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Interest rate dispersion in commercial loans

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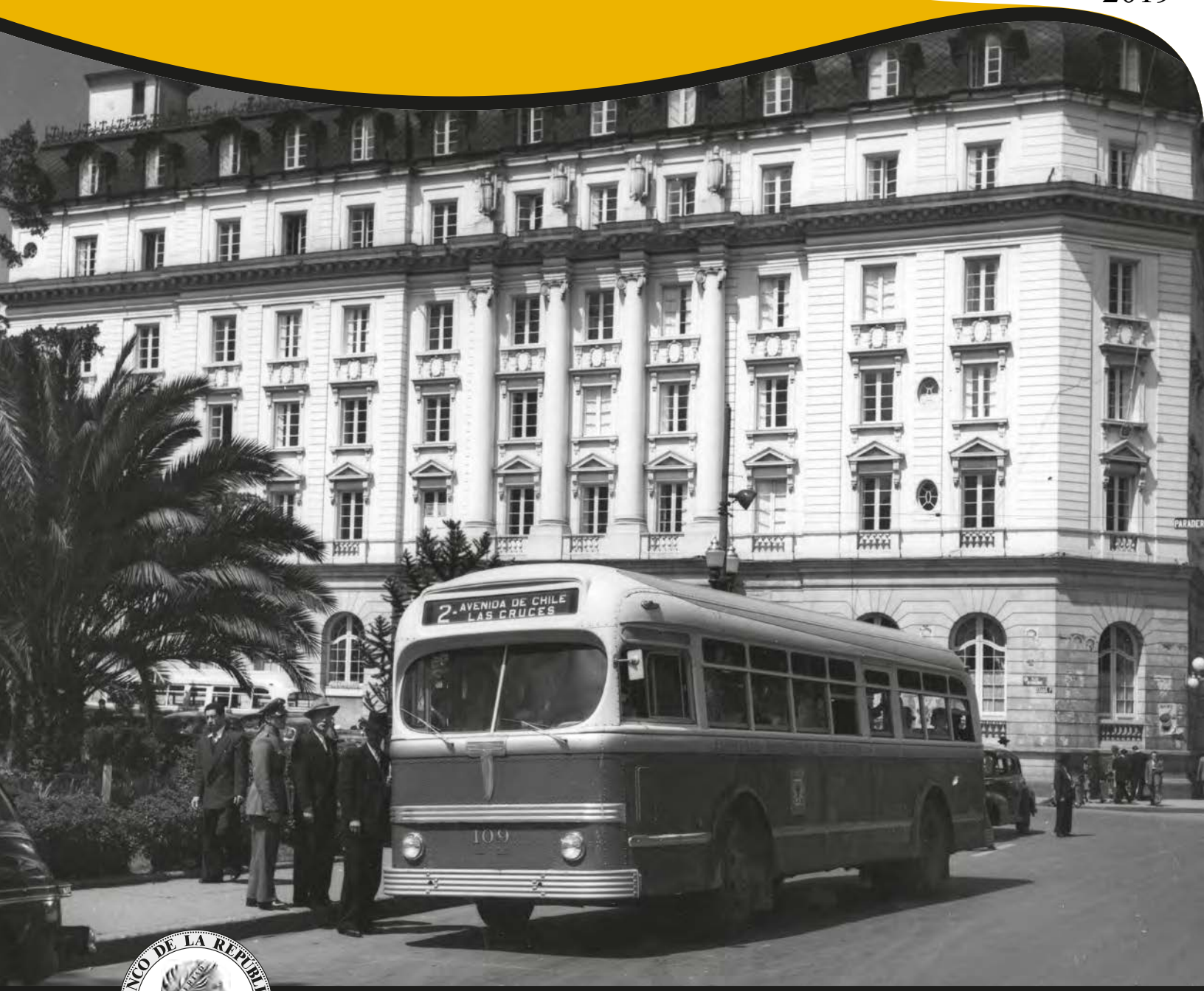

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BANCO DE LA REPÚBLICA
COLOMBIA

Dispersión de tasas de interés de créditos comerciales

*Stefany Moreno-Burbano, Andrés Vargas-Vargas, Juan Sebastián Vélez-Velásquez**

Resumen

En este documento estudiamos las tasas de interés de los créditos comerciales otorgados por bancos a las firmas manufactureras colombianas entre 2005 y 2013. La dispersión puede ser causada por dos tipos de heterogeneidad de las firmas. Las firmas pueden diferir en su habilidad para negociar las tasas de interés o en qué tan costosas son para proveerles crédito. Nosotros documentamos la magnitud de la dispersión en tasas de interés y caracterizamos el impacto de las características de los deudores, los bancos y el mercado sobre la dispersión. Las regresiones en forma reducida muestran que, en promedio, las firmas con un historial crediticio que no es impecable y firmas que son leales a sus bancos pagan en equilibrio tasas de interés más altas. Usando regresiones cuantílicas nosotros encontramos que, condicional a que las tasas de interés sean altas, un incremento marginal en los ingresos de la firma está asociado con unas tasas de interés más altas. Finalmente, evaluamos el impacto que la estructura de mercado tiene sobre el nivel y la variación de las tasas de interés en créditos comerciales, tomando ventaja de una ola de fusiones que tuvieron lugar entre 2006 y 2008.

Palabras clave: tasas de interés, créditos comerciales, dispersión de precios, fusiones.

Clasificación JEL: L1, L6, C31, D53, G21.

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Abstract

We study the dispersion of interest rates on commercial loans granted by banks to Colombian manufacturing firms between 2005 and 2013. Dispersion can be caused by two types of firm heterogeneity. Firms can differ in their ability to negotiate interest rate or firms can differ in how costly it is to provide a loan to them. We document the extent of interest rate dispersion and characterize the impact of borrowers', banks' and market characteristics on dispersion. Reduce-form regressions show that, on average, firms with less-than impeccable credit history and firms that are loyal to their banks, pay on equilibrium higher interest rates. Using quantile regressions, we find that, conditional on rates being high, a marginal increase on the firm's revenue is associated with higher interest rates. Finally, we evaluate the impact that the market structure has on the level and variation of interest rates on commercial loans, taking advantage of a wave of mergers that took place between 2006-2008.

Keywords: interest rates, loans, price dispersion, mergers.

JEL Classification: L1, L6, C31, D53, G21.

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1. Introduction

In markets where there is room to negotiate prices (real estate, automobile, professionals services) price dispersion tends to be higher than in others. The dispersion is caused, chiefly, by consumer heterogeneity, which takes two forms. In one, consumers differ in their ability to haggle and as a result the equilibrium price distribution reflects the distribution of bargaining abilities. The more diverse consumers are in terms of their ability to bring down a posted price, the more disperse the transaction prices are. In the other, sellers find that the cost of providing a good or service to different consumers is different. Specifically, in the case of financial markets, risk of default has a predominant role in determining this kind of borrower heterogeneity associated with the cost of providing the service.

In this paper, we study price dispersion in a specific setting: interest rates of commercial loans granted by banks to manufacturing firms. We do two things. First, we document the extent of interest rate dispersion for loans taken by Colombian manufacturing firms between 2005 and 2013. Second, we characterize the impact of borrower, bank and market characteristics on the ability to obtain discounted rates. However, despite controlling for the key determinants of interest rates we are still left with a lot of unexplained price dispersion.

