.

Our first finding is that the differences in interest rates between cities are substantial. A naive comparison of average interest rates shows that cities in the 25th and 75th percentiles of the distribution differ by approximately 460 basis points. However, this raw difference overlooks spatial variation in loan composition, bank identity, and firm characteristics. To address this, we regress loan-specific interest rates on a set of controls, including the firms' size, industry, and proxies for risk (see Section 3 for details). After accounting for these observable factors, the gap between cities in the 25th and 75th percentiles narrows to 220 basis points. 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 in the local loan market as a control, we find a positive and statistically significant relationship between local concentration and interest rates. This result is in line with theoretical models of bank competition (Aguirregabiria et al., 2024), but the richness of our data allows us to substantiate the role of competition empirically using data on interest rates and controlling for other characteristics (such as risk) that can also vary geographically.

In the previous analysis, we include bank fixed effects to isolate the effect of geography on interest rates. 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 networks, we relate cost differences across banks to the pool of deposits available to each bank. 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 for loans and an increase in lending (Kashyap et al., 2002; Hanson et al., 2015). Evidence from Brazil and the United States is consistent with this mechanism (Gilje et al., 2016; Bustos et al., 2020). We provide additional evidence using comprehensive data from Chile: Following a positive regional shock to deposits, banks exposed to the shock issued more loans in cities that were not directly exposed to the deposit shock but not one-for-one.

To quantify the welfare and productivity costs of interest rate dispersion, 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, 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. Through the lens of the theoretical model, local interest rates in a city are driven by the marginal cost of raising funds for banks with local branches and the extent of local competition. Introducing trade, migration, and endogenous savings and investment decisions allows us to incorporate rich general equilibrium effects of interest rate differentials into our quantification.

We follow three complementary approaches to estimate the model. 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. Second, we use the effect of exogenous deposit shocks on lending to quantify the frictions in the wholesale market. If it was infinitely costly to operate in the wholesale market, banks should increase their lending by the same amount of an increase in deposits, while we find that they do so less than one-for-one. Finally, we calibrate the remaining parameters to match data on loans, wages, and employment.

We use the estimated model to quantify the welfare and productivity effects induced by the main drivers of interest rate dispersion: market power in interest rate setting and cost differences across banks. The model consists of two types of agents: workers, who are mobile between cities, and local capitalists which are immobile. In our first counterfactual, the government taxes workers and uses the proceeds to subsidize lending and borrowing by city-banks to undo their local market power. This leads to productivity gains of 19%, while workers' welfare decreases by 2.4% and capitalist's welfare increases by 27%. Productivity increases partly because the dispersion of the marginal productivity across capital decreases by 36%, reducing misallocation. To further disentangle the role of markups in driving the welfare costs induced by banks' pricing decisions, we consider a counterfactual in which banks behave as monopolistic competitors. We find that productivity increases by 2.8%, while workers' welfare remains fairly constant and capitalist's welfare increases by 3.9%. Finally, we eliminate frictions in the inter-bank market. This leads to a productivity increase of 2.5%, while workers' welfare increases by 2% and capitalist's welfare increases by 27%.

The remainder of this paper is organized as follows. In the remainder of this section, we discuss our contribution to the literature. In Section 2, we describe the most relevant features of the banking sector in Chile and describe our data sources, 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 conclude in Section 7.

Related literature. We contribute to the literature on spatial dimensions of banking and misallocation. The intersection of finance and spatial economics has received increasing attention in recent years (Manigi, 2023; Morelli et al., 2024; Oberfield et al., 2024; D'Amico and Alekseev, 2024). Our paper is closely related to Oberfield et al. (2024), where the authors study the endogenous formation of bank branch networks while taking the 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 the geographic footprint of banks and the diversification of risk (Acharya et al., 2010; Morelli et al., 2024), which we abstract from controlling for risk measures whenever possible. We view the mechanisms we focus on, namely local market power and banks' cost differences, as working independently of risk. At a broader level, we build on Kleinman et al. (2023) and incorporate capital accumulation into a quantitative spatial model with trade and migration but does not feature banks.

At the heart of our analysis and most of the papers discussed above lies the premise that agents rely disproportionately on available local bank branches, 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 since the 1970s. However, Nguyen (2019) analyzes US data from 1999-2012 and finds that branch closures lead to substantial and persistent reductions in small business lending at the census tract level, suggesting that despite technological change, distance still matters. 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 studies focus on banks reaching previously unbanked populations, a priority in developing countries. By focusing on Chile, a financially developed country, our study is concerned with countries higher on the development ladder, where the main problem is not reaching unbanked populations but fostering local competition between banks. The market power of banks on the loans and deposit markets has been studied in developed countries by researchers in finance and industrial organization (Drechsler et al., 2017; Aguirregabiria et al., 2024). The richness of our data, particularly on interest rates, allows us to substantiate some of the theoretical mechanisms proposed in this literature.

We also contribute to the literature on misallocation. The literature, as pioneered by Hsieh and Klenow (2009), initially focused on the misallocation of factors of production between firms. Midrigan and Xu (2014) study the impact of financial frictions on capital misallocation, assuming that all firms face the same interest rate. Our empirical evidence suggests that the interest rate that firms face depends on their location. In a closely related paper, Cavalcanti et al. (2024) introduces firm differences in interest rates but does not focus on the spatial determinants of such disparities. Whited and Zhao (2021) study misallocation across different sources of finance while we focus on the misallocation of bank loans (the main source of firm credit in Chile) across space. Our focus on the network of bank branches is based on empirical studies documenting the importance of the internal capital markets of banks for domestic capital flows within countries (Gilje et al., 2016; Bustos et al., 2020).

2 Context and data sources

Chile stands out for its advanced financial development and the role of banks as sources 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 reveal 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. In the next subsection, we summarize the main facts about the network of banks' branches in the country and the extent of local competition across banks.

2.1 The network of bank branches

Table 1 reports summary statistics from the geographic distribution of bank branches across Chile, excluding the capital, Santiago. Panel A shows the number of city-bank pairs by year. The declining trend can be attributed to two mergers: Itaú-Corpbanca in 2016 and Scotiabank-BBVA in 2018. Panel B shows that the number of new and disappearing city-bank pairs, excluding those attributable to these mergers, is small. Given these facts, in the rest of the paper, we take the network of bank branches as given[2].

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 ten largest banks practically dominated the entire Chilean loan market. The deposit market exhibits a similar level of concentration.[3] At the local level, the number of competing banks is even smaller. Panel C presents the main statistics on the distribution of banks per city, showing that most cities have only one bank. In panel D, we compare the national Herfinahl-Hirschmann index with the average index across cities. Local credit markets are significantly more concentrated than the national market, which underlies our focus on banks' local market power throughout the rest of the paper.

Table 1: Bank Network outside Santiago

	2013	2015	2017	2019
A.				
City-Bank Pairs	558	544	540	510
Cities	172	180	196	203
B. Annualized change between columns				
New city-bank pairs		5	9	10
Disappearing city-bank pairs		10.5	1.5	-
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. Herfindahl–Hirschman Index				
National	0.16	0.16	0.17	0.17
Average across local indices	0.67	0.69	0.71	0.73

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 two rows of the table.

[1] See Appendix Section A.1 and Section A.2 for a discussion of the empirical results in this paragraph.
[2] See Oberfield et al. (2024) for an analysis of an endogenous branch network.
[3] See Figure 8 in Appendix Section A.3.

In Table 2, we repeat the analysis but exclude branches from the main state bank, Banco del Estado de Chile, from the sample. We also drop cities without private banks. Given that there are cities where the branch of the state bank is the only branch (and get dropped), the results in Table 2 show somewhat lower average indices of market concentration and a higher number of average banks per city. The concentration levels in local credit markets remain high even when abstracting from cities in which the state bank is the only bank.

Table 2: Bank Network outside the Metropolitan Region (excluding *Banco del Estado de Chile*)

	2013	2015	2017	2019
A.				
City-Bank Pairs	390	367	347	309
Cities	86	83	82	80
B. Annualized change between columns				
New city-bank pairs		0.5	1	2
Disappearing city-bank pairs		10.5	1.5	-
C. Banks per City				
Mean	4.5	4.4	4.2	3.9
Standard Deviation	3.5	3.1	2.7	2.4
Min	1	1	1	1
25th percentile	2	2	2	2
50th percentile	3	3	3	3
75th percentile	7	7	7	6
Max	12	11	10	9
D. Herfindahl–Hirschman Index				
National	0.19	0.19	0.19	0.21
Average across local indices	0.50	0.48	0.47	0.47

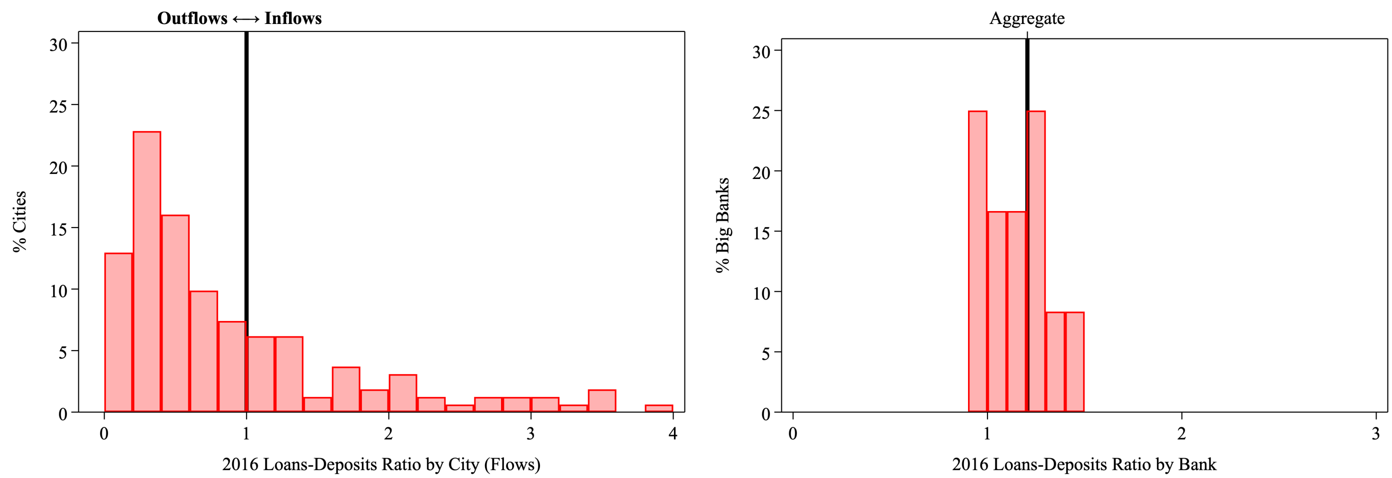
Source and notes: CMF. We first excluded the Banco del Estado de Chile from the sample, then counted city-bank pairs in which bank branches had outstanding loans. We exclude mergers from the new and disappearing calculations in the last two rows of the table.

A distinctive feature of the banking sector in Chile is that all banks' 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.

By operating in many cities, banks can fund loans in one city with deposits from another. The importance of the branch network in allowing capital flows between cities has been studied in the United States (Aguirregabiria et al., 2024) and also plays a role in Chile. The left panel in Figure 1 shows Chilean cities' loan-to-deposit 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-to-deposit ratio for the biggest banks, and shows that the ratio of loans to deposits is close to one. In the model we use for the quantitative analysis, we will assume that banks can lend to each other into a wholesale market to account for dispersion in the loan-deposit ratio across banks.

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.

2.2 Data sources

We combine administrative microdata with publicly available aggregate data from the following 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 to calculate travel times between cities, which we use to quantify domestic trade costs.[4]

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 that relies on loan-level data, we focus on new loans that private firms take from commercial banks. We impose that these loans must 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

[4]This study was developed within the scope of the research agenda conducted by the CBC in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the authors and did not involve nor compromise the SII and AFC. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service.

of the firm and whether the firm defaulted on its debt in the last few years. We use this loan-level data in Section 3.

Panel A of Table 3 presents summary statistics by loan type. Factoring loans, which allow firms to obtain liquidity by selling their receivables to banks, are the most common. These loans tend to be small, reinforcing their role in short-term liquidity management rather than long-term investment. Installment loans are the second most frequent type and are widely used, as shown by the number of firms borrowing under this category. These loans are significantly larger in amount and have longer maturities, making them better suited for investment. Our baseline analysis includes all loan types, controlling for loan type with fixed effects.

Table 3: Summary Statistics by Loan Type

	Count			Amount		Interest Rate			Maturity		Sales	
	Loans	Cities	Firms	Mean	Median	Mean	W. Mean	Median	Mean	Median	Mean	Median
A.All Firms												
Factoring	3,224,206	271	14,708	19.9	0.7	8%	6%	7%	2	2	87,783	4,331
Installments	397,396	303	54,716	357.9	87.5	11%	6%	10%	11	3	1,251	184
Real Estate	19,125	147	1,847	1,167.7	288,9	6%	4%	6%	4	2	3,976	825
Foreign Trade	12,952	155	2,011	700.7	199.5	8%	5%	7%	6	4	4,725	1,058
B.Single-City Firms												
Factoring	850,358	264	11,734	225.0	2.2	10%	8%	9%	2	2	1,403.2	338.8
Installments	263,880	302	44,918	222.3	63.6	12%	7%	11%	12	4	486.9	117.2
Real Estate	7,884	126	1,101	518.5	135.3	8%	5%	7%	5	2	1,112.8	368.7
Foreign Trade	5,205	107	1,145	409.6	150.6	9%	6%	8%	7	5	1,805.6	387.4

Source and notes: Authors' calculations using data from the CMF. Maturity is denominated in months and both Loan Amount and Firm Sales are denominated in thousands of USD at market exchange rates. In the column *W. Mean* we compute the average interest rate weighted by the amount of each loan.

In our empirical analysis in Section 3, we focus on firms that operate within a single city, allowing us to establish an unambiguous link between a firm and a city. During the period we study, single-city firms accounted 51% of private-sector employment. Panel B of Table 3 recalculates the main summary statistics by loan type, restricting the sample to these firms. Compared to the full sample, single-city firms face slightly higher interest rates and borrow smaller amounts, consistent with their generally smaller size. However, as in the broader dataset, installment loans remain the primary credit instrument for larger borrowing needs.