Understanding the dispersion of interest rates in this context is important because there are enormous differences in the cost of financing investment projects for firms paying rates in both ends of the distribution of rates in our data. For instance, if a firm borrowed an amount equivalent to the median loan -which is around 200 million COP- for a year, the difference in the cost of debt between obtaining the loan at the 25th and 75th percentile rate would be over 23 million COP which is equivalent to the cost of hiring 1.5 full-time minimum wage workers for a year.

We employ data collected by two of Colombia's regulatory agencies. One of them is the the Superintendencia Financiera de Colombia (Superfinanciera), which is the

agency charged with monitoring institutions in the financial, securities and insurance sectors. The other agency is the Superintendencia de Sociedades (Supersociedades) which oversees large private corporate sector firms. From these sources we are able to obtain detailed information on loan and borrower characteristics, and the market structure, to see how they interact to determine the distribution of equilibrium interest rates we observe.

The first exercise consists of a series of reduced-form regressions exploring the relation between spreads -defined as the difference between the negotiated rate and the opportunity cost for the bank. The data suggest that, everything else constant, firms with negative credit history events pay higher interest rates controlling on average. Longer terms and larger amounts, on the other hand, are correlated with smaller spreads. Finally, as is expected, firms that perform better, that is, that are more productive and report more revenue, are able to negotiate larger discounts.

Since we are dealing with considerable price dispersion, we estimate quantile regressions (QR) which allow as to understand the effect of the observed characteristics, not only on the interest rates close the mean rate, but on rates located somewhere else in the distribution. Importantly, we find that the effects around the mean (MCO estimates) and the estimates on other parts of the distribution of interest rates vary considerably. For instance, firms with more revenue get on average lower rates, however, conditional on rates being high a marginal increase on revenue is associated with higher interest rates.

We find that consumer-based pricing is important, so, after controlling for loan characteristics, the attributes of the firm applying for it are still key in determining the interest rate. For instance, as expected, new borrowers pay higher rates that experienced borrowers. However, we find that firms obtaining loans from banks with which they have made business recurrently -or as we call them *home-banks*- pay higher rates. This finding coincides with the widespread suspicion that the banking industry is characterized by non-negligible switching costs that allow banks to extract willingness to pay from their

customers.

Finally, we look at rates and their dispersion around a wave of mergers that rocked the financial markets around 2006, in a bid to assess the impact that the market structure has on the level and variation of interest rates. We find evidence of a decrease of interest rates on loans granted by the merged banks right after the mergers but find no evidence of any effect on dispersion.

The remainder of the paper is organized as follows. First, we discuss literature related to our endeavor. Second, we describe the data we use and provide some stylized facts about interest rate dispersion. Third, we show the results of estimating the impact of observed attributes of loans, borrowers and markets on interest rates with two empirical strategies, a reduce-form on mean and quantile regressions. Fourth, we assess the effect of mergers on rates' level and dispersion. Finally, we conclude.

2. Literature Review

Theorizing about the causes and effects of price dispersion is a long tradition that started with the seminal paper of Stigler (1961), who demonstrated that imperfect information among buyers gives rise to price dispersion even in markets with homogeneous products. The reason behind this is that consumers differ in the their ability to search for the lowest price which allows firms to charge different prices to different consumers. In most of the theory literature consumers incur search costs to find the lowest price as the reason behind the price dispersion (Wilde and Schwartz (1979), Burdett and Judd (1983), Janssen and Moraga-González (2004), Reinganum (1979), MacMinn (1980), Carlson and McAfee (1983)) while in a subset of articles consumers pay a third party -a clearinghouse- to do the search for them instead (Varian (1980), Stahl (1989), Baye and Morgan (2001), Baye, Morgan, and Scholten (2007)).

In financial markets, specifically, the level of risk of borrowers and the lenders' ability to perceive it interact to determine the degree of price dispersion (Allen, Clark, and

Houde (2014a), Panetta, Schivardi, and Shum (2009a), Einav, Jenkins, and Levin (2013); Adams, Einav, and Levin (2009), Stango and Zinman (2016)). However, the empirical literature shows that even controlling for risk and characteristics of the financial product there can be price dispersion even across borrowers with identical observed features, which could be caused by consumers having different search costs or different bargaining leverages.

For instance, Allen, Clark, and Houde (2014a) study the Canadian mortgage market and find substantial price dispersion even after controlling for a vast arrangement of observed characteristics. Their empirical strategy, which ours resembles, consists of an analysis of variance of the dispersion, and mean and quantile regressions of the interest rates on loan, lender and borrower characteristics. Similarly, Stango and Zinman (2016) using a rich data-set from credit card costs in the U.S.find evidence of substantial price dispersion even among similarly risky borrowers, debt levels and similar characteristics of the financial product.

More recently, Allen, Clark, and Houde (2014b) using the aforementioned data-set, estimate a structural model of bargaining to assess the importance of search frictions, in negotiated markets and measure the impact of the search and switching costs on lender's market power. Their main results show that search frictions reduce consumer surplus. Furthermore, through counter-factual experiments to quantify the extent to which banks can use loyalty to extract surplus from consumers, they find that nearly 50% of the market power of banks is related to loyalty advantages.

Martin-Oliver, Salas-Fumas, and Saurina (2008) document the effect of market structure on the level and dispersion of interest rates in the Spanish financial market, assuming that the density of bank branches and number of banks in a location are proxies for search costs. They use data from lending and deposit products for a wide number of Spanish banks for the period 1989 to 2003. They find that interest rates on loans decrease with the number of banks. They also find that interest rate dispersion is positively correlated with number of banks and negatively with branch density, which

suggests an inverse relation between search costs and dispersion.

Specifically for Colombian financial markets, some literature inquires about price dispersion and its effects on macroeconomic outcomes (Ma (1998); Jaramillo and Cerquera (1999)) while others study the role of information on interest rates and banking relationships. For instance, Orozco et al. (2011) search for the micro and macroeconomic determinants of the number of banking relationships of Colombian firms. They find that leverage, size, return on assets and economic cycle, play a crucial role in determining the number of banking relationships established by the firms. Moreover, they find that manufacturing firms have, on average, more banking relationships compared to other economic sectors. Morales (2016) study the impact that Law 1266, a law that reduced the information on borrowers available to lenders, had in the characteristic of the loans granted.

Our work contributes to the price dispersion literature in general and specifically to the understanding of price dispersion on an important economic sector like financial markets. Our work also contributes to the existing literature related to the impact of mergers in the Colombian financial system (Estrada (2005); Clavijo et al. (2006); Sarmiento et al. (2018); Galán, Veiga, and Wiper (2015); Martínez et al. (2016)).

3. Data

3.1 Data sources

We use data from two sources: Superfinanciera's Form 341 and Supersociedades' Business Filing Information System - SIREM (for its Spanish acronym). All financial institutions in Colombia are required to file Form 341 which collects detailed information about every credit granted. The Form records information on consumer loans, mortgages, micro credits, leasing and commercial loans. In this document we focus on commercial loans, specifically, loans that banks grant to manufacturing firms. Banks must report all active loans at the end of every quarter, specifying characteristics like balance, interest rate, credit score, and term. Because we observe all loans granted by the banks over

time and the identity of the borrower firms, we can know if a firm and a bank have a history of doing business together, as well as the intensity of that history.

We start with over 11 million observations corresponding to the universe of commercial loans active between 2005 and 2013, regardless of when they were granted, but we do some filtering so that the data match our goals. First, we keep only new loans, that is, loans issued during the same quarter they are reported. Second, we keep loans issued by banks and drop loans issued by any other type of financial institutions, because we want more homogeneous lenders. After these two filters we are left with 23% of the original records. In addition, we remove observations of firms with incomplete or odd information like interest rates reported as zero or interest rates above the usury rate. We drop all those, along with outliers. To be able to talk about interest rate dispersion we want somehow homogeneous loans, so we restrict ourselves to loans with terms below 10 years, further reducing the number of records to 3.5% of the original.

We supplement the loans data with firm-level information obtained from SIREM, a database containing detailed financial statements (balance sheets, income statements, cash flow statements) and operational information about all firms supervised by Supersociedades.[1] This information is reported by the firms on a yearly basis, and contains key firm characteristics like revenue, total assets, input use, investments, outlays, number of employees, etc. Lastly, we also add a measure of productivity for each firm obtained in Casas and González (2016).

Finally, we add to the data-set of loans and firm characteristics, two attributes of the banks: number of branches and number of employees in each city.

3.2 Variables and descriptive statistics

We use four types of variables to characterize loan, firm, bank and market features. From the loans data we obtain the amount in current pesos, the term in months, and interest rate negotiated (Annual Percentage Rate - APR). The spread is calculated as

[1] Firms are supervised by Supersociedades if their assets or revenue is equal or more than 20.000 legal monthly minimum wages on January 1st after . So basically we have the universe of manufacturing firms that are large enough.

APR minus the return of government bonds with equivalent maturity to the term of the loan. We also observe past credit scores rating the firm taking the loan. The credit scores range from A (lowest risk) to E (higher risk), and we use it to construct three measures of credit history. *Bad CS ever* is a dummy that indicates whether the firm taking the loan has ever scored worse than A in loan application. We also include the number of times the firm has been given scores worse than A in the past, *Number of bad CS*, because banks may perceive firms carrying more instances of poor scores in their pasts as riskier. Finally, *Current bad CS* is an indicator for when the firm has currently a bad score with other bank different than the one issuing the loan to reflect the fact that banks may discount past information relative to present information about the borrower credit worthiness.

We construct a measure of loyalty, home-bank, defined as the bank with which a firm has the largest number of transactions. We use loan balances as tiebreaker, that is, when the firm has had the same number of transactions with two banks we consider home-bank as the bank with which the firm has a larger debt. From the firms' balance sheet we obtain revenue in current pesos and leverage (the ratio between debt and equity). Finally we construct a measure of market power similar to a Herfindahl-Hirschman index, but instead of adding squares of market shares, we square the proportion of branches belonging to a specific bank and add them up. Table 1 summarized the description of the variables used.

Table 2 displays a summary of descriptive statistics for the variables used below. A key aspect of our data is that borrowers tend to interact only with a small number of banks. Figure 1 shows a histogram of the number of banking relationships that the firms in our date engage in. As can be seen, a large proportion of our firms have loans with only one bank and the vast majority does so with at most 2 banks. There are several plausible explanations for this strong loyalty. One reason has to do with very little shopping around, that is, firms do not collect enough quotes when deciding to get a loan and end up getting loans from the same bank, which suggest the existence of

Table 1: Definitions of loans, borrowers and market characteristics

Variables	Descriptions
Home-bank	Bank with which the borrower firm has a deeper, longer history
Loan Term	Period over which a loan agreement is in force, and before or at the end of which the loan should either be repaid or renegotiated for another term
Loan Amount	Pesos amount of the loan
Interest rate	Annual percentage rate
Spread	Negotiated interest rate minus premium of term-equivalent bonds
Credit score	A (lowest risk) to E (higher risk)
Productivity	Estimated total factor productivity as in Casas and González (2016)
HHI	Herfindahl-Hirschman index using number of branches
Revenue	Revenue accrued by the borrower firm during the year prior to the loan
Debt	Total debt accumulated by the borrower firm until the prior year
Leverage	Debt/Equity
Sector	ISIC two digits
City	Firm's location city
Employees	Number of employees of the bank
Size	Lenders total number of branches nationwide

non-negligible search costs. Unfortunately, we do not observe the firms' search history before obtaining a loan, so we cannot test this hypothesis.

The second possible reason for the small number of banking relationships is the presence of high switching costs. In this case even getting several quotes and potentially lower interest rates is not enough to establish relationships with many banks, because the borrower incurs a cost, that could be explicit or an opportunity cost. A third reason for firms that are overly loyal to banks might have to do with specialization. If a bank specializes in certain economic activity, or sector, then firms in those sectors or activities will find it advantageous to establish a relationship with said bank.

Figure 2 shows one of the most interesting features of our data: firms pay higher interest rate at their home-bank. The plot shows the evolution over time of the average interest rates minus the term premium of term-equivalent bonds, for three groups of firms: new borrowers (firms who have never had a loan before), previous borrower with home-bank (firms with credit history taking up loans with their usual bank), and previous borrowers with other banks (firms with credit history taking up loans with banks other than their