We draw from publicly available data by the CMF to construct aggregate outstanding loans and deposits at the bank-city level. We sum deposits and loans denominated in local currency, inflation-adjusted units, and foreign currency. We also sum loans for commercial and mortgage purposes and deposits with different degrees of liquidity. We use this data to calibrate the quantitative model in Section 5.

Google API. We retrieve travel times between pairs of cities from the Google Maps API.

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 withi n a 2-month window of any change. We use the most recent issue of this database, which corresponds to December 2021.

Unemployment Funds Administrator: AFC is the regulated private entity that manages the contributions that every formal worker in the private sector and their employer makes to the worker's unemployment insurance fund. Monthly contributions are a defined percentage of the worker's salary, with a cap of 5,000 USD monthly. The database contains identifiers for employers and employees, allowing us to construct a panel of workers. We use this data to calculate firm size, which we use as a control in Section 3, and to calibrate the model in Section 5.

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 at least 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. In the second subsection we delve deeper into the determinants of cost differences across banks, which affects differences in local the costs of investment due to banks' heterogeneous geographical presence. We show evidence that the pool of deposits a bank can tap into affects their interest rates and lending. This highlights the importance of jointly studying the bank network from the perspective of loans and deposits.

3.1 Geographic dispersion in interest rates

Using micro-data on the universe of loans extended to firms during 2015-2018, we estimate the following equation

$$i_{\ell ft} = \delta_0 + \delta_{s(f)\times t} + \delta_{c(f)} + \gamma_1' X_{ft} + \gamma_2' X_{\ell t} + \delta_{b(\ell)} + \epsilon_{\ell ft}. \tag{1}$$

The outcome variable $i_{\ell ft}$ is the net interest rate charged for the loan ℓ extended to firm f in period t. We include sector-quarter fixed effects $\delta_{s(f)\times t}$, which absorb variation in both credit and sectoral conditions over time. Our main object of interest, $\delta_c(f)$, is a fixed effect of the municipality of the firm. In our baseline specification, we keep only firms present in one city.

To address spatial variation in firm characteristics, we control for characteristics of the firm X_{ft}, including the firm's size in terms of employment 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 large enough, 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 performed by grouping firms with similar characteristics and then classifying them jointly. We include one fixed effect for each of the 16 categories. Our 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, estimated from the special pool of firms borrowing from many banks.

Finally, we also include characteristics of the loan $X_{\ell t}$, including the amount lent, type of loan, maturity, and bank fixed effects. The types of loans include installment loans, factoring, and trade credit. We keep maturities between 3 days and 10 years and denominated in local currency.

Table 4 shows the results of estimating equation (1) in our sample with single-city firms and weighting observations by the amount of each loan, as we progressively add more controls. In the first column, we include city fixed effects as well as sector interacted with quarter fixed effects. The interest rate differential between a city in the 25^{th} and 75^{th} percentile in this specification captures differences in average interest rates within periods and is approximately 462 basis points. As expected, the 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 25^{th} and 75^{th} percentile narrows to approximately 220 basis points in the third column, around half of what a crude comparison of geographic averages would yield.

3.1.1 Local market power

What characterizes cities with high fixed effects in this specification? To address this question, in the last column we replace city-fixed effects with region-fixed effects and include a measure of local competition between banks. Our measure of local competition is the Herfindahl-Hirschman Index (HHI) in the local loan market.

The fourth column shows a positive and statistically significant impact of local concentration on interest rates. Additionally, the R2 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.

Table 4: Geographic dispersion in interest rates (including multi-city firms)

	Interest Rate	**Interest Rate**	**Interest Rate**	**Interest Rate**
City/Province Fixed Effects, normalized percentile				
p10	-303.2	-232.8	-202.9	
p25	-172.8	-119.5	-92.1	
p50	0.0	0.0	0.0	
p75	286.6	137.1	138.0	
p90	494.7	304.4	309.4	
HHI_t				93.0***
				(3.5)
p75-p25	462	256	220	
Sector-Quarter FE	✓	✓	✓	✓
Size of the Firm		✓	✓	✓
Firm Risk		✓	✓	✓
Loan Characteristics		✓	✓	✓
Bank FE			✓	✓
Region FE				✓
R^2	0.162	0.397	0.431	0.415
Observations	710,182	705,598	705,598	705,603
Number of Banks	18	18	18	18
Number of Firms	32,049	31,864	31,864	31,869
Number of Cities	292	292	292	297

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

3.2 Costs differences across banks: The role of deposits

The standard view in banking is that deposits are the preferred source of funding of banks (Kashyap et al., 2002; Hanson et al., 2015). Compared to issuing bonds or taking loans, deposits are both cost-effective and stable because of the liquidity services they offer depositors[5]. This creates a second mechanism through which the branch network can affect spatial variation in funding costs: banks with better access to deposits face lower funding costs, potentially enabling them to offer loans at lower interest rates. Whether this mechanism operates in Chile is an empirical question, particularly given the access of banks to alternative funding sources, such as bond issuance (which we label borrowing from the wholesale market). We explore this question in the remainder of this subsection.

The effect of deposit shocks on lending are informative about the relative preference for deposits and the nature of the costs of borrowing from the wholesale market. If wholesale borrowing costs are independent of the amount borrowed, an increase in deposit funding would lead to a reduction in wholesale funding without affecting the size of the balance sheet. In contrast, if wholesale borrowing costs rise with the amount borrowed, a positive deposit shock enables the bank to reduce funding costs and expand the balance sheet.

[5] In Chile, as in many other countries, the deposits are insured by the government up to some limits, further enhancing their stability as a funding source.

Figure 2: Balance sheet effects of deposit shocks

(a) Constant wholesale cost r^F (b) Increasing wholesale cost

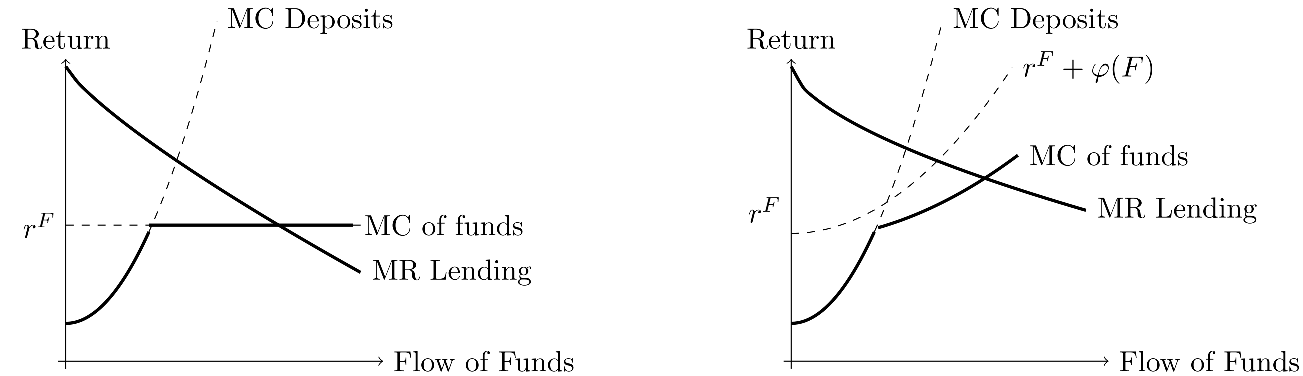


Figure 2 provides a schematic view of this argument, illustrating the optimal balance sheet size under different assumptions on the costs of borrowing from the wholesale market. In the presence of market power in deposits and loans, the marginal cost of attracting deposits is an increasing function, while the marginal revenue from lending is a decreasing function. The wholesale market serves as the second source of funding. Figure 2a shows the case where the wholesale borrowing costs are constant at r^F. Here, a reduction in deposit costs (equivalent to an outward shift of the MC of deposits) alters the funding composition between deposits and wholesale borrowing, but does not increase lending. In contrast, Figure 2b illustrates a scenario in which wholesale borrowing costs increase with the amount borrowed. In this case, a positive deposit shock leads to higher lending and lower interest rates, as the marginal cost of funds decreases. Our empirical findings in this subsection align with the scenario in Figure 2b, which informs the model presented in Section 4.

In the presence of market power in deposits and loans, the marginal cost of attracting deposits is increasing, and the marginal revenue from lending is decreasing. The second source of funding is the wholesale market. Figure 2a describes the case where the cost is constant, r^F. In such a case, a decrease in the cost of deposits would change the share of funding received from deposits versus wholesale, but would not lead to an increase in lending. Figure 2b describes the case where the costs of tapping into the wholesale market are increasing. In such case, a deposit shocks translates into an increase in lending and lower interest rates, as the cost of funds decrease on the margin. Our empirical results in this subsection are consistent with Figure 2b, which informs our model of Section 4.

3.2.1 The effects of deposit shocks on lending

Our equation of interest is

$$Loans^b_{nt} = \beta_0 + \beta_1 Loans^b_{nt-1} + \beta_2 Deposits^b_t + \gamma X^b_{nt} + \epsilon^b_t, \tag{2}$$

where n and b denote city and bank, respectively. We estimate equation (2) using aggregate data from the CMF on loans and deposits. This data is available from 2005 at a half-yearly frequency. We include the lagged value of loans, city-bank fixed effects, city-semester fixed effects, and the interaction between bank fixed effects and the GFC period as control variables (all captured in X^b_{nt}). Our coefficient of interest is β_2, the effect of deposits on banks' lending. As discussed above, a positive estimate of β_2 suggests that banks face increasing costs of borrowing from the wholesale market.

Equation (2) cannot be estimated by OLS, as the error term is likely to be correlated with D_t^b. For example, a bank may be improving the quality of its branches, which can affect its appeal as a source of deposits and loans. Building on Gilje et al. (2016), we instrument for deposit shocks at the bank level by leveraging shocks to the global price of salmon and banks' exposure to cities engaged in salmon production. Our instrument for deposits at bank b in semster t, denoted as Z_{bt}, is

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

Here, the first term represents the share of bank b's total deposits in 1998–2001 that originated from cities in the salmon-producing region ($c \in \mathcal{F}$)[6]. We measure banks' presence in these cities before the price of salmon increased sharply in the early 2000s to avoid endogeneity in banks' entry to these regions as a response to increasing salmon prices. The second term, p_{t-1}^{salmon}, is the world price of salmon lagged one semester. We introduce a lag to capture the time between the increase in prices and the increase in wages and profits, which ultimately become deposits.

Focusing on the fishing industry to construct deposit shocks offers several advantages in the Chilean context. First, the global price of salmon experienced significant fluctuations during our sample period. Using data from the IMF Commodity Price series, Figure 12 in Appendix A.6 illustrates the evolution of the world price of salmon between 2005 and 2019. 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 salmon industry is geographically concentrated, with most firms headquartered locally. This geographic clustering ensures that profits are deposited in local bank branches rather than being redirected to headquarters in Santiago, as might occur with mining price shocks.

In our first stage we estimate

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

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 5. There is a statistically significant and economically large relationship between the world price of salmon and deposits. To serve as a benchmark, deposits grew at an average (median) rate of 2.92% (3.43%) during the period.

In the second stage we estimate equation (2) excluding fishing cities from the sample (for the exclusion restriction to be plausible). The second and third columns in Table 5 show, respectively, the OLS and IV estimates of equation (2). When we instrument for deposits, we find a strong and statistically significant effect on loans. 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%).

The results in this subsection suggest that the banks' internal capital markets play an important role in the allocation of funds across cities in Chile, consistent with what has been found in the United States and

[6] To identify fishing cities, we calculate employment in the fishing industry as a percentage of local employment using AFC data from 2015. The results, shown in Figure 13 in the Appendix A.6, indicate that cities specializing in fishing cluster in the country's south. We identify the set of 'fishing cities' as those in which the local percentage of employment in the fishing industry is above 4.33%, the 90^{th} percentile.

Table 5: Deposit Shocks and Loan Growth

	Bank Deposits (Logs) OLS	**City-Bank Loans (Logs)** OLS	**City-Bank Loans (Logs)** IV
Log Deposits$_t$		0.73***	0.76***
		(0.07)	(0.08)
Log Deposits$_{t-1}$	0.25***		
	(0.05)		
Log Loans$_{t-1}$		0.15***	0.13***
		(0.03)	(0.02)
Log Price of Salmon$_{t-1}$	1.16***		0.19***
	(0.31)		(0.05)
Z_{bt}	4.63***		
	(1.24)		
Controls included			
Bank FE	Yes	-	-
Bank FE × GFC Dummy	Yes	Yes	Yes
Bank × City FE	-	Yes	Yes
F-statistic	-	-	103.3
Observations	222	14475	12020
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.

Brazil in previous studies (Gilje et al., 2016; Bustos et al., 2020). In Section 6, we analyze the quantitative importance of this mechanism for spatial differences in the cost of investment. We will used our estimated coefficient of 0.76 to quantify the strength of financial frictions in the inter-bank market through the lens of the quantitative model.

4 Model

To study the aggregate effects of interest rate differentials it is crucial to consider how the level of interest rates affects investment, wages, and ultimately the incentives for workers to move into a city. We build a general equilibrium model with investment, trade, and migration. The framework incorporates firms' and households' reliance on local bank branches, oligopolistic competition between banks, and banks' preference for deposits as a source of funding.

4.1 Setup

The economy is comprised of N cities, indexed by n, and B banks, indexed by b. Time is discrete. There are three types of agents: workers, capitalists, and bank owners. Workers are homogeneous, do not make saving decisions, 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 $\mathcal{B}^n$.

Each bank b operates in a set of cities $\mathcal{C}^b$, assumed to be fixed. Every period, bank owners set city-specific nominal interest rates for loans, r^b_{nt}, and deposits, $\tilde{r}^b_{nt}$, to maximize profits. Banks face city-specific demand for loans and deposits and compete oligopolistically 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 tap into the wholesale market, which is subject to frictions. Banks are also subject to a balance sheet constraint: every period, total outstanding assets must equal total outstanding liabilities.