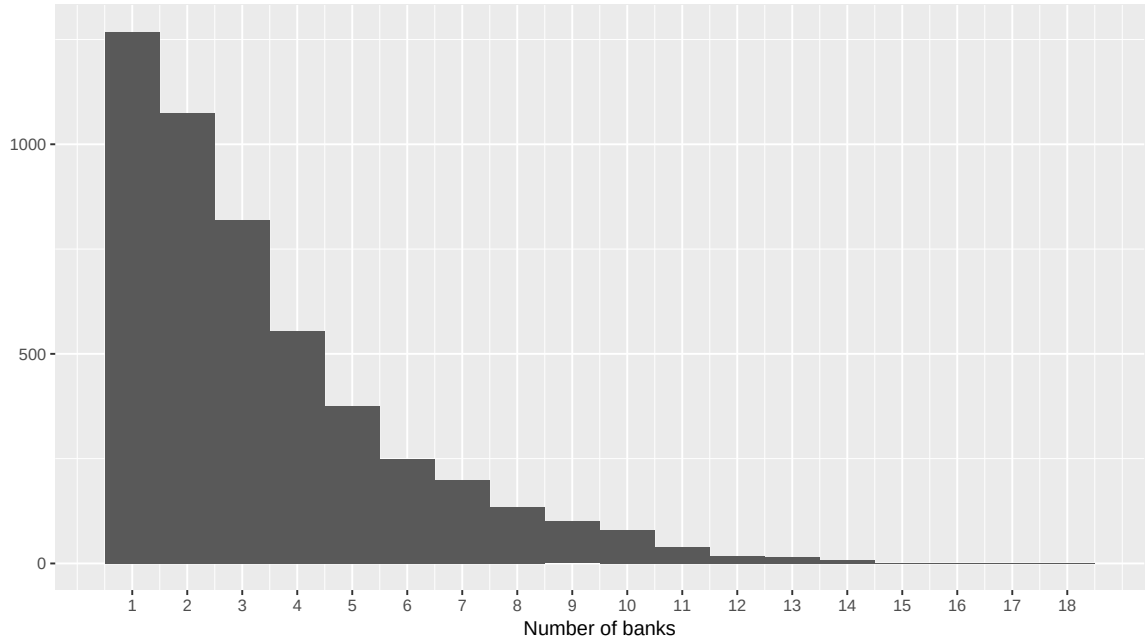

Figure 1: Number of banks borrower have loans from

Figure 2: Home-bank premium

Table 2: Descriptive statistics of Loans, Firms and Banks characteristics

	Mean	Median	Sd.	Coef.Var	25th	75th
Loans (n=57748)						
Interest rate	15.14	14.09	8.26	0.55	9.16	20.95
Spread	14.64	13.49	8.35	0.57	8.58	20.58
Term (months)	11.74	6.00	15.56	1.33	1.00	12.00
Amount (millions current cop)	1347.79	159.94	5480.26	4.07	36.67	642.14
Home-bank	0.44	0.00	0.50	1.13	0.00	1.00
Credit score = A	0.95	1.00	0.22	0.23	1.00	1.00
Credit score = B	0.04	0.00	0.19	5.02	0.00	0.00
Credit score = C	0.01	0.00	0.08	12.51	0.00	0.00
Credit score = D	0.01	0.00	0.07	13.46	0.00	0.00
Credit score = E	0.00	0.00	0.04	22.83	0.00	0.00
Firms (n=3620)						
Productivity	81.46	60.59	92.89	1.14	41.56	90.30
Revenue (billion current COP)	40.45	4.91	319.56	7.90	1.85	15.85
Debt (billion current COP)	4.98	0.37	45.17	9.06	0.08	1.60
Leverage	0.55	0.23	5.08	9.24	0.07	0.53
Bad CS ever	0.58	1.00	0.49	0.84	0.00	1.00
Number of bas CS	5.92	1.00	13.26	2.24	0.00	5.00
Current bad CS	0.27	0.00	0.44	1.65	0.00	1.00
Banks (n=29)						
Number of credits	17.33	11.00	18.63	1.08	4.00	24.00
Employees	198.33	26.00	655.83	3.31	11.00	87.00
Bank size (branches nationwide)	243.00	170.00	235.54	0.97	76.00	311.25

usual bank). As expected, firms taking up loans for the first time, pay on average higher rates than previous borrowers, arguably, because banks have no information about their past credit worthiness. New borrowers are, after all, ex-ante more risky and even more costly from the administrative standpoint, because their credit worthiness has to be assessed, their profiles created, etc. However, when we split the sub-sample of experienced borrowers into loans with their home-bank and loans with other banks we see that firms pay higher rates on loans issued by their home-banks. We interpret this penalty is preliminary evidence of high switching costs that give the bank the ability to extract more surplus from loyal borrowers.

4. Empirical strategy

4.1. Boxplot

In figure 3, we start by showing the cross-sectional dispersion of spreads (centered around the median) of commercial interest rates for every quarter in our data. We define "spread" as the difference between the interest rate negotiated at the beginning of the loan -reported in Form 341- and the lender's opportunity cost (yield on term-equivalent government bonds). In the graph below, we present the results obtained using term premia as a measure of the bank's opportunity cost. But the patterns in the graph are robust to other measures of opportunity cost, like the returns expected from comparable, shorter-dated instruments over the same time period. The plot also includes two vertical lines corresponding to policies that could have affected the level of price dispersion.

The first vertical line corresponds to the outset of the System for the Management of Credit Risk, or SARC for its Spanish acronym. SARC was an important macro shock to the banking industry. Superfinanciera's SARC is an integral system that introduced changes to the way lenders managed credit risk and covers all the stages of a credit operation, from assessing the credit worthiness of the borrower to recovery. SARC also establishes a baseline model to assign credit scores and evaluate the credit worthiness of potential borrowers while allowing individual banks to build upon it. Additionally, these models are used to calculate the expected loss of each credit operation, which is derived from the probability of the borrower not paying and the unpaid balance. The impact of the changes introduced by SARC were notable. As shown in Vargas et al. (2008), after the implementation of SARC there was an abrupt increase in the ratio of provisions to risky portfolio. Similarly, Vargas et al. (2010) show that the implementation of SARC also succeeded at curbing the excessive credit expansion that characterized the years prior to the implementation of the system.[2]

The second vertical line corresponds to the enactment of Law 1328, a law which, among other things, made it easier for consumers to gather information about financial products

[2]Similar events are documented in Brazil are documented by Nakane and Koyama (2003).

which, in principle, should increase the consumers ability to bargain. In 2009, Congress passed Law 1328 aimed at protecting consumers of financial services by reducing the asymmetry of information between lenders and borrowers, and to increase the overall transparency of the banking industry and the information available. Specifically, the Law states that borrowers have the right to receive information that allows them to compare the costs of different financial services. Moreover, borrowers are mandated to publish the prices of any services provided.

The quarters leading to the implementation of SARC, going from the end of 2005 to mid 2007, are characterized by less dispersion (short ranges) than the rest of periods in our data.[3] We see an increase in the dispersion right after the implementation of SARC with most of the extra dispersion caused by unusually low interest rates. After the enactment of Law 1328, which in theory made it easier for financial consumers to find the lowest rate available, we see a period of relatively low dispersion, lasting until 2012 when price dispersion surges again, this time caused by exceptionally large interest rates. It is however a stretch to try and match the patterns of dispersion to said policies because, for instance, they do not happen in isolation. For example, the unusually low rates around 2008 coincide with a global financial crisis.

Moreover, the first period, characterized by low price dispersion, overlaps with a wave of major mergers and acquisitions that altered Colombia's financial landscape. As a result, at the end of 2007 the market had the smallest number of competitors since 1991. The most salient of these mergers, in terms of their importance in the commercial loans segment that we study, happened in 2005 and involved Banco de Occidente-Aliadas and Bancolombia-Conavi. Two more mergers happened a year later, in 2006, as Banco de Bogota and Banco Unión Colombiano merged, and BBVA acquired Granahorrar. The last of these big mergers happened at the end of 2007 when Davivienda and Bancafé merged.[4]

[3] We define range as $Q3 + 1.5\text{IQR} - [Q1 - 1.5\text{IQR}]$ where Qi is a quartile and IQR is the inter-quartile range.

[4] This period is dubbed as a period of *financial reconstruction* by Clavijo et al. (2006) due to the restructuring of the country's financial system after the 1999 crisis.

These events are notable due to the sheer size of the entities involved, in particular, in terms of their shares of the total portfolio of commercial loans. At the end of 2004, before the wave of mergers started, the banks involved in the mergers represented over 67% of the total industry and held over 43% of the total commercial portfolio. After the wave, the banks merged represented over 71% of the banking industry and held over 55% of the total balances of commercial loans granted.