We proceed by first analyzing the worker's problem. 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. The price of a good of variety i for a consumer located in n is given by

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

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 hand-to-mouth workers. The problem of the worker located in city n is as follows. First, she decides how much to consume of each of the N goods in the economy, aggregating goods from all origins with a constant elasticity of substitution,

$$C^w_{nt} = \Big(\sum_{i=1}^{N} c_{it}^{\frac{\sigma_c-1}{\sigma_c}}\Big)^{\frac{\sigma_c}{\sigma_c-1}}. \tag{3}$$

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

$$P_{nt} \equiv \Big(\sum_i (\tau_{ni}p_{iit})^{1-\sigma_c}\Big)^{\frac{1}{1-\sigma_c}} \quad \text{and} \quad \pi_{nit} = \Big(\frac{\tau_{ni}p_{iit}}{P_{nt}}\Big)^{1-\sigma_c}. \tag{4}$$

The budget constraint of a worker is given by

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

where τ is a labor income tax. While it is set to zero in our baseline scenario, they will be positive in the counterfactual analysis in Section 6. After consuming in period t, the worker faces idiosyncratic utility shocks of moving to each destination city d, ϵ_{dt} and makes her moving decision at the end of period. We assume there are no migration costs, as in our analysis we focus on comparing steady state outcomes.

All things considered, the value of living in city n at t combines an amenity value b_n, consumption utility, and the continuation value of moving

$$v^w_{nt} = \log(b_n C^w_{nt}) + \max_d\{\beta\mathbb{E}_t[v^w_{dt+1}] + \rho\epsilon_{dt}\}. \tag{5}$$

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 idiosyncratic shocks ϵ_{dt+1}.

4.1.3 Capitalists

There is one capitalist per city who lives indefinitely and cannot move to other cities. For clarity, we omit sub-indices n associated with location in this section. 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 from the bank branches available locally.

Banks' role in financing local investment. In order to finance investment in physical capital, the capitalist needs to borrow from local banks. Moreover, loans from different banks are imperfect substitutes when funding new investments. A unit of investment good is produced by borrowing from different banks and using the borrowed amounts to buy the final good,

$$i_t = \Big[\sum_{b\in\mathcal{B}} (\gamma^b \tfrac{L^b_{t+1}}{P_t})^{\frac{\sigma-1}{\sigma}}\Big]^{\frac{\sigma}{\sigma-1}}, \tag{6}$$

where L_{t+1} denotes loans issued in period t and maturing at $t+1$. Equation (6) captures, in a parsimonious way, heterogeneity between banks, which are specialized in funding different types of businesses. The elasticity of substitution between banks σ is a key parameter in the model, underlying banks' ability to exploit local market power in interest rate setting. The cost of investment comes from solving

$$\mathcal{L}_t(i_t) = \min_{\{L^b_{t+1}\}_b} \sum_{b\in\mathcal{B}} L^b_{t+1}(1+r^b_{t+1}) \;\; s.t: \textit{equation } (6).$$

Manipulating the first-order conditions from this problem, we can express the equilibrium demand of loans from bank b in period t as

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

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

$$\mathcal{L}_t(i_t) = i_t R_{t+1} P_t. \tag{8}$$

Capitalist's full problem. Capitalists decide how much to consume, save using deposits, and invest. Following the finance literature, we assume that capitalists derive utility from consumption and the liquidity services provided by deposits, with parameter α controlling the relative utility of the latter (Drechsler et al., 2017; Morelli et al., 2024). Using C^c_{nt} to denote capitalist's consumption, the full problem of a capitalist is

$$\begin{aligned} \max_{\{C^c_t, D^b_{t+1}, k_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \Big[\log C^c_t + \alpha \log D_{nt+1}\Big] \text{ with } D_{t+1} = \Big[\sum_b {D^b_{t+1}}^{1-\frac{1}{\eta}}\Big]^{\frac{\eta}{\eta-1}}, \\ \underline{s.t:}\; P_t C^c_t + \sum_b D^b_{t+1} + i_{t-1}R_t P_{t-1} = \hat{r}_t k_t + \sum_b D^b_t(1+\tilde{r}^b_t) + T^c_t \\ k_{t+1} = k_t(1-\delta) + i_t \text{ and } k_0, \{D^b_0, L^b_0\}_b. \end{aligned} \tag{9}$$

The budget constraint, equation (9), is expressed in nominal terms: capitalist's income comes from renting out capital at rental rate $\hat{r}_t$, the payout of her previous deposits and a transfer from the government T^c_t (which we specify below). Income is spent in consumption, new deposits and re-paying loans that mature at t. Manipulating first-order conditions of this problem, the demand for deposits from bank b is

$$D^b_{t+1} = D_{t+1}\left(\frac{Q_{t+1}}{q^b_{t+1}}\right)^{\eta}, \tag{10}$$

where

$$q^b_{t+1} \equiv 1 - \underbrace{\left(1+\tilde{r}^b_{t+1}\right)}_{\text{Return on deposits}} \Big/ \underbrace{\left(\frac{(1-\delta)R_{t+1}P_t}{R_tP_{t-1}-\hat{r}_t}\right)}_{\text{Return on investment}} \text{ and } Q_{t+1} \equiv \left(\sum_b (q^b_{t+1})^{1-\eta}\right)^{\frac{1}{1-\eta}}. \tag{11}$$

From the consumer's perspective, the total price of a deposit with bank b is q^b_{t+1}. This cost captures the dollar that the capitalists gives up when they make a deposit, net of the interest income accruing tomorrow. The pecuniary cost is adjusted by the marginal rate of substitution between periods. Moreover, the latter is linked to the rate at which resources can be transferred by investing in physical capital. Thus, the return on investment in physical capital can be used to adjust the future pecuniary benefit of a deposits in the definition of q^b_{t+1}.

The total demand for deposits and consumption is given by

$$D_{t+1} = \frac{\alpha M_t}{Q_{t+1} + \alpha Q^{\eta}_{t+1}\tilde{Q}_{t+1}}, \tag{12}$$

$$P_tC^c_t = \frac{Q_{t+1}M_t}{Q_{t+1} + \alpha Q^{\eta}_{t+1}\tilde{Q}_{t+1}}. \tag{13}$$

where we have defined total income as $M_t \equiv \hat{r}_t k_t + \sum_b (1+\tilde{r}^b_t)D^b_t - i_{t-1}R_tP_{t-1}$ and $\tilde{Q}_{t+1}$ is an alternative index of q^b_{t+1}, defined in the appendix.

From equation (7), equation (10) and equation (12) the bank-specific demand for deposits and loans are

$$D^b_{t+1} = \frac{\alpha M_t}{Q_{t+1} + \alpha Q^{\eta}_{t+1}\tilde{Q}_{t+1}}\left(\frac{Q_{t+1}}{q^b_{t+1}}\right)^{\eta} \tag{14}$$

$$L^b_{t+1} = i_tP_t\Big(\frac{R_{t+1}}{1+r^b_{t+1}}\Big)^{\sigma}(\gamma^b)^{\sigma-1}. \tag{15}$$

By increasing the interest rate on deposits $\tilde{r}^b_{t+1}$ (which translates into a decrease in q^b_{t+1}), the demand of deposits from bank b increases. By increasing the interest rate on loans r^b_{t+1}, the demand for loans from bank b decreases. We now turn to the problem of setting interest rates by banks, who take these two functions as given.

4.1.4 Banks

Banks are operated by a bank owner that sets active and passive interest rates in each city to maximize total profits. For clarity, in this section we omit super-indices b associated with the identity of the bank. The cash-flow of a bank at t, Π_t, is given by

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

Inflows consist of loans maturing and new deposits issued at t across all cities. Outflows consist of loans issued at t and deposits maturing at t. The variable F_{t+1} captures the bank's interaction with the inter-bank market. All banks have access to the same interest rate r^F_t in the wholesale market. A value $F_{t+1} > 0$

indicates that the bank borrows in the wholesale market at t. The final term T_t is a bank-specific tax, discussed below.

The bank owner maximizes the discounted sum of per-period cash flows and a non-pecuniary cost of tapping into the wholesale market. Taking as given the supply of deposits and demand for loans from local capitalists, equation (14) and equation (15). We assume banks compete oligopolistically, i.e: they take into account their own influence on local indices $R(r_{nt}, \{r^b_{nt}\}_{v\neq b}), Q(\tilde{r}_n, \{\tilde{r}^b_{nt}\}_{v\neq b}), \tilde{Q}(\tilde{r}_{nt}, \{\tilde{r}^b_{nt}\}_{v\neq b})$. The full problem of the bank owner is

$$\max_{\{\{r_{nt},\tilde{r}_{nt}\},F_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \Big\{ \Pi_t - \Big(\exp\Big(\frac{\phi F_t}{\sum_n D_{nt}} \Big) - 1 \Big)(1+r^F_t)F_t \Big\} \tag{16}$$

$$\underline{s.t:}\ [\mu_t]\ \sum_n L_{nt+1} = \sum_n D_{nt+1} + F_{t+1} \quad \forall t. \tag{17}$$

$$R(r_{nt}, ...), Q(\tilde{r}_{nt}, ...), \tilde{Q}(\tilde{r}_{nt}, ...) \tag{18}$$

At very period, banks are subject to a balance sheet constraint, equation (17), limiting the amounts of funds they can lend to the deposits and wholesale funding they receive. We model the non-pecuniary effects of relying on the wholesale market as in (Oberfield et al., 2024). The relative advantage of deposits as a source of funding is standard in the literature and we find empirical evidence consistent with this preference in Section 3.2. The parameter ϕ captures the cost of tapping into the wholesale market.

Manipulating the first-order conditions, interest rates chosen by the bank owner can be written as

$$1 + r^*_{nt+1} = \frac{\varepsilon^L_{nt}}{\varepsilon^L_{nt} - 1}\Big(\frac{1}{\beta} + \mu_t\Big) \text{ and} \tag{19}$$

$$1 + \tilde{r}^*_{nt} = \frac{\varepsilon^D_{nt}}{\varepsilon^D_{nt} + 1}\Big(\frac{1}{\beta} + \mu_t - \exp\Big(\frac{F_{t+1}}{D_{t+1}}\Big)(1+r^F_t)\frac{\phi F^2_{t+1}}{D^2_{t+1}}\Big), \tag{20}$$

where $\varepsilon^L_n = -\frac{\partial L^b_n}{\partial r^b_n}\frac{(1+r^b_n)}{L^b_n}$ and $\epsilon^D_n = \frac{\partial D^b_n}{\partial \tilde{r}^b_n}\frac{1+\tilde{r}^b_n}{D^b_n}$ denote the city-specific elasticities of loan and deposit demand with respect to an individual bank's interest rates. The term in brackets, $\frac{1}{\beta} + \mu_t$, represents the total marginal cost of issuing a loan which includes the dollar the bank needs to give up from its cash flows today and the balance sheet space used to issue a loan. The latter is captured by the value of the multiplier on the balance sheet constraint.

Equation (19) and equation (20) describe the city-specific markups that banks charge for their loans, and the markdowns they charge on depositors. City-specific derivatives play a key role in determining markups and markdowns, and can be decomposed as the sum of direct and indirect effects. In the case of loans,

$$\frac{\partial L^b_n}{\partial r^b_n} = \underbrace{-\sigma\frac{L^b_n}{1+r^b_n}}_{\text{direct effect}} + \underbrace{\sigma\frac{(L^b_n)^2}{i_n R_n P_n}}_{\text{indirect effect through } R_n} + \underbrace{\Big(\frac{L^b_n}{i_n}\Big)\frac{\partial i_n}{\partial r^b_n}}_{\text{indirect effect through } i_n} \tag{21}$$

Our framework captures why the same bank can charge different interest rates across different cities, which we documented in Section 3.1. 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. Cities with more competition will experience lower markups and markdowns on interest rates, as banks are less able to influence the aggregate interest rate R_n when changing interest rates. Our data does not allows us to analyze geographic dispersion in deposits as we did with loans, but the idea that banks also exploit their market power on deposits is standard (Drechsler et al., 2017; Albertazzi et al., 2024).

Our framework can also capture cost differences across banks as a source of differences in the cost of capital across cities, which we discussed in Section 3.2. Cost differences across banks are tightly linked to their branch structure, and the extent of their reliance on the wholesale market to attract funds. To see this, equation (22) shows the value of μ_t in equilibrium. Because all banks can intervene as lender or borrower in the inter-bank market, it equals

$$\mu_t = \exp\left(\frac{\phi F_{t+1}}{D_{t+1}}\right)(1 + r^F_{t+1})\Big(1 + \frac{\phi F_{t+1}}{D_{t+1}}\Big) - \frac{1}{\beta}, \tag{22}$$

which increases in F.

4.1.5 Government

The main role oft he government in the baseline scenario is to tax banks and rebate the revenue back to local capitalists. We assume that bank taxes are

$$T^b_t = \sum_n L^b_{nt} r^b_{nt} - D^b_{nt}\tilde{r}^b_{nt} - r^F_t F_t. \tag{23}$$

The government taxes banks for the retail and wholesale profits. Under these assumptions, after-tax bank cash flows are zero in a steady state, as we discuss in the next subsection. Therefore, we do not have to make an assumption of where (in what city) to locate the cash flows of the banking industry.

Finally, we assume that the fraction of taxes on banks associated with retail profits get passed on to local capitalists in the form of transfers,

$$T^c_{nt} = \sum_{b\in\mathcal{B}^n} L^b_{nt} r^b_{nt} - D^b_{nt}\tilde{r}^b_{nt}. \tag{24}$$

After defining a steady state, we show that governments' budget is balanced in steady state under these assumptions.

4.2 Steady state

Given a vector of productivity and amenity values, $\{z_n, b_n\}_{n\in N}$, the set of cities in which each bank is present, $\{\mathcal{C}^b\}_{b\in B}$, and the tax rate τ a steady state consists of a vector of prices $\{w_n, p_n, \{r^b_n, \tilde{r}^b_n\}_{b\in B}\}_{n\in N}, r^F$ and quantities $\{\ell_n, k_n, i_n, y_n, C^w_n, C^c_n, k_n, T^w_n, T^c_n, \{L^b_n, D^b_n\}_{b\in B}\}_{n\in N}, \{F^b\}_{b\in B}$ such that

- Workers' consumption decisions maximize their flow utility, with consumption shares given by equation (4). Workers' migration decisions, derived in Section B.1, are optimal. Population shares are given by

$$\ell_n = \frac{\left(\frac{b_n w_n (1-\tau^{ss})}{P_n}\right)^{\frac{\beta}{\rho}}}{\sum_{i=1}^{N}\left(\frac{b_i w_i (1-\tau^{ss})}{P_i}\right)^{\frac{\beta}{\rho}}}. \tag{25}$$

Notice from this expression that income taxes do not distort moving decisions.

- Capitalists' consumption, saving and borrowing decisions maximize their lifetime utility, equation (13)-equation (14)-equation (15).
- Bank-specific interest rates set optimally, equation (19)-equation (20). Bank's marginal costs are given by equation (22).
- The market for wholesale funds clears,

$$\sum_b F^b = 0 \tag{26}$$

- Final goods market clear. The revenue in city n, equal to total cost, equals expenditure by workers and capitalists (for consumption and investment purposes) in all other cities.

$$w_n \ell_n + \hat{r} k_n = \sum_{i=1}^{N} \pi_{ni}(P_i C_i^w + P_i C_i^c + \sum_{b \in \mathcal{B}^i} L_i^b). \tag{27}$$

- Demand for factors is and final good prices satisfy final good's producers optimality conditions,

$$\frac{k_n}{\ell_n} = \frac{1-\mu}{\mu}\frac{w_n}{\hat{r}_n} \text{ and } p_{nn} = \frac{w_n^{\mu}\hat{r}_n^{1-\mu}}{z_n}. \tag{28}$$

- $i_n = \delta k_n$ and all other variables stay constant across periods.

4.2.1 Fiscal policy in steady state

Bank's are fully taxed at the steady state. Bank b's cash flows are

$$\Pi_t^b = \left\{\sum_n L_{nt}^b(1+r_{nt}) + D_{nt+1}^b - L_{nt+1} - D_{nt}^b(1+\tilde{r}_{nt}^b)\right\} + F_{t+1} - (1+r_t^F)F_t^b - T_t^b.$$

At a steady state in which $L_n = L_{nt} = L_{nt+1}$ and $D_n = D_{nt} = D_{nt-1}$ and using equation (23),

$$\Pi^b = \left\{\sum_n L_n^b r_n - D_n^b \tilde{r}_n^b\right\} - r^F F^b - T^b = 0.$$

Budget balance. We can write the budget constraint of the government as

$$T_n^c = \sum_b T^b$$
$$\sum_{b\in\mathcal{B}^n} L_n^b r_n^b - D_n^b \tilde{r}_n^b = \sum_b (\sum_n L_n^b r_n - D_n^b \tilde{r}_n^b) - r^F F^b$$
$$r^F \sum_b F^b = 0$$

The last equation follows from market clearing in the wholesale market equation (26). Then, the government's budget is balanced at the steady state.

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 178 cities. We exclude the capital, Santiago, from the analysis.

We follow three 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. 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. 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 $\tau_{ni} = t_{ni}^{0.375}$. We estimate the value of ϕ to match the empirical results in Section 3.2.1. All other parameters are calibrated externally from different sources in the literature. Table 6 summarizes how we estimate each set of parameters.

Table 6: Estimation

	Description	Value	Source or Objective
		Externally calibrated	
μ	Capital share	0.35	Kleinman et al. (2023)
δ	Rate of depreciation	0.05	Kleinman et al. (2023)
β	Discount factor	0.95	Kleinman et al. (2023)
ρ	Elasticity of migration to ϵ_d	3β	Kleinman et al. (2023)
η	Elasticity of substitution (deposits)	1.6	Albertazzi et al. (2024)
σ_c	Elasticity of substitution (consumption)	4	Redding and Rossi-Hansberg (2017)
$\{\tau_{nj}\}_{n,j=1,..,N}$	Trade costs as a function of travel times t_{ij}	$t_{ij}^{0.375}$	Redding and Rossi-Hansberg (2017)
		Internally estimated/calibrated	
σ	Elasticity of substitution (loans)	5.21	Difference-in-differences around Corpbanca-Itaú merge
ϕ	Cost of wholesale funding	0.73	Calibrated to IV results in Section 3.2.1
$\{z_n\}_{n=1}^N$	Productivities	Section 5.3	Calibrated to match $\{\ell_n\}_n$
$\{b_n\}_{n=1}^N$	Amenities	Section 5.3	Calibrated to match $\{w_n\}_n$
$\{\{\gamma_n^b\}_{b=1}^B\}_{n=1}^N$	Bank-city match	Section ??	Calibrated to match $\{L_n^b\}_n$

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.*[7] The merger was made effective in April 2016.

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 (as shown in Appendix Section C.1), 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 quarters of data. We deflate the value of new loans 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,

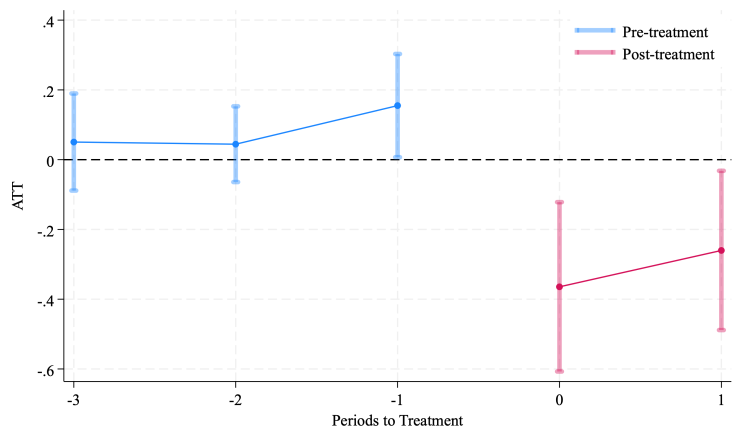
$$Loans_{nt}^{b} = \eta_n^b + \theta_b \times Year_t + \sum_{t=1}^{5} \alpha_t D_{nt} + \epsilon_{nt}^{b}. \tag{29}$$

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

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 at t. We estimate equation (29) over a balanced panel of the city-bank pairs nb that we observe throughout the whole 2013Q2-2018Q1 period and 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.

Loans in treated and control groups grow in parallel between 2013Q2 and 2016Q1, which makes the parallel trend assumption at the time of treatment more plausible. The slight increase in lending by other banks immediately before the merger 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. The coefficients for both 2016Q2-2017Q1 and 2017Q2-2018Q1 are economically large and statistically significant.

Figure 3: Loan substitution after the merger



Our estimated effects can be mapped to σ. To see this, start by taing logs in equation (15),

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

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 in 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 σ of 5.21.

5.2 Productivity, amenity, and city-bank complementarities

We can invert the model using data on wages, employment, loans, and interest rates.

1. We cannot extract information specific to a bank from the micro-data, so in this section we use data on new loans by city-bank and the average interest rate by bank, both from the CMF. We calculate loan repayment in each city

$$\mathcal{L}(i_n) = \sum_{b\in\mathcal{B}^n} (1 + r^b)L^b_n.$$

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

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

in $\tilde{N}$ unknowns, the vector of γ_n^b. $\tilde{N}$ is the number of city-bank pairs in Chile in 2017. The vector of $\{\gamma_n^b\}$ rationalize the observed amount of loans at the city-bank level perfectly.

2. We estimate the trade costs between cities, τ_{ni} using data on travel times between them from Google and borrowing the response of trade costs to travel times from Redding and Rossi-Hansberg (2017).

3. Using the wages observed in the data, we estimate the value of productivity $\{z_n\}$ and amenities $\{b_n\}$ in each city as those that rationalize observed labor shares and such that model-implied market clearing conditions hold.

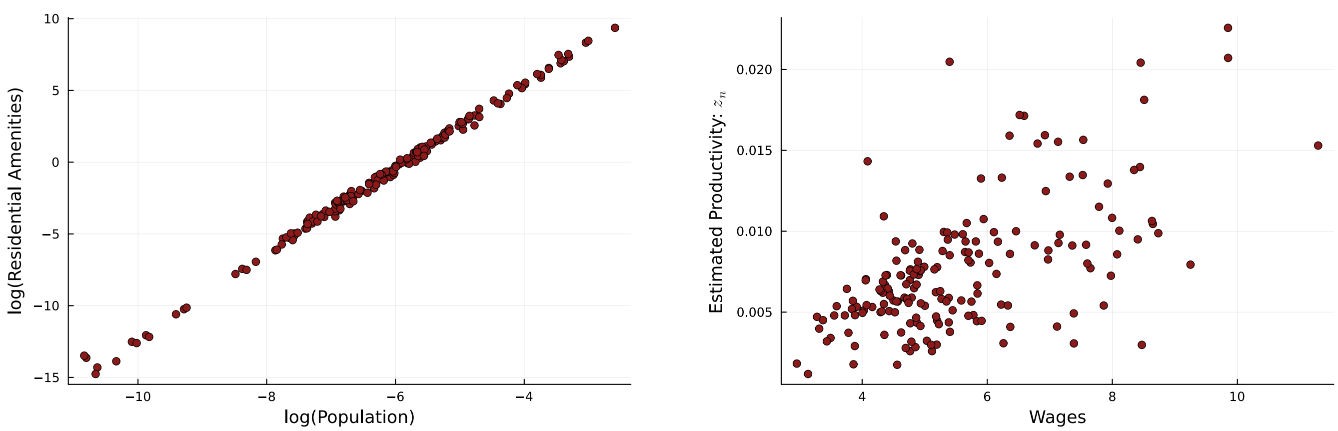
4. Finally, we calibrate ϕ to match our IV results shown in Table 5.

5.3 Results

Figure 4 show the estimates from the fourth step of our estimation. 4a shows the estimated amenity values against employment share by city, which are tightly related through the lens of the model. 4b shows the estimated productivity levels against average local wage data. These two are positively related but the relationship is not as tight. The reason is that we are imposing market clearing, which introduces additional constraints on wages besides the direct effect.

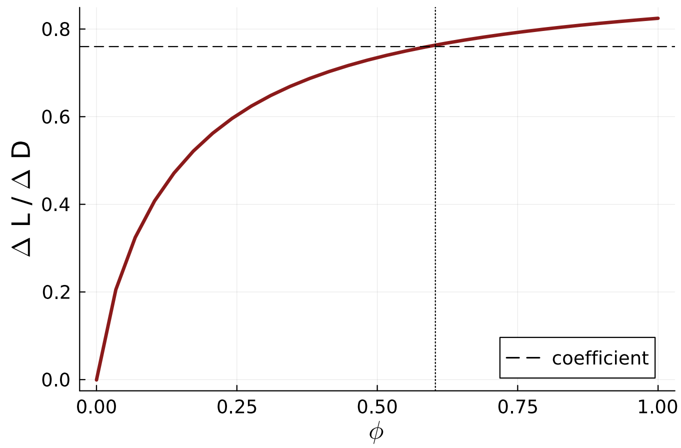
Figure 4: Estimated Residential Amenities and Productivity Parameters

(a) Population Data and Estimated Amenity Value (b) Wage Data and Estimated Productivity



We calibrate ϕ to match the results of our IV in Section 3.2.1. In particular, we choose a bank, bank $\tilde{b}$, and increase its deposits exogenously by 10%. We then run the model under different assumptions on ϕ and compare the average growth of loans from bank $\tilde{b}$ and all other banks in the cities where bank $\tilde{b}$ has branches. Figure 5 shows the results. For sufficiently high values of ϕ, lending increases one-for-one with deposits, as the inter-bank market shuts down.

Figure 5: Calibration of ϕ



6 How costly is interest rate dispersion?

We use the quantified model to measure the welfare and output effects of banks' branch networks. To isolate the underlying mechanisms, we consider three distinct counterfactuals that progressively remove different sources of inefficiency in the banking sector: variable markups, market power, and cost differences across banks. In our model, aggregate productivity and GDP are equivalent, as the total population is normalized to one.

No Markups. We consider a policy in which the government eliminates market power on both the deposit and loan sides through subsidies. For loans, for instance, the government provides a city-bank-specific subsidy such that the post-subsidy loan rate is given by

$$1 + r_n^b = \mu^b \ \forall n, b, \tag{30}$$

and bank b charges a uniform interest rate across cities, equal to its marginal cost μ^b. This policy is financed through a labor income tax, $\tau > 0$.

Constant Markups. To isolate the role of markup variation in welfare and productivity effects, we consider a scenario in which banks behave as monopolistic competitors and charge the same interest rate across cities. Specifically, in this counterfactual, all banks apply a constant markup of $\frac{\sigma}{\sigma-1}$ across cities.

No Financial Frictions. To explore the role of cost differences across banks driven by differential access to deposits, we set $\phi = 0$.

Table 7 presents the results. Productivity increases under all counterfactual scenarios. One driver of this increase is a reduction in the dispersion of marginal productivity of capital, as shown in Figure 6a. Another key driver is the overall increase in the stock of capital. Figure 6b shows the change in the stock physical capital across cities, ordered by their exogenous productivity parameter z_n. Investment rises in nearly all cities.

Table 7: Counterfactual Analysis

	No Markups	Constant Markups	No Frictions in the Wholesale Market
Productivity (GDP)	19%	2.8%	2.5%
Spatial Dispersion in MPK	−36%	−17%	−9%
Workers' Welfare	−2.4%	0%	2%
Capitalists' Welfare	27%	27%	3.9%

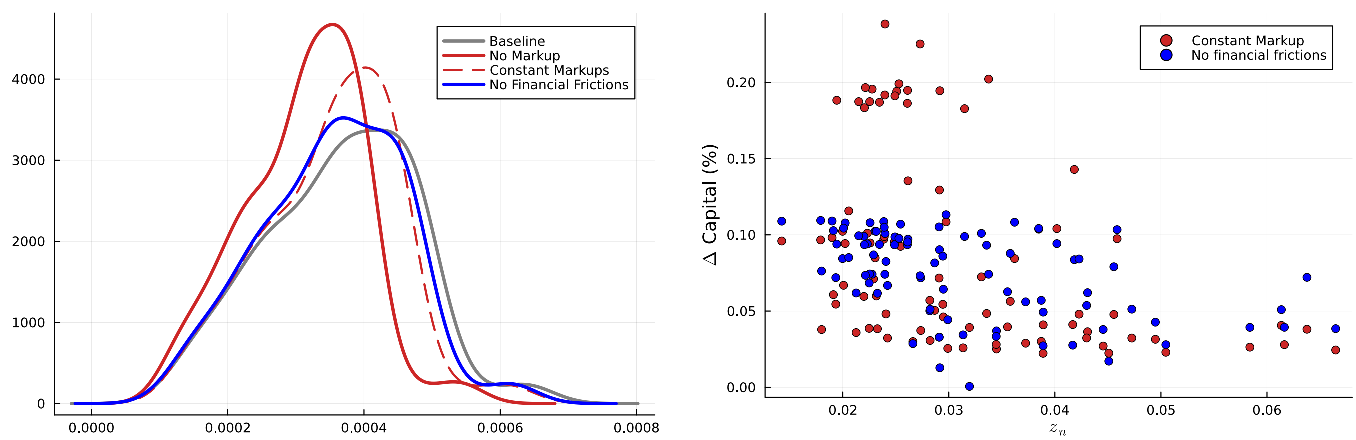
Notes: The first counterfactual eliminates markups and is financed by taxing workers; the second assumes monopolistic competition between banks; the third sets $\phi = 0$.