Finally the third period coincides with another period of consolidation of the banking industry. This period was characterized by several mergers and acquisitions which heavily impacted the market structure. Martínez et al. (2016) calculate the increase of 10.64% in the industry's HHI -from 1052 in 2009 to 1164 in 2014. The increase is even more abrupt when considering just the segment of commercial loans, which was, at the time, even more concentrated then the industry as a whole. The HHI of the commercial loans segment jumps 13.17% -from 1382 to 1564 during the same period. Although not as severe as the consolidation that happened around 2006, some of the merged lenders were focused on corporate clients which makes this events more relevant for our endeavor. For instance, when Corpobanca acquires Helm Bank they held 1.7% and 4.7% of the industry's commercial portfolio respectively. Around the same period Colpatria, with 4.6% of commercial loans, acquires Scotiabank, and GNB and Sudameris merge. Finally, Banco Santander after stopping its operations in the country for several years, comes back focusing exclusively on corporate clients.

4.2. Variance decomposition

Next, we want to study the importance of consumer-based pricing. We want to quantify how much of the observed dispersion is due to the bank's ability to extract willingness to pay from the borrowers, based on the borrower's observed characteristics. To do so we decompose the observed price dispersion between four groups of covariates. In particular, we regress the spread y_i, defined as the negotiated rate minus the opportunity cost (term premium), on 4 groups of categorical variables X: quarter dummies, loan

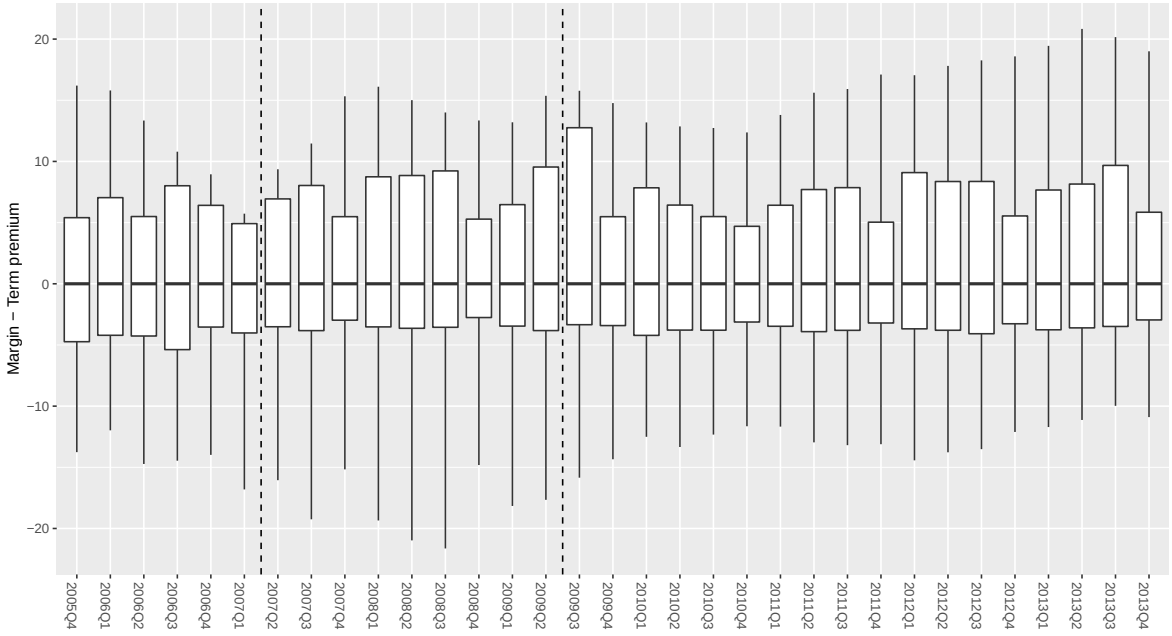

Figure 3: Interest rate dispersion over time

characteristics, borrower characteristics and market structure dummies.

The quarter dummies should capture all macro shocks affecting the determination of the spread, in particular, they should control for the variation of the lender's opportunity costs not captured by term premia because they dampen, for instance, the effects of treasury bonds. Loan and borrower characteristics should be the key determinants of the negotiated interest rates, while the market structure dummies should account for the differential ability of banks in more or less competitive markets to extract rents. Specifically, the equation we take to the data is

$$y_i = \alpha + \sum_{x=1}^{4} \sum_{j=1}^{J_x} \mathbf{1}(x_i = j)\beta_{xj} + e_i$$

As loan characteristics, we use term, amount and a dummy describing whether the loan was issued by the firm's home-bank. We include as characteristics of the borrowing firms, revenue, debt, credit score, productivity and sector dummies. According to people working in the banking industry evaluating credit worthiness of commercial loans

Table 3: Variance decomposition

	Period 1	Period 2	Period 3
Quarter	0.050	0.027	0.037
Loan Term	0.180	0.299	0.309
Loan Amount	0.061	0.171	0.159
Home Bank	0.018	0.000	0.000
Revenue	0.005	0.005	0.005
Credit score	0.002	0.001	0.001
Productivity	0.001	0.001	0.000
Sector	0.003	0.002	0.002
Debt	0.001	0.001	0.001
City	0.016	0.007	0.005
HHI	0.001	0.000	0.001
Lender size	0.254	0.015	0.028
Residuals	0.409	0.470	0.451

applications, revenue is a key determinant of the risk of default. Finally, we include city dummies, a measure of market concentration and the size of the lender's network (total number of branches nationwide). The continuous characteristics are discretized by percentiles 10th through 90th.

Table 3 shows the amount of variation explained by every group of dummies while table 4 shows the same information, but grouping the dummies into the 4 groups described above. Period 1 to 3 refer to the periods delimited by the vertical lines in figure 3, corresponding to the implementation of SARC and the enactment of Law 1328. In summary, there has been some reallocation of the ability to explain dispersion among the groups of variables over time. For instance, from market structure, which explanatory power between periods 1 and 3 is falls to a tenth, to loan characteristics which doubles during the same period. Additionally, we see an increment of the variance of interest rates explained by no-observables over time -from 41% in period 1 to 45% in period 3.

At most the observed variables explain 59% of the variation which happens in Period 1. Reassuringly, across all periods, the loan characteristics *Loan Term* and *Loan Amount*, are important variables in explaining the dispersion of interest rates. These variables jointly explain up to 47%. Moreover, the ability of loan characteristics to explain the

Table 4: Variance decomposition (Grouped)

	Period 1	Period 2	Period 3
Quarter	0.050	0.027	0.037
Loan Characteristics	0.259	0.470	0.468
Borrower Characteristics	0.011	0.010	0.010
Market Structure	0.270	0.023	0.034
Residuals	0.409	0.470	0.451

interest rate variation has increased over time, almost doubling between the first and third period.

Quarter dummies, which account for macroeconomic shocks, explain between 2.75% and 5.03% of the dispersion, implying a reduction in quarter-specific pricing between periods 1 and 3. A seemingly surprising fact is that the credit score has very little to do with interest rate dispersion, as it explains at most, 0.18% of the variation of interest rates. Moreover, in period 3 it explains only half of the observed variation it explains in period 1 . The reason behind this, is that we observed granted loans and the vast majority (94.81%) of them get the a score of A, so the variable contains little information.

The importance of the market structure in explaining the price dispersion falls over time almost to a tenth between the first and the third periods. In particular, the portion of dispersion explained by city dummies falls between the first and third period by about a third. Concentration measures explain very little of the dispersion. We tried 3 alternate measure of HHI based on different definitions of share: proportion of a bank's loans in the total amount lent in market, proportion of a banks loans in the total number of loans in the market and proportion of branches owned by a bank in the total number of branches of the market with the same results. However, the raw size of the lender, measured as number of branches nationwide, is capable of explaining between 1.55% and 25.43% of the dispersion.