The welfare implications of these policies vary. In all cases, capitalists' welfare increases as they benefit from lower loan rates and higher returns on deposits. However, the effects on workers are negative in scenario with no markups. While productivity, and therefore wages, rises due to the higher capital stock and improved allocation across cities, this gain is insufficient to offset the direct welfare loss imposed by higher income taxes.

Figure 6: Effects on Capital Allocation and Investment

(a) Misallocation

(b) Investment Responses



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 analyzed detailed loan-level data from Chile and showed that within-country differences in interest rates can also be substantial, of the order of 220 basis points between cities at the 25 and 75 percentile of the interest rate distribution. An important aspect of our empirical analysis was controlling for risk. An avenue for future research would be to focus on how firms sort across cities depending on their risk, and what determines variation in risk across cities. Moreover, in our analysis we focused on loans with fixed interest rates only. Future research could explore how the type of products offered by banks varies depending on features of the local economy.

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 eliminate financial frictions. In our counterfactual analysis, we find that local market power plays a larger role in driving the welfare costs of interest rate dispersion across cities. A direction for future research would be to consider different policies directed at increasing bank competition in local credit markets.

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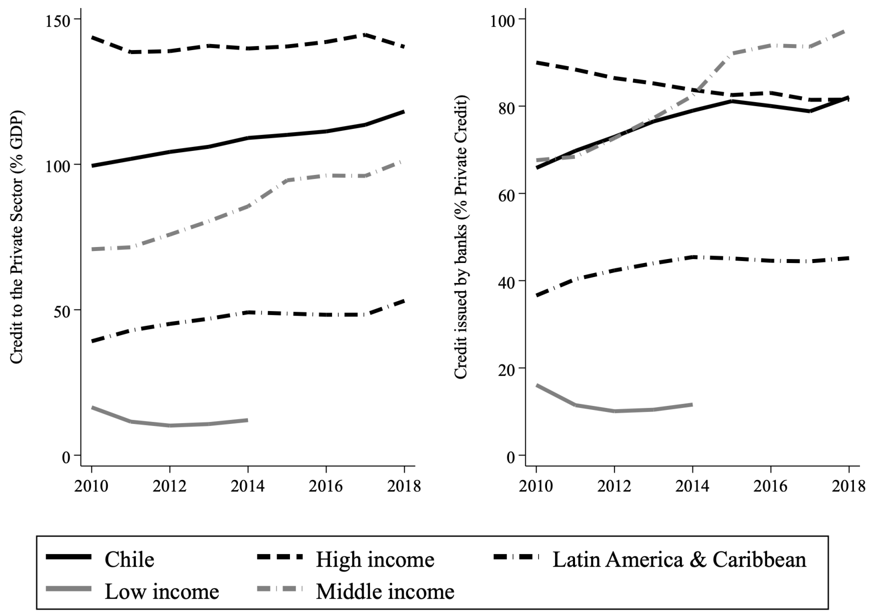
Appendix

A Empirical appendix

A.1 Chile's financial development

We use public data from the World Bank, accessed online on June 2024. Figure 7 below shows the evolution of the two indicators of financial development mentioned in the main text.

Figure 7: Financial development



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 8 show that banks stand out as the main source of credit for large private firms outside the capital area.

Table 8: 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

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 9 shows — for the sub-sample of 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 9 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.

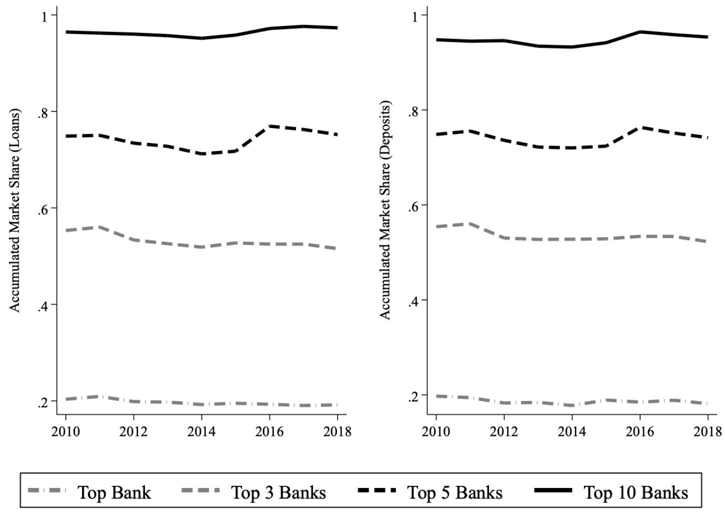
Table 9: Households' savings behavior

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 8.

Figure 8: Concentration in the Banking Industry



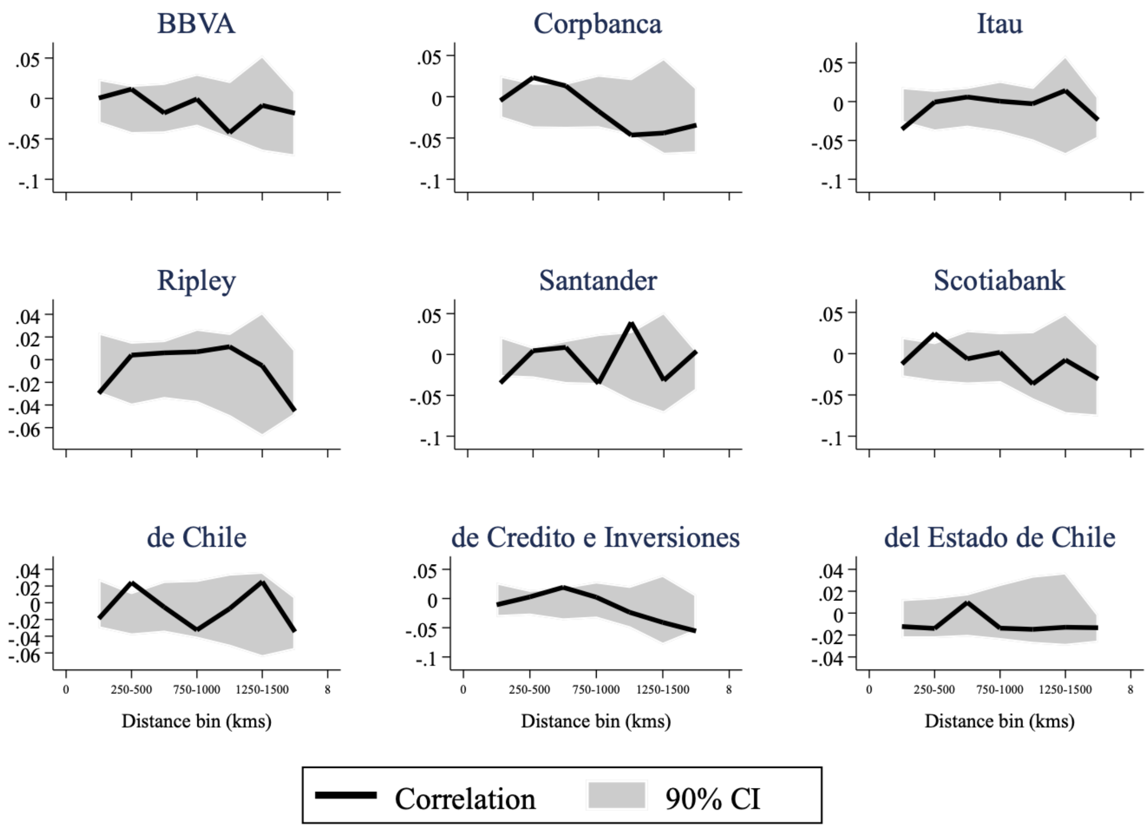
A.4 Spatial Clustering of Banks

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 9 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.

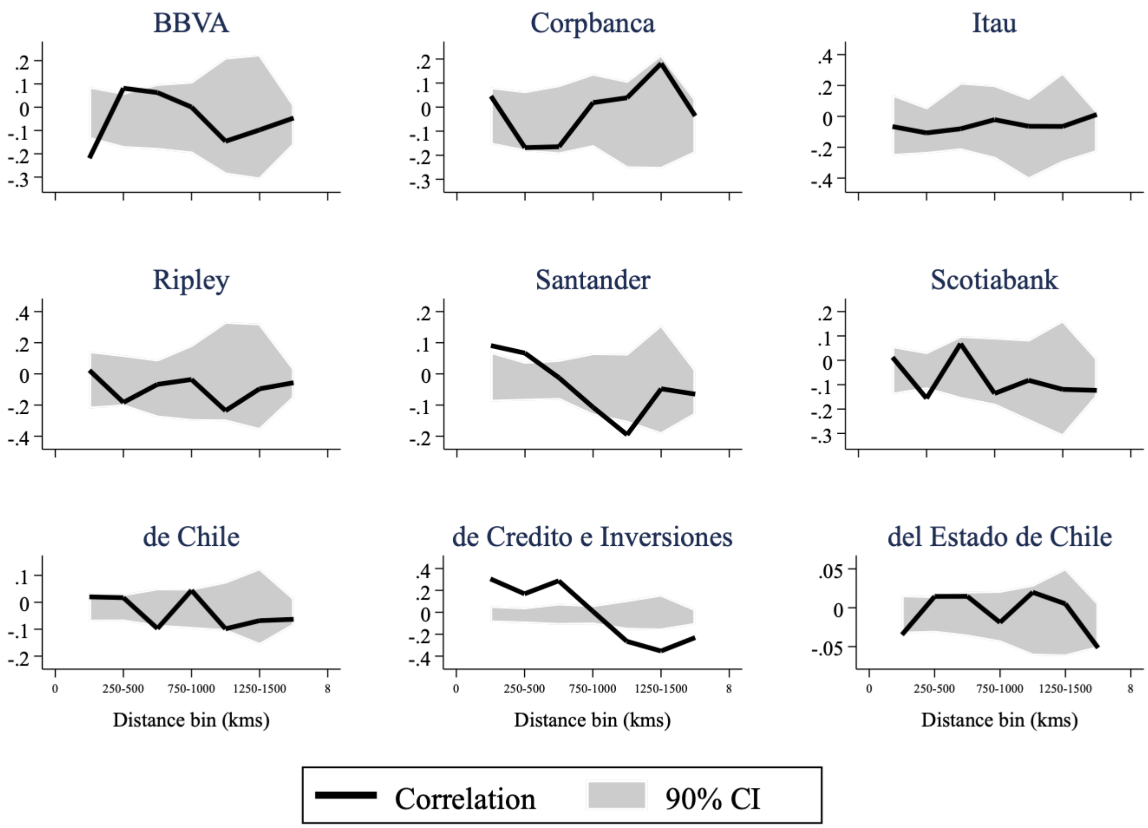
Figure 9: Spatial Correlation in Bank's Presence (Extensive Margin)



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 10 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 10: Spatial Correlation in Loan Market Shares (Intensive Margin)

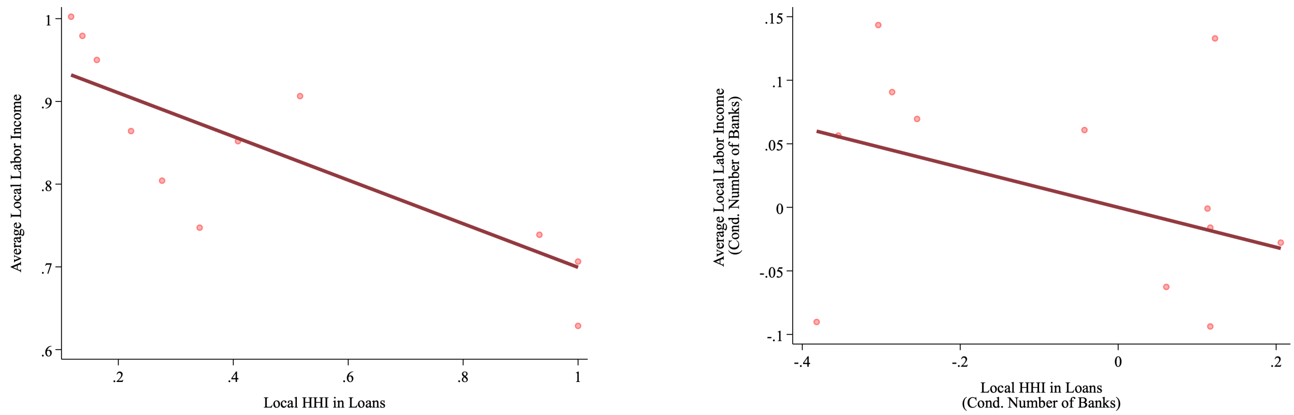


A.5 Correlation between loan-market concentration and wages

The relationship between local bank concentration and local prosperity is a first-order feature of the data. In the two bin-scatters in Figure 11, 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 11: 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.

A.6 Details on the Shift-Share IV

Figure 12 shows the world price of salmon during the period we analyze.