4.3. Effect on the mean

In this section we look at how the observed characteristics of loans, borrowers and markets interact to determine the spreads that the lenders can make. In equilibrium,

spreads are determined by a negotiation process that weighs the bargaining power of lenders and borrowers. The bargaining power of each party, in turn, is determined by their characteristics. Modelling the bargaining game between banks and firms is beyond the scope of this paper. Instead, we estimate the following reduced-form equation:

$$\text{Spread}_i = X_i\beta + \varepsilon_i$$

where Spread_i is the difference between the negotiated rate and opportunity cost for the lender which we approximate with the term premium of term-equivalent bonds and X_i is the set of observed characteristics.

We include several variables describing the borrower's riskiness, based on its credit history: *Bad CS ever*, *Number of bad CS*, and *Current bad CS*. In general one would expect all three variables to be positively correlated with the negotiated interest rate.

Table 5 shows the result of regressing the spreads on observed variables describing loans, borrowers, lenders and markets. The columns report alternative specifications that differ in the fixed effects included. The sign, magnitude and statistical significance of the estimated parameters are stable across specifications, with the exception of the estimates on the measure of market concentration (HHI index) and the number of employees which lose significance after controlling for time fixed effects. We obtain the expected positive signs on the variables describing the borrower's credit history, implying that firms whose credit history is not impeccable pay on equilibrium higher interest rates. In other words, having a bad credit score in their history and having a current bad score correlate with an increase in the interest rate of about 75 basis points, while an additional instance of bad score in their credit history is correlated with additional 2 basis points.

Longer terms and larger amounts are correlated with smaller spreads. After including all the fixed effects, loan terms with an additional month correlate with a decrease in spread of around 5 basis points while a 1% increase in the amount, with everything

Table 5: Interest rate determinants

	Dependent variable:				
	Spread				
	(1)	(2)	(3)	(4)	(5)
Bad CS ever	0.869***	0.711***	0.730***	0.709***	0.862***
	(0.125)	(0.119)	(0.118)	(0.116)	(0.126)
Number of bad CS	0.023***	0.025***	0.025***	0.024***	0.017**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)
Current bad CS	1.141***	1.061***	1.050***	1.060***	0.844***
	(0.141)	(0.122)	(0.119)	(0.118)	(0.135)
Term (months)	−0.058***	−0.053***	−0.054***	−0.054***	−0.053***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Amount (log)	−1.787***	−1.773***	−1.760***	−1.754***	−1.566***
	(0.033)	(0.031)	(0.031)	(0.031)	(0.034)
Home bank	0.310***	0.296***	0.282***	0.271***	0.015
	(0.104)	(0.100)	(0.100)	(0.100)	(0.115)
Productivity	−0.001***	−0.002***	−0.001***	−0.001***	−0.001**
	(0.001)	(0.0004)	(0.0004)	(0.0004)	(0.001)
Revenue (log)	−0.088*	−0.137***	−0.173***	−0.160***	−0.253***
	(0.048)	(0.045)	(0.046)	(0.045)	(0.049)
Leverage	0.006	−0.001	−0.001	−0.001	−0.004
	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)
HHI	0.004***	0.001	0.001	−0.001	−0.005**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Employees (log)	0.118***	0.014	0.028	−0.087	−0.306***
	(0.033)	(0.032)	(0.032)	(0.076)	(0.086)
Specialization					−0.459
					(0.545)
Constant	48.237***	49.355***	48.747***	49.408***	49.676***
	(0.589)	(0.572)	(0.499)	(1.336)	(0.910)
Bank FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	Yes	Yes	Yes	Yes
City FE	No	No	No	Yes	Yes
Sector FE	No	No	Yes	Yes	Yes
Observations	57,311	57,311	57,311	57,311	36,425
Adjusted R^2	0.333	0.440	0.441	0.444	0.449

Note: *p<0.1; **p<0.05; ***p<0.01
Clustered SE

else constant, implies a reduction of almost 2% of the interest rate (not percent points). Of course, being that size and terms are not assigned randomly we can't give these estimates a causal interpretation. For instance, larger amounts and longer terms might be demanded by firms with more bargaining power, thus able to negotiate lower interest rates.[5]

One would expect more productive firms, on average, to be able to negotiate lower rates, notion that is confirmed by the negative sign estimated on the productivity parameter. Similarly, our estimates suggest that firms with more revenue can negotiate larger discounts, because the revenue of the borrower firm is negatively correlated with the risk of default. Holding everything else constant, firms with 1% more revenue get 0.2% lower equilibrium rates.

In contrast, we find no evidence that current leverage, market concentration (HHI) or the number of employees affect the equilibrium interest rates. We find, at first, a positive correlation between concentration, measured as the market's HHI, and spread. However, the estimate can't withstand the inclusion of time fixed effects, and it's rendered non significant across the rest of specifications.

The estimate on the effect of the dummy *Home Bank*, an identifier for when the loan is granted by the bank with which the firms has a long history, yields an interesting result. We estimate a positive sign which implies that lenders charge higher rates to their most loyal customers and the average premium charged to their clients relative to other customers is around 30 basis points. This suggest the existence of high switching/search costs that the banks use to leverage their bargaining power and extract surplus from the borrowers. As an informal check, we run the same regression with a sub sample of same-day loans, which arguably leave the borrower with very little ability to negotiate better rates, and find that the estimates on *Home Bank* are five times larger and statistically significant.[6]

[5] Another plausible explanation is that branch managers may agree to lower rates and longer terms, as it increases their revenues.

[6] Regression in the appendix Table 1.

In column 5, we add a measure of the level of rapport between the bank and the firm. The measure, that we call *Specialization*, reflects the proportion of loans that the bank granted to firms in the same sector as the firm with the loan. We construct the measure following Paravisini, Schnabl, and Rappoport (2017)[7] with a subset of firms that report the same sector across years. The results suggest, that the higher the proportion of loans a bank grants to firms in a specific sector, the smaller the average spread of loans granted to firms in that sector are. This could reflect the fact that banks with expertise lending to firms in a sector well and that have assessed many loan applications to firms in that sector find it less costly to assess the credit worthiness of other firms producing in it. The fact that *Home-bank* loses statistical significance after controlling including our measure of specialization reflects the tension of a bank that can take advantage of loyalty to extract surplus but has lower costs of lending to firms in a business it know well.

4.4. Effects beyond the mean (across the distribution of spreads)

Since we are interested in price dispersion, a more natural approach is to study the marginal effect of the covariates on different quantiles of the distribution instead of looking exclusively at their effect on the mean. We do this by estimating quantile regressions (QR) which allows us to know whether the relation between the spread and the covariates changes with the level of spread. In addition quantile regressions are more robust to outliers than mean regression which are a feature of our data.