Figure 12: World Price of Salmon

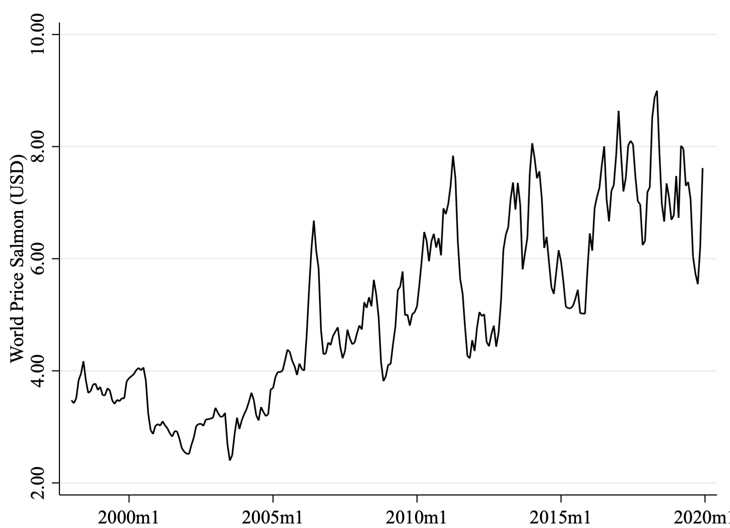
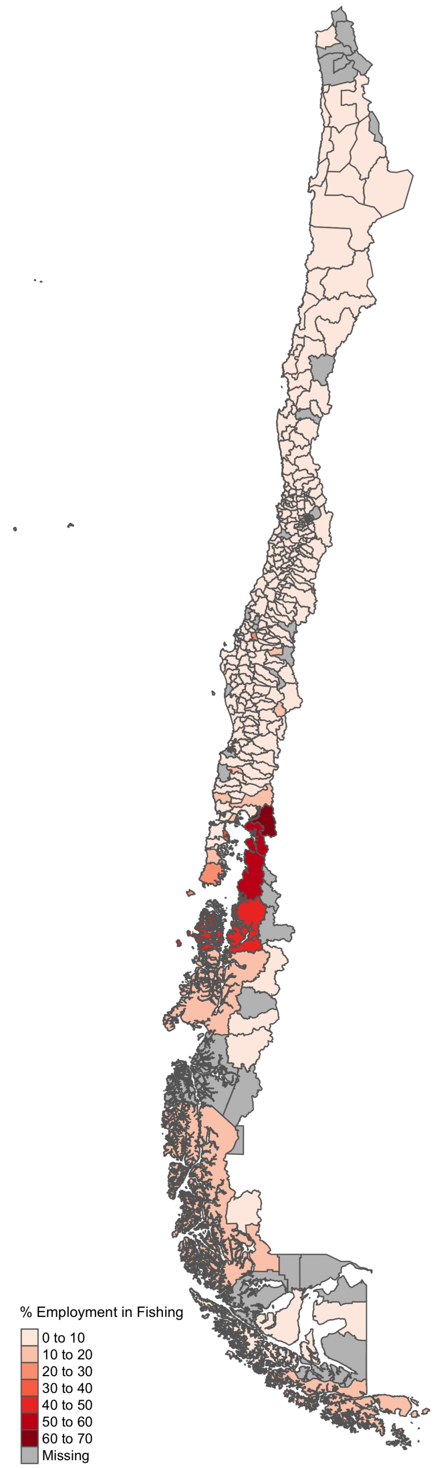


Figure 13 shows the share of local employment in the Fishing industry. The industry is concentrated in the Southern region.

Figure 13: Share of local employment in the fishing industry



B Mathematical appendix

B.1 Workers

We elaborate on the analysis of equation (5) in the main text. Using properties of the T1EV distribution of shocks and dropping time-subindices as we focus on a steady state, the value function of a worker who has moved to n is[8]

$$v_n = \ln b_{nt} + \ln \frac{w_n(1-\tau^{ss})(1+s)}{P_{nt}} + \rho \ln \Big(\sum_{d=1}^{N} exp\Big(\tfrac{\beta}{\rho} v_d\Big)\Big).$$

Then,

$$exp\Big(\frac{\beta}{\rho} v_n\Big) = b_n^{\frac{\beta}{\rho}} \times [w_n(1-\tau^{ss})(1+s)]^{\frac{\beta}{\rho}} \times P_n^{\frac{-\beta}{\rho}} \times \Big(\sum_{d=1}^{N} exp\Big(\tfrac{\beta}{\rho} v_d\Big)\Big)^{\beta}.$$

We define

$$\phi \equiv \sum_{d=1}^{N} exp\Big(\tfrac{\beta}{\rho} v_d\Big). \tag{31}$$

Putting all together, in a steady state the equilibrium value of ϕ solves

$$\phi = \sum_{d=1}^{N} b_d^{\frac{\beta}{\rho}} \times [w_d(1-\tau^{ss})(1+s)]^{\frac{\beta}{\rho}} \times P_d^{\frac{-\beta}{\rho}} \times \phi^{\beta} \tag{32}$$

$$= \Big(\sum_{d=1}^{N} b_d^{\frac{\beta}{\rho}} \times [w_d(1-\tau^{ss})(1+s)]^{\frac{\beta}{\rho}} \times P_d^{\frac{-\beta}{\rho}} \Big)^{\frac{1}{1-\beta}} \tag{33}$$

Relying again on the T1EV assumption, migration shares M_{nd} between any city-pairs, n and d, are given by

$$M_{nd} = M_d = \frac{exp\Big(\frac{\beta}{\rho} v_d\Big)}{\sum_{m=1}^{N} exp\Big(\frac{\beta}{\rho} v_m\Big)} = exp\Big(\frac{\beta}{\rho} v_d\Big)\phi^{-1} = b_d^{\frac{\beta}{\rho}} [w_d(1-\tau^{ss})(1+s)]^{\frac{\beta}{\rho}} P_d^{\frac{-\beta}{\rho}} \phi^{\beta-1}.$$

Given that we have normalized the population to 1, migration shares need to satisfy

$$\ell_d = M_d. \tag{34}$$

The budget constraint of the social security system reads

$$\sum_b T^b + s \sum_n w_n(1-\tau^{ss})\ell_n = \tau^{ss} \sum_n w_n \ell_n + r^w \tau^{ss} \sum_n w_n \ell_n, \tag{35}$$

where T^b are the transfers to banks. Asumming that the government returns the interest accrued in the wholesale market, $\sum_b T^b = r^w \tau^{ss} \sum_n w_n \ell_n$. From here it follows that $(1+s)(1-\tau^{ss}) = 1$.

[8] See Kleinman et al. (2023).

B.2 Capitalists

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, $\mathcal{L}_t(i_t)$, as given. The problem at the second stage an be written as

Solving for $\mathcal{L}_t(i_t)$ The problem of minimizing the cost of investment is

$$\mathcal{L}_t(i_t) = \min_{\{L^b_{t+1}\}_b} \sum_{b\in\mathcal{B}} L^b_{t+1}(1+r^b_{t+1}) \tag{36}$$

$$s.t.\ \ i_t = \Big[\sum_{b\in\mathcal{B}} (\gamma^b \tfrac{L^b_{t+1}}{P_t})^{\frac{\sigma-1}{\sigma}}\Big]^{\frac{\sigma}{\sigma-1}}, \tag{37}$$

From the first order condition with respect to an arbitrary L^b_t,

$$\mu(\tfrac{\gamma^b}{P_t})^{\frac{\sigma-1}{\sigma}}\Big(\frac{i_t}{L^b_{t+1}}\Big)^{\frac{1}{\sigma}} = (1+r^b_{t+1}), \tag{38}$$

where μ is the multiplier associated with the constraint in equation (37). Taking the ratio of equation (38) for two banks b and b',

$$\frac{L^{b'}_{t+1}}{L^b_{t+1}} = \Big[\frac{(1+r^b_{t+1})}{(1+r^{b'}_{t-1})}\Big]^{\sigma}\Big[\frac{\gamma^{b'}}{\gamma^b}\Big]^{\sigma-1}. \tag{39}$$

From here, picking an arbitrary b':

$$i_t = \Big(\sum_{b\in\mathcal{B}} (\gamma^b \tfrac{L^b_{t+1}}{P_t})^{\frac{\sigma-1}{\sigma}}\Big)^{\frac{\sigma}{\sigma-1}} = (1+r^{b'}_{t+1})^{\sigma}(\gamma^{b'})^{1-\sigma}\tfrac{L^{b'}_{t+1}}{P_t}\Big[\sum_{b\in\mathcal{B}}(\tfrac{1+r^b_{t+1}}{\gamma^b})^{1-\sigma}\Big]^{-\frac{\sigma}{1-\sigma}}. \tag{40}$$

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

$$i_t R^{\sigma}_{t+1} = (1+r^b_{t+1})^{\sigma}(\gamma^b)^{1-\sigma}\tfrac{L^b_{t+1}}{P_t} \tag{41}$$

and, therefore, we can express the equilibrium loans from bank b as

$$\frac{L^b_{t+1}}{P_t} = \Big(\frac{R_{t+1}}{1+r^b_{t+1}}\Big)^{\sigma} i_t(\gamma^b)^{\sigma-1}, \tag{42}$$

which appears in the main text. From equation (42) and the definition of $\mathcal{L}_t(i_t)$,

$$\mathcal{L}_t(i_t) = \sum_{b\in\mathcal{B}} L^b_{t+1}(1+r^b_{t+1}) = i_t R_{t+1} P_t. \tag{43}$$

Capitalist's full problem The full problem of the capitalist is

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

$$\underline{s.t:}\; C_t^c + \sum_b \frac{D_{t+1}^b}{P_t} + \frac{(k_t - k_{t-1}(1-\delta))R_t P_{t-1}}{P_t} = \frac{\hat{r}_t k_t}{P_t} + \sum_b \frac{D_t^b}{P_t}(1+\tilde{r}_t^b) + \frac{T_t^c}{P_t} \tag{44}$$

$$D_{t+1} = \Big[\sum_b {D_{t+1}^b}^{1-\frac{1}{\eta}} \Big]^{\frac{\eta}{\eta-1}} \tag{45}$$

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

where we have replaced $i_{t-1} = k_t - k_{t-1}(1-\delta)$ and we express the budget constraint in real terms. The first-order conditions with respect to k_t, C_t^c and D_{t+1}^b are

$$\lambda_t \frac{\hat{r}_t}{P_t} + \lambda_{t+1} \frac{(1-\delta)R_{t+1}P_t}{P_{t+1}} = \lambda_t \frac{R_t P_{t-1}}{P_t}, \tag{46}$$

$$\frac{\beta^t}{C_t^c} = \lambda_t, \tag{47}$$

$$\text{and}\;\; \beta^t \alpha D_{t+1}^{\frac{1-\eta}{\eta}} (D_{t+1}^b)^{-\frac{1}{\eta}} + \lambda_{t+1} \frac{1+\tilde{r}_{t+1}^b}{P_{t+1}} = \frac{\lambda_t}{P_t}. \tag{48}$$

Equation (46) 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 (47), is standard. The first order condition with respect to deposits in a specific bank, equation (48), reflects the dual role of deposits in the model: they increase utility and transfer resources between periods.

By combining equation (46) and equation (47) we derive the following Euler equation,

$$\frac{P_{t+1}C_{t+1}}{P_t C_t} = \beta(1-\delta) \frac{R_{t+1}P_t}{R_t P_{t-1} - \hat{r}_t}. \tag{49}$$

Replacing equation (47) into equation (48), and then replacing $C_{t+1}P_{t+1}$ from the Euler equation above, we get

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

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

$$\frac{D_{t+1}^b}{D_{t+1}^{b'}} = \left(\frac{q_{t+1}^b}{q_{t+1}^{b'}} \right)^{-\eta}, \tag{50}$$

where we defined q_{t+1}^b as

$$q_{t+1}^b \equiv 1 - \left(1 + \tilde{r}_{t+1}^b\right) / \left(\frac{(1-\delta)R_{t+1}P_t}{R_t P_{t-1} - \hat{r}_t} \right). \tag{51}$$

We define the deposit price index as

$$Q_{t+1} \equiv \left(\sum_b (q^b_{t+1})^{1-\eta} \right)^{\frac{1}{1-\eta}}. \tag{52}$$

It follows from equation (50) and the definition of D_{t+1} that the supply of deposits to bank b is given by

$$D^b_{t+1} = D_{t+1} \left(\frac{Q_{t+1}}{q^b_{t+1}} \right)^{\eta}. \tag{53}$$

Replacing this back into equation (48) we get an equalization of expenditure on the two 'goods' available to the consumer

$$D_{t+1}Q_{t+1} = \alpha P_t C_t. \tag{54}$$

The nominal value of total deposits at t is given by

$$\sum_b D^b_{t+1} = \sum_b D_{t+1} (\tfrac{Q_{t+1}}{q^b_{t+1}})^{\eta} = D_{t+1} Q^{\eta}_{t+1} \overbrace{\sum_b (q^b_{t+1})^{-\eta}}^{\equiv \tilde{Q}_{t+1}}. \tag{55}$$

Plugging equation (55) into the budget constraint equation (44), using equation (54) and defining M_t as

$$M_t \equiv \hat{r}_t k_t + \sum_b (1 + \tilde{r}^b_t) D^b_t - (k_t - (1-\delta)k_{t-1}) R_t P_{t-1} + T_t \tag{56}$$

we get

$$\frac{Q_{t+1}D_{t+1}}{\alpha} + D_{t+1}Q^{\eta}_{t+1}\tilde{Q}_{t+1} = M_t \rightarrow D_{t+1} = \frac{\alpha M_t}{Q_{t+1} + \alpha Q^{\eta}_{t+1}\tilde{Q}_{t+1}} \tag{57}$$

$$\text{and } P_t C^c_t = \frac{Q_{t+1} M_t}{Q_{t+1} + \alpha Q^{\eta}_{t+1}\tilde{Q}_{t+1}}. \tag{58}$$

B.2.1 Derivatives at the steady state

Having calculated capitalists' demand for loans and deposits, we calculate the derivatives of these functions with respect to the cost of loans and deposits (r and q respectively). We also calculate the derivatives of the inverse demand schedules, that is, the derivatives of r and q with respect to deposits and loans. We will rely on the latter when we study oligopolistic competition in quantities.

Throughout, we will use the fact that in a steady state, the Euler equation equation (49) becomes

$$1 = \frac{\beta(1-\delta)R_n P_n}{R_n P_n - \hat{r}_n}. \tag{59}$$

Derivative of L with respect to r. The demand function for loans is

$$L^b_{t+1} = P_t i_t(R_{t+1})(\gamma^b)^{\sigma-1} \left(\frac{R_{t+1}}{1 + r^b_{t+1}} \right)^{\sigma}.$$

The derivative and elasticity of loans with respect to r are, respectively,

$$\frac{\partial L_{t+1}^b}{\partial r_{t+1}^b} = \underbrace{\left\{\sigma \frac{L_{t+1}^b}{R_{t+1}} + \frac{L_{t+1}^b}{i_t} \frac{\partial i_t}{\partial R_{t+1}}\right\} \left(\frac{R_{t+1}}{1+r_{t+1}^b}\right)^{\sigma} (\gamma^b)^{\sigma-1}}_{\frac{\partial L_n^b}{\partial R_n}\frac{\partial R_n}{\partial r_n}} \underbrace{-\sigma \frac{L_n^b}{1+r_n^b}}_{\frac{\partial L_n^b}{\partial r_n^b}}$$

$$\begin{aligned}
\text{and } \epsilon_L &\equiv -\frac{\partial L_{t+1}^b}{\partial r_{t+1}^b} \frac{1+r_{t+1}^b}{L_{t+1}^b} \\
&= \sigma\left(1 - s_{t+1}^b\right) - s_{t+1}^b \times \underbrace{\frac{\partial i_t}{\partial R_{t+1}} \frac{R_{t+1}}{i_t}}_{\equiv -\varepsilon_n^{i,R}} \\
&= \sigma\left(1 - s_{t+1}^b\right) + s_{t+1}^b \varepsilon_n^{i,R}, \\
\text{where } s_{t+1}^b &\equiv \left(\frac{R_{t+1}}{1+r_{t+1}^b}\gamma^b\right)^{\sigma-1} = \underbrace{\frac{(1+r_{r+1}^b)L_{t+1}^b}{i_t R_{t+1} P_t}}_{\text{Revenue Share}}.
\end{aligned}$$

To calculate the elasticity of investment with respect to the interest rate R, start from the budget constraint at $t+1$ and the Euler equation

$$\frac{P_{t+1}C_{t+1}}{P_t C_t} = \frac{\hat{r}_{t+1}k_{t+1} + \sum_b D_{t+1}^b(1+r_{t+1}^b) + T_{t+1}^c - \sum_b D_{t+2}^b - i_t R_{t+1} P_t}{P_t C_t} = \frac{\beta(1-\delta)R_{t+1}P_t}{R_t P_{t-1} - \hat{r}_t}$$

$$i_t\left(\hat{r}_{t+1} - R_{t+1}P_t\right) + \hat{r}_{t+1}(1-\delta)k_t + \sum_b D_{t+1}^b(1+r_{t+1}^b) + T_{t+1}^c - \sum_b D_{t+2}^b = \frac{\beta(1-\delta)R_{t+1}P_t}{R_t P_{t-1} - \hat{r}_t} P_t C_t$$

$$i_t = \frac{1}{\hat{r}_{t+1} - R_{t+1}P_t}\left(\frac{\beta(1-\delta)R_{t+1}P_t}{R_t P_{t-1} - \hat{r}_t} P_t C_t - \hat{r}_{t+1}(1-\delta)k_t - \sum_b D_{t+1}^b(1+r_{t+1}^b) - T_{t+1}^c + \sum_b D_{t+2}^b\right)$$

$$\frac{\partial i_t}{\partial R_{t+1}} = -\frac{i_t P_t}{R_{t+1}P_t - \hat{r}_{t+1}} - \frac{\beta(1-\delta)P_t}{R_t P_{t-1} - \hat{r}_t} \times \frac{P_t C_t}{R_{t+1}P_t - \hat{r}_{t+1}}$$

In steady state, this expression can be simplified to

$$\begin{aligned}
\frac{\partial i_n}{\partial R_n} &= -\frac{1}{R_n} \times \frac{i_n R_n P_n + P_n C_n}{\beta(1-\delta)R_n P_n}, \\
\rightarrow \epsilon_n^{i,R} &= -\frac{1}{i_n} \times \frac{i_n R_n P_n + P_n C_n}{\beta(1-\delta)R_n P_n}, \\
\epsilon_n^{L,r} &= \sigma(1-s_n^b) + s_n^b \epsilon_n^{i,R}.
\end{aligned}$$

Derivative of r with respect to L. The inverse demand function for loans and the definition of investment are, respectively,

$$(1+r_{t+1}^b) = R_{t+1}\left(\frac{P_t i_t}{L_{t+1}^b}\right)^{\frac{1}{\sigma}} (\gamma^b)^{\frac{\sigma-1}{\sigma}},$$

$$i_t = \left(\sum_b (\gamma^b \frac{L_{t+1}^b}{P_t})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}.$$

Then,

$$\begin{aligned}\frac{\partial r_{t+1}^b}{\partial L_{t+1}^b} &= \frac{1}{\sigma}\frac{(1+r_{t+1}^b)}{L_{t+1}^b} + \frac{1}{\sigma}\frac{(1+r_{t+1}^b)}{i_t}\frac{\partial i_t}{\partial L_{t+1}^b} + \frac{(1+r_{t+1}^b)}{R_{t+1}}\frac{\partial R_{t+1}}{\partial i_t}\frac{\partial i_t}{\partial L_{t+1}^b} \\ &= -\frac{1}{\sigma}\frac{(1+r_{t+1}^b)}{L_{t+1}^b} + \frac{1}{\sigma}\frac{(1+r_{t+1}^b)}{i_t}\left(\frac{i_t}{L_{t+1}^b}\right)^{\frac{1}{\sigma}}\left(\frac{\gamma^b}{P_t}\right)^{\frac{\sigma-1}{\sigma}} - \frac{(1+r_{t+1}^b)}{R_{t+1}}\left(\frac{i_t}{L_{t+1}^b}\right)^{\frac{1}{\sigma}}\left(\frac{\gamma^b}{P_t}\right)^{\frac{\sigma-1}{\sigma}}\frac{\partial R_{t+1}}{\partial i_t}\end{aligned}$$

The elasticity of interest becomes

$$\begin{aligned}\epsilon_n^{r,L} &\equiv -\frac{\partial r_{t+1}^b}{\partial L_{t+1}^b}\frac{L_{t+1}^b}{r_{t+1}^b} \\ &= \frac{1}{\sigma} - \frac{1}{\sigma}s_t^b + s_t^b \epsilon_{R,i} \\ &= \left(\frac{1}{\sigma}(1-s_t^b) + \epsilon_{R,i}s_t^b\right)\end{aligned}$$

Where we have defined

$$s_t^b = \left(\frac{P_t i_t}{\gamma^b L_{t+1}^b}\right)^{\frac{1}{\sigma}-1} = \frac{(1+r_{t+1}^b)^{1-\sigma}}{\sum_\ell (1+r_{t+1}^\ell)^{1-\sigma}}.$$

To calculate the elasticity of the interest rate index R with respect to investment, $\epsilon_n^{R,i}$, start from equation (49) and the budget constraint of the capitalist,

$$\frac{P_{t+1}C_{t+1}}{P_tC_t} = \frac{\hat{r}_{t+1}k_{t+1} + \sum_b D_{t+1}^b(1+r_{t+1}^b) + T_{t+1}^c - \sum_b D_{t+2}^b - i_t R_{t+1} P_t}{P_tC_t} = \frac{\beta(1-\delta)R_{t+1}P_t}{R_tP_{t-1} - \hat{r}_t}$$

$$i_t\left(\hat{r}_{t+1} - R_{t+1}P_t\right) + \hat{r}_{t+1}(1-\delta)k_t + \sum_b D_{t+1}^b(1+r_{t+1}^b) + T_{t+1}^c - \sum_b D_{t+2}^b = \frac{\beta(1-\delta)R_{t+1}P_t}{R_tP_{t-1} - \hat{r}_t}P_tC_t$$

$$R_{t+1} = \left\{\frac{\beta(1-\delta)P_t}{R_tP_{t-1} - \hat{r}_t}P_tC_t + P_ti_t\right\}^{-1} \times (\hat{r}_t(i_t + (1-\delta)k_t + ...)$$

The derivative of interest becomes

$$\frac{\partial R_{t+1}}{\partial i_t} = -\left\{\frac{\beta(1-\delta)P_t}{R_tP_{t-1} - \hat{r}_t}P_tC_t + P_ti_t\right\}^{-1} R_{t+1}P_t + \left\{\frac{\beta(1-\delta)P_t}{R_tP_{t-1} - \hat{r}_t}P_tC_t + P_ti_t\right\}^{-1}\hat{r}_t$$

In steady state,

$$\frac{\partial R_n}{\partial i_n} = -\frac{R_n^2 \beta(1-\delta)}{C+iR}$$
$$\to \epsilon_n^{R,i} = -\frac{\partial R_n}{\partial i_n}\frac{R_n}{i_t} = \frac{iR\beta(1-\delta)}{C+iR}$$
$$\epsilon_n^{r,L} = \left(\frac{1}{\sigma}(1-s_n^b) + s_n^b \epsilon_n^{R,i}\right).$$

Derivative of D with respect to q Using equation (54) to write D_{t+1} as a function of the aggregate price of deposits, Q_{t+1},

$$\begin{aligned} D_{t+1}^b &= D_{t+1}\left(\frac{Q_{t+1}}{q_{t+1}^b}\right)^{\eta} \\ &= \alpha \frac{M_t}{Q_{t+1} + \alpha Q_{t+1}^{\eta}\sum_b (q_{t+1}^b)^{-\eta}}\left(\frac{Q_{t+1}}{q_{t+1}^b}\right)^{\eta}. \end{aligned}$$

From here, the derivative of interest becomes

$$\frac{\partial D_{t+1}^b}{\partial q_{t+1}^b} = \eta \frac{D_{t+1}^b}{Q_{t+1}}\left(\frac{Q_{t+1}}{q_{t+1}^b}\right)^{\eta} - D_{t+1}^b \frac{1+\alpha\eta Q_{t+1}^{\eta-1}\tilde{Q}_{t+1}}{Q_{t+1}+\alpha Q_{t+1}^{\eta}\tilde{Q}_{t+1}}\left(\frac{Q_{t+1}}{q_{t+1}^b}\right)^{\eta} - \eta\frac{D_{t+1}^b}{q_{t+1}^b} + D_{t+1}^b \frac{\alpha\eta Q_{t+1}^{\eta} q_{t+1}^{-\eta-1}}{Q_{t+1}+\alpha Q_{t+1}^{\eta}\tilde{Q}_{t+1}}.$$

The elasticity of interest becomes

$$\begin{aligned} \epsilon_n^{D,q} &\equiv -\frac{\partial D_{t+1}^b}{\partial q_{t+1}^b}\frac{q_{t+1}^b}{D_{t+1}^b} \\ &= \eta\left(1-\tilde{s}_{t+1}^b\right) + \left\{\frac{1+\alpha\eta Q_{t+1}^{\eta-1}\tilde{Q}_{t+1}}{1+\alpha Q_{t+1}^{\eta-1}\tilde{Q}_{t+1}} - \frac{\alpha\eta/q_{t+1}^b}{1+\alpha Q_{t+1}^{\eta-1}\tilde{Q}_{t+1}}\right\}\tilde{s}_{t+1}^b. \end{aligned}$$

where we have defined

$$\tilde{s}_{t+1}^b \equiv \left(\frac{Q_{t+1}}{q_{t+1}^b}\right)^{\eta-1} = \underbrace{\frac{q_{r+1}^b D_{t+1}^b}{D_{t+1}Q_{t+1}}}_{\text{Revenue Share}}.$$

Derivative of q with respect to D. We start by writing the inverse demand for deposits,

$$q_{t+1}^b = Q_{t+1}\left(\frac{D_{t+1}}{D_{t+1}^b}\right)^{\frac{1}{\eta}},$$
$$D_{t+1} = \left(\sum_b (D_{t+1}^b)^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}.$$

Using equation (54) we can express Q_{t+1} as a function of D_{t+1} and objects taken as given by the banks.

$$q^b_{t+1} = \alpha \frac{M_t - \sum_b D^b_{t+1}}{D_{t+1}} \left(\frac{D_{t+1}}{D^b_{t+1}} \right)^{\frac{1}{\eta}}.$$

The derivative of interest becomes

$$\frac{\partial q^b_{t+1}}{\partial D^b_{t+1}} = -\frac{1}{\eta} \frac{q^b_{t+1}}{D^b_{t+1}} - \alpha \frac{q^b_{t+1}}{D_{t+1} Q_{t+1}} + \left(\frac{1}{\eta} - 1 \right) \frac{q^b_{t+1}}{D_{t+1}} \left(\frac{D_{t+1}}{D^b_{t+1}} \right)^{\frac{1}{\eta}}.$$

The elasticity of interest becomes

$$\begin{aligned} \epsilon^{q,D}_n &\equiv -\frac{\partial q^b_{t+1}}{\partial D^b_{t+1}} \frac{D^b_{t+1}}{q^b_{t+1}} \\ &= \frac{1}{\eta} \left(\tilde{s}^b_n - 1 \right) + \frac{\alpha}{q^b_{t+1}} s^b_{t+1} + s^b_{t+1}. \end{aligned}$$

where we have defined

$$\tilde{s}^b_{t+1} = \left(\frac{D_{t+1}}{D^b_{t+1}} \right)^{\frac{1}{\eta}-1} = \frac{q^b_{t+1} D^b_{t+1}}{Q_{t+1} D_{t+1}}.$$

B.3 Banks

We follow the approach in Atkeson and Burstein (2008) in our setting where banks compete oligopolistically within each city.