In figure 4, we summarize the results of the quantile regressions. Each panel shows the estimates for 9 quantiles (percentiles 10th-90th) along with the OLS estimate and their respective 95% confidence intervals. The first insight from the figure is that, in general, the estimates for different quantiles differ from the OLS estimate, implying that the

[7] Equation 6 in Paravisini, Schnabl, and Rappoport (2017)

$$S^{j}_{(-i)bt} = \frac{\Sigma^{I}_{k\neq i} L_{bkt} Y^{j}_{kt}}{\Sigma^{J}_{j=1} \Sigma^{I}_{k\neq i} L_{bkt} Y^{j}_{kt}}$$

with j=sector, i=firm, b=bank, L=loans and Y=revenue.

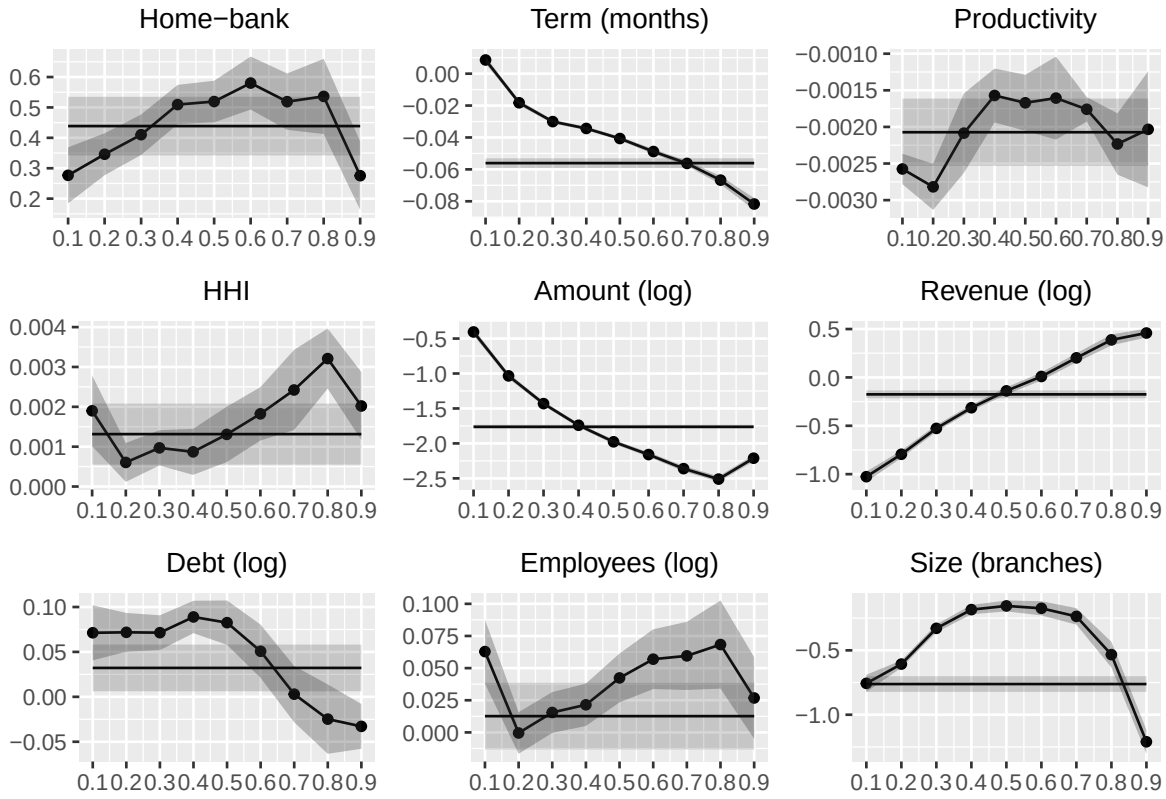

Figure 4: QR Estimates

effects that loan, borrower or market characteristics have on spread vary with the size of the spread. In other words, marginal changes in the covariates have differential impact on small and large spreads.

The second salient insight, albeit not surprising, is reassuring because it confirms that our estimations capture the importance of the key determinants of the interest rates: *Term*, *Amount*, and borrower's *Revenue*. Not only are the estimates on these variables, along with *Size*, estimated with far greater precision than the rest (note the tight confidence intervals) but also they are orders of magnitude larger. Next we go into more detail about the implications of our estimates.

The positive estimate on *Home Bank* across all quantiles, means that firms that take loans from banks with which they have a long history pay a premium, relative to other

borrowers. Most of the estimates are not statistically different than the OLS estimate. However, both the extreme quantile estimates are smaller than the OLS estimate, which means that, although home banks keep the ability to extract rents when spreads are really small or really large, the rents they extract are smaller than for average spreads. In other words, they have reduced ability to extract surplus when spreads are really small (maybe because the borrower has the bargaining power) and really large spreads (not much more to extract even if home-bank has the bargaining power).

The QR estimate on *Term* provides and explanation for the seemingly counter intuitive result of obtaining a negative OLS estimate which implied that borrowers asking for longer term loans get smaller spreads. When looking at specific quantiles, we see that the relation between term and spread is positive for most quantiles (10th percentile to 60th) and only when spreads are really large an increase in term is associated with smaller spreads. Except for the 70th percentile, all QR estimates are statistically different than the OLS estimate, so additional months increase interest rates more for the smallest spreads. In other words, for spreads below the 60th percentile, additional months correlate but the increase is larger for smaller spreads.

The estimates on *Productivity* suggest that lenders make smaller spreads on more productive firms. There are at least two reasons for this result. On one hand, more productive firms are inherently less risky. On the other, productivity might be correlated with overall managerial ability which in turn can translate into higher bargaining power, for instance, if better managers are better at getting quotes from other banks. The negative effect of productivity on negotiated rates has the same magnitude across all quantiles and it is not statistically different than the OLS estimate.

Concentration, measured as *HHI* over the number of branches of each lender, correlates with larger spreads, which means that lenders in more concentrated markets can extract more rents from lenders. The QR estimates suggests that the effect is statistically larger than the OLS estimate for percentiles 70th , 80th and 90th, so banks can exert their market power more easily on already relatively large spreads.

Larger amounts are correlated with smaller spreads regardless of whether the spreads are very large, moderate or very small and the QR estimates suggest that the discount is larger for larger spreads. All QR estimates are statistically different than the OLS estimate.

The effect an increase in *Revenue* has on the negotiated spreads is more complex and highlights the importance of using QR to learn about the effects of the covariates on the distribution of spreads. For small spreads, that is, spreads below the 60th percentile an increase in revenue is correlated with discounts in interest rates. However conditional on spreads being large enough, that is above the 60th percentile, an increase in revenue is associated with larger spreads. This suggests a pricing consistent with the use of third degree price discrimination, as an increase in revenue for firms already willing and able to pay large spreads causes further rent extraction.

Debt's effect on negotiated spreads also depends on where in the spread distribution we are looking. For spreads below the median, the QR estimates are positive and statistically different than the mean effect, implying that higher debt is correlated with higher interest rates, which is the sign one would expect if the only determinant of the interest rate was risk. For large spreads (above .80th percentile), however, the increase in debt is negatively correlated with spreads.

The OLS estimate of the effect of the bank's number of *Employees* on spreads is not statistically significant. For spreads between the .60th and .80th percentile, however, the QR estimates are positive and statistically significant, suggesting that for spreads in that part of the distribution, banks with more employees can extract more surplus from borrower.