B.3.1 Oligopolistic competition in prices

$$\begin{aligned} \max_{\{\{r_{nt}, \tilde{r}_{nt}\}, F_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \Big\{ \sum_n L_{nt}(1 + r_{nt}) + D_{nt+1} - L_{nt+1} - D_{nt}(1 + \tilde{r}_{nt}) + F_{t+1} - \exp\left(\phi \frac{F_t}{\sum_n D_{nt}} \right) (1 + r^F_t) F_t \Big\} \\ \underline{s.t:}\ [\lambda_t]\ \sum_n L_{nt+1} = \sum_n D_{nt+1} + F_{t+1} \quad \forall t. \end{aligned}$$

FOC with respect to F_{t+1}:

$$\beta^t - \beta^{t+1} \left\{ \exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}} \right) (1 + r^F_{t+1}) + \exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}} \right) (1 + r^F_{t+1}) \phi \frac{F_{t+1}}{\sum_n D_{nt+1}} \right\} + \lambda_t = 0$$

$$\frac{1}{\beta} + \mu_t = \exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}} \right) (1 + r^F_{t+1}) \left\{ 1 + \phi \frac{F_{t+1}}{\sum_n D_{nt+1}} \right\} \tag{60}$$

Where $\mu_t = \frac{\lambda_t}{\beta^{t+1}}$. Now the FOC with respect to L_{nt}.

$$\begin{aligned} \frac{\partial L_{nt+1}}{\partial r_{nt+1}} \left[\frac{1}{\beta} - (1 + r_{nt+1}) + \mu_t \right] &= L_{nt+1} \\ \epsilon_L \left[-\frac{1}{\beta} + (1 + r_{nt+1}) - \mu_t \right] &= (1 + r_{nt+1}) \end{aligned}$$

Solving for $(1+r)$,

$$(1+r_{nt+1}) = \frac{\epsilon_L}{\epsilon_L - 1}\left(\frac{1}{\beta} + \mu_t\right) \tag{61}$$

Now, same for deposits, D_{nt}:

$$\frac{\partial D_{nt+1}}{\partial q_{nt+1}} \underbrace{\frac{\partial q_{nt+1}}{\partial \tilde{r}_{nt+1}}}_{\text{in SS: } -\beta} \left[\frac{1}{\beta} - (1+\tilde{r}_{nt+1}) + \exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}}\right)(1+r^F_{t+1})\phi\left(\frac{F_{t+1}}{\sum_n D_{nt+1}}\right)^2 + \mu_t\right] = D_{nt+1}$$

$$\epsilon_D \left[\underbrace{1 - \beta(1+r_{nt+1})}_{q_{nt+1}} + \beta\exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}}\right)(1+r^F_{t+1})\phi\left(\frac{F_{t+1}}{\sum_n D_{nt+1}}\right)^2 + \beta\mu_t\right] = q_{nt+1}$$

Solving for q

$$q_{nt+1} = -\frac{\epsilon_D}{\epsilon_D - 1}\beta\left\{\exp\left(\phi \frac{F_{t+1}}{\sum_n D_{nt+1}}\right)(1+r^F_{t+1})\phi\left(\frac{F_{t+1}}{\sum_n D_{nt+1}}\right)^2 + \mu_t\right\} \tag{62}$$

B.3.2 Oligopolistic competition in quantities

The bank problem is:

$$\max_{\{\{D^b_{nt}, L^b_{nt}\}, F_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \Big\{ \sum_n L_{nt}(1+r_{nt}) + D_{nt+1} - L_{nt+1} - D_{nt}(1+\tilde{r}_{nt}) + F_{t+1} - \exp\left(\phi \frac{F_t}{\sum_n D_{nt}}\right)(1+r^F_t)F_t \Big\}$$

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

Take the FOC with respect to D^b_{t+1} from the bank's problem:

$$\beta^t - \beta^{t+1}(1+\tilde{r}^b_{t+1}) - \beta^{t+1} D^b_{t+1} \times \underbrace{-\frac{1}{\beta}}_{\frac{\partial(1+\tilde{r}^b_{t+1})}{\partial q^b_{t+1}}} \times \underbrace{\left\{-\frac{1}{\eta}\frac{q^b_{t+1}}{D^b_{t+1}} - \alpha\frac{q^b_{t+1}}{D_{t+1}Q_{t+1}} + \left(\frac{1}{\eta} - 1\right)\frac{q^b_{t+1}}{D_{t+1}}\left(\frac{D_{t+1}}{D^b_{t+1}}\right)^{\frac{1}{\eta}}\right\}}_{\frac{\partial q^b_{t+1}}{\partial D^b_{t+1}}}$$
$$+\beta^{t+1}\tau^F(1+r^F_t)\phi\left(\frac{F_{t+1}}{\sum_n D^b_{nt+1}}\right)^2 = \lambda_t$$

Defining the following revenue share:

$$\tilde{s}^b_{t+1} = \left(\frac{D_{t+1}}{D^b_{t+1}}\right)^{\frac{1}{\eta}-1} = \frac{q^b_{t+1}D^b_{t+1}}{Q_{t+1}D_{t+1}}$$

Then,

$$1 - \beta(1+\tilde{r}^b_{t+1}) + q^b_{t+1}\left\{-\frac{1}{\eta} - \frac{\alpha}{q^b_{t+1}}s^b_{t+1} + \left(\frac{1}{\eta} - 1\right)\tilde{s}^b_{t+1}\right\} = \tilde{\lambda}_t - \beta\tau^F(1+r^F_t)\phi\left(\frac{F_{t+1}}{\sum_n D^b_{nt+1}}\right)^2$$

$$q^b_{t+1} - q^b_{t+1}\left\{\frac{1}{\eta}(1-\tilde{s}^b) + (1+\frac{\alpha}{q^b_{t+1}})\tilde{s}^b\right\} = \tilde{\lambda}_t - \beta\tau^F(1+r^F_t)\phi\left(\frac{F_{t+1}}{\sum_n D^b_{nt+1}}\right)^2$$

Following AA we define $\epsilon(s) = \left(\frac{1}{\eta}(1-s) + (1+\alpha/q)s\right)^{-1}$

$$q^b_n = \frac{\epsilon(\tilde{s}^b_n)}{\epsilon(\tilde{s}^b_n)-1}\left\{\tilde{\lambda}^b - \beta\tau^F(1+r^F_t)\phi\left(\frac{F_{t+1}}{\sum_n D^b_{nt+1}}\right)^2\right\}$$

$$(1+r^b_{t+1}) = R_{t+1}(i_{t+1})\left(\frac{P_t i_t}{L^b_{t+1}}\right)^{\frac{1}{\sigma}}(\gamma^b)^{\frac{\sigma-1}{\sigma}}$$

Take the FOC with respect to L^b_{t+1} from the bank's problem:

$$-\beta^t + \beta^{t+1}(1+r^b_{t+1}) + \beta^{t+1}L^b_{t+1}\left\{-\frac{1}{\sigma}\frac{(1+r^b_{t+1})}{L^b_{t+1}} + \frac{1}{\sigma}\frac{(1+r^b_{t+1})}{i_t}\left(\frac{i_t}{L^b_{t+1}}\right)^{\frac{1}{\sigma}}\left(\frac{\gamma^b}{P_t}\right)^{\frac{\sigma-1}{\sigma}} - \frac{(1+r^b_{t+1})}{R_{t+1}}\frac{R^2\beta(1-\delta)}{C+iR}\left(\frac{i_t}{L^b_{t+1}}\right)^{\frac{1}{\sigma}}\left(\frac{\gamma^b}{P_t}\right)^{\frac{\sigma-1}{\sigma}}\right. + \lambda_t = 0$$

$$1 - \beta(1+r^b_{t+1}) + \beta(1+r^b_{t+1})\left\{\frac{1}{\sigma}(1-s^b_t) + \epsilon_{R,i}s^b_t\right\} = \tilde{\lambda}_t$$

If we define:

$$s^b_t = \left(\frac{P_t i_t}{\gamma^b L^b_{t+1}}\right)^{\frac{1}{\sigma}-1} = \frac{(1+r^b_{t+1})^{1-\sigma}}{\sum_\ell (1+r^\ell_{t+1})^{1-\sigma}}$$
$$\epsilon(s^b_t) = \left(\frac{1}{\sigma}(1-s^b_t) + \epsilon_{R,i}s^b_t\right)^{-1}$$

Where as in Atkeson and Burstein (2008), s^b_t is the market share of bank b in city n in time t. Then,

$$(1+r^b_{t+1}) = \frac{\epsilon(s^b_t)}{\epsilon(s^b_t)-1}\frac{1}{\beta}(1-\tilde{\lambda}^b_t) \tag{63}$$

$$1 - \tilde{\lambda}^b_t = \beta\tau^F(1+r^F_{t+1})\left\{1 + \phi\frac{F_{t+1}}{\sum_n D^b_{nt+1}}\right\} \tag{64}$$

C Estimation appendix

C.1 Mapping our ATT estimate to σ

Our difference-in-differences strategy allows us to estimate substitution across banks in treated cities (ATT). Our outcome variable is the log of real loans issued by bank b in city n at t. Given our definition of treated cities as those in which Corpbanca was present but Itaú was not, the shock affects the interest rates of one bank in the city, which we label b^T. Using $\tilde{L}$ to denote real loans, the model-implied equation for our outcome variable is

$$\log\left(\tilde{L}^b_{nt}\right) = \log(i^b_n) + \gamma^b_n + \sigma\Big[\log R_{nt} - \log(1 + r^b_{nt})\Big]. \tag{65}$$

We focus on the symmetric case and assume that the return on capital $\hat{r}_n$ stays constant around the time of the merger. From equation (**??**), city-bank elasticities of loan demand do not change in treated cities, as neither the number of banks nor the primitive elasticity of substitution across banks, σ, changed. This leads to changes in interest rates responding only to changes in banks' marginal costs,

$$\Delta \log(1 + r^b_{nt}) \approx \Delta\mu^b.$$

Differencing out equation (65),

$$\Delta \log(L^b_n) = \Delta \log(i_n) + \sigma\Delta \log(R_n) - \sigma\Delta\mu^b \tag{66}$$

Including bank-year fixed effects takes care of the last term. To unwrap the other terms we start by taking logs in the definition of R_n under the assumption of symmetry,

$$\log(R_n) = \frac{\log(\sum_b \frac{1+r^b_n}{\gamma_n}^{1-\sigma})}{1-\sigma} = \frac{\log(B_n\gamma^{\sigma-1}(1+r_n)^{1-\sigma})}{1-\sigma} \tag{67}$$

The associated change in R_n once bank b^T changes its interest rate (breaking the symmetry) is

$$\Delta \log(R_n) = \frac{1}{1-\sigma}\log\Big(\frac{B_n - 1}{B_n} + \frac{(1 + r^{b^T}_n)^{1-\sigma}}{B_n(1+r^b_n)^{1-\sigma}}\Big) \tag{68}$$

where B_n denotes the number of banks in city n. To calculate the change in investment in city n upon the shock to bank b^T, start with the definition of investment in the symmetric baseline,

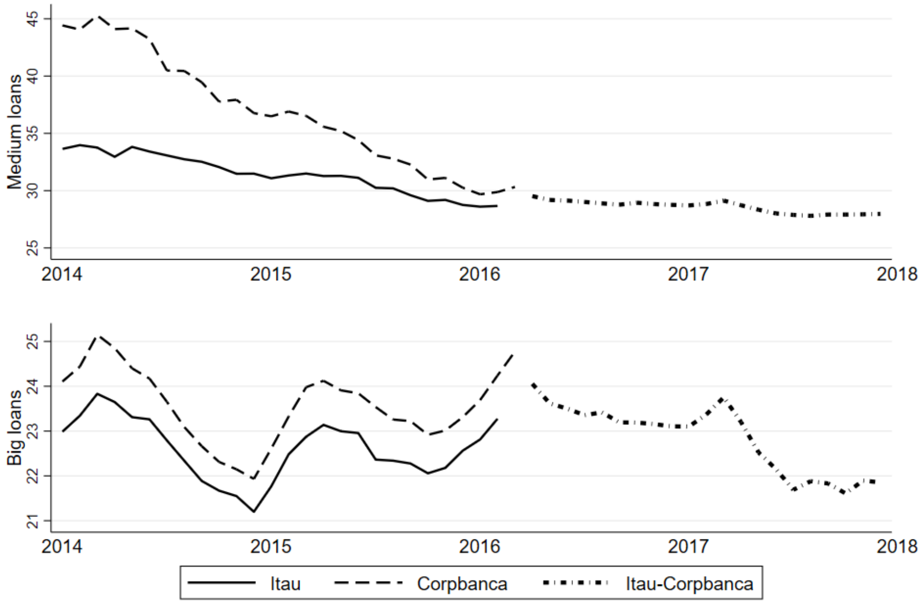
$$\log(i_n) = \frac{\sigma}{\sigma-1}\log\Big(\gamma_n \sum_b L_n^{\frac{\sigma-1}{\sigma}}\Big). \tag{69}$$

Following analogous steps as for the interest rate index,

$$\Delta \log(i_n) = \frac{\sigma}{\sigma-1}\log\Big(\frac{B_n-1}{B_n}(1+\Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1+\Delta^{L^T})^{\frac{\sigma-1}{\sigma}}}{B_n}\Big) \tag{70}$$

Where $(1 + \Delta^L)$ is the gross growth in loans for all banks except for the treated bank, which is captured by $(1+\Delta^{L^T})$. Equation (70) states that the growth of investment is a weighted sum of growth in loans from the treated bank and other banks in the city. From equation (66), the change in loans issued by the treated

Figure 14: Interes Rates around the time of the Merger



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

bank (whose competition did not change rates) can be written as

$$\Delta^{L^T} = \Delta \log(i_n) - \sigma \Delta \log(1 + r_{b_n}). \tag{71}$$

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

$$\Delta^L = \frac{\sigma}{\sigma - 1} \log\left(\frac{B_n - 1}{B_n}(1 + \Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1 + \Delta^{L^T})^{\frac{\sigma}{\sigma-1}}}{B_n}\right) + \frac{\sigma}{1 - \sigma} \log\left(\frac{B_n - 1}{B_n} + \frac{(1 + r_n^{b^T})^{1-\sigma}}{B_n(1 + r_n^b)^{1-\sigma}}\right) \tag{72}$$

$$\Delta^{L^T} = \frac{\sigma}{\sigma - 1} \log\left(\frac{B_n - 1}{B_n}(1 + \Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1 + \Delta^{L^T})^{\frac{\sigma}{\sigma-1}}}{B_n}\right) - \sigma \Delta \log(1 + r_{b^T}). \tag{73}$$

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 14 shows the evolution of interest rates for Itaú and Corpbanca before and after the merger, for medium and big loans, 1.2327 and 1.2424 respectively leads to

Using the change in the interest rate for big loans leads to

$$\left(\frac{1 + r_{b^T}}{1 + r_b}\right)^{1-\sigma} = 0.992^{1-\sigma} \text{ and } \log\left(\frac{1 + r_{b^T}}{1 + r_b}\right) = -0.0034 \tag{74}$$

Then, our two equations of interest become

$$\Delta^L = \frac{\sigma}{\sigma - 1} \log\Big(\frac{B_n - 1}{B_n}(1+\Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1+\Delta^{L^T})^{\frac{\sigma}{\sigma-1}}}{B_n}\Big) + \frac{\sigma}{1-\sigma} \log\Big(\frac{B_n - 1}{B_n} + \frac{0.992^{1-\sigma}}{B_n}\Big) \tag{75}$$

$$\Delta^{L^T} = \frac{\sigma}{\sigma - 1} \log\Big(\frac{B_n - 1}{B_n}(1+\Delta^L)^{\frac{\sigma-1}{\sigma}} + \frac{(1+\Delta^{L^T})^{\frac{\sigma}{\sigma-1}}}{B_n}\Big) + 0.0034\sigma. \tag{76}$$

$$\tag{77}$$

Our difference-in-differences estimate is the average Δ^L. The average $\frac{1}{B_n}$ in the treated cities is 0.22, and we approximate the average of the changes with the changes evaluated at the average B_n. Plugging in these values, we end up with a system of two equations into two unknowns, $(1 + \Delta^{L'})$ and σ. The solution of the system leads to $\hat{\sigma} = 5.2$.