Finally, the effect of *Size*, measured as total number of branches, on spreads is always negative and its magnitude is smallest at moderate spreads. The estimates for all quantiles are weakly and statistically larger than the OLS estimate except for the 90th percentile. Larger banks make smaller spreads and the drop in spreads as banks grow

are larger for larger spreads which could be capturing economies of scale.

5. Effect of mergers on interest rates' level and dispersion

In this section we use the timing of mergers to identify the effect of market structure on interest rates' levels and dispersion. Before obtaining point estimates, we turn to graphic analysis.

Some literature has focused on the impact of exogenous events as mergers and laws on interest rate levels, dispersion and lending relationships. Sapienza (2002) analyzes the effect of banking mergers on individual contracts with corporate borrowers. Using data from Italian manufacturing firms in 1989 - 1995, he shows that borrowers experienced a decrease in interest rate when mergers involved the acquisition of banks with small market shares. Another finding is that borrowers with many bank relationships (more than eight) do not not suffer an increase in the cost of credit, suggesting that lending for multiple borrowers decrease the ability of banks to extract monopolistic rents as a consequence of the asymmetrical evolution of borrower information in a lending relationship (Sharpe (1990), Rajan (1992)). Similar results were documented by Erel (2011) using data of US banking mergers from 1987 to 2003 while Panetta, Schivardi, and Shum (2009b) assess the effect of Italian banking mergers in improving the ability of banks to screen borrowers and charged interest rate consistent with their unknown default risk.

In a further step Allen, Clark, and Houde (2014c) add the role of unobserved abilities and search costs to negotiation of interest rates. They investigate the impact that mergers had on the cost of loans and price dispersion using data from Canadian Mortgage Market. First, authors try to find the effects of mergers in interest rate levels and the distributional impact. Later, a negotiation price model is developed to explain the role of search costs in negotiated spreads. In the first stage, they employ a quasi-experimental method and find evidence of an increase in the average interest rate after mergers. As well, they found that this effect mask heterogeneity in consumers. Finally, they estimate

that a reduction in search costs leads to a large decrease in the level and dispersion of interest rates. In general, interest rate dispersion, measured as the coefficient of variation, falls as a result of these events, this is in line with the results of present paper.

Figure 5 shows the evolution over time of interest rate's spreads. Each pane depicts two groups: firms whose home-bank merged, which we call *treated* and the rest of firms in the data, which we call *control*. The dashed line shows the quarter in which each merger took place.

In the top-left pane we see that, before BBVA and Granahorrar merged, the average spread they made on their customers was above the average spread the rest of the banks made on theirs. Moreover, the average spread of both groups evolved in a parallel manner before the merger. One quarter later, the average spreads on loans offered by the rest of the banks surpasses the average spread on loans granted by the merged. This change in the trend of the average spreads suggest that the merger was beneficial to BBVA's clients, at least relative to the clients of other banks.

Of course, it is easier to attribute the change in relative trends to the merger in the succeeding quarters because as we move further out is more likely that any events, other than the merger, could have had an effect on the spreads, specially since there were several mergers afterwards.

A very similar pattern can be seen in the top-right pane, where the treated group corresponds to loans granted by either Banco de Bogotá or Banco Unión Colombiano who merged at the end of 2006. In contrast, the merger of Davivienda and Granbanco doesn't provide evidence of a clear change in relative trends, as can be seen on the bottom-left plot.

Finally, the bottom-right pane shows the evolution of the average spreads of loans granted by Scotiabank and Colpatria to their clients along with the average spread made by other banks. However, we don't have enough periods after the merger to make a very strong statement. In general, except for the merger BBVA - Granahorrar, there

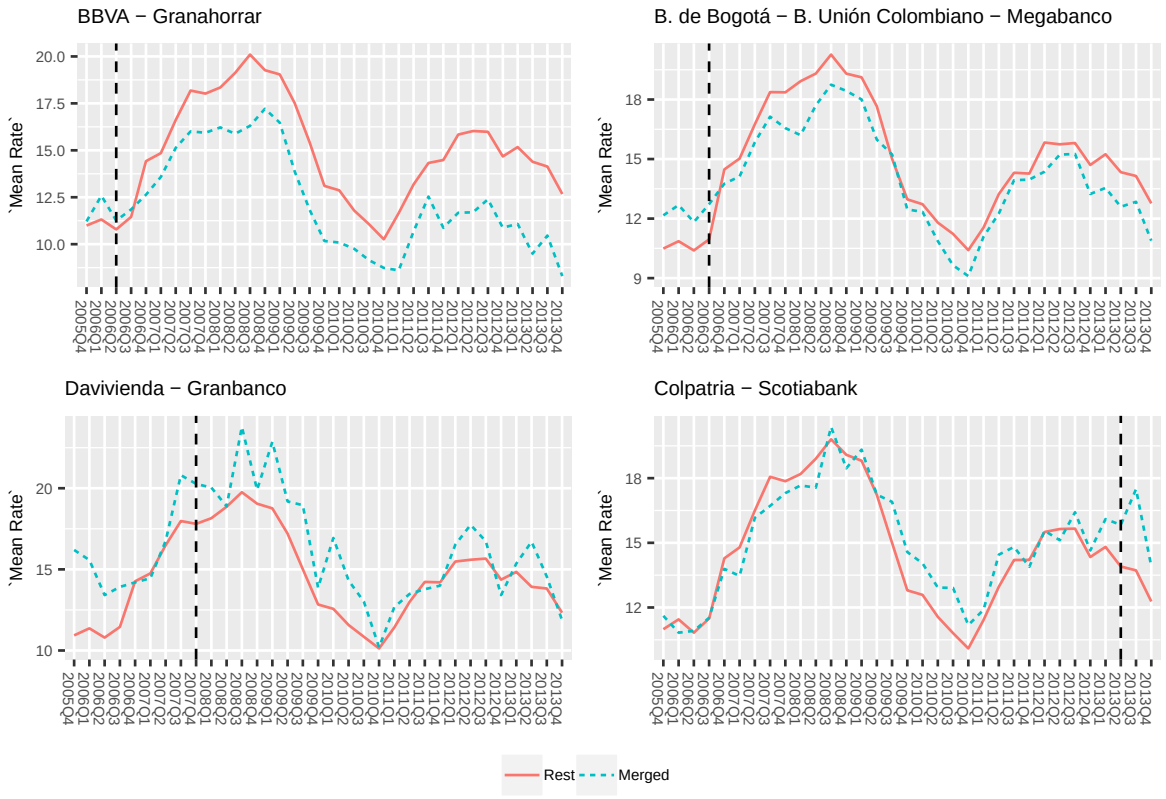

Figure 5: Interest rates over time

doesn't seem to be a definite effect of the mergers that affected differentially the spreads charged by the merged.

Since our main interest lies in price dispersion we plot in figure 6, for the same mergers as before, the coefficients of variation for loans granted by the merging banks (treated) and loans granted by their competitors (control). Across panes we see a general decrease in the dispersion of spreads right after the wave of mergers. This general reduction in price dispersion could be caused by the wave of mergers or by some macro shock or a policy (too early for Law 1328 of 2009). However, it is going to be challenging to argue that the reduction in price dispersion is caused by the wave of mergers.

Besides the general reduction in dispersion, we observe that the price dispersion on the treated loans is higher than the control loans. Which is also confirmed by figure 6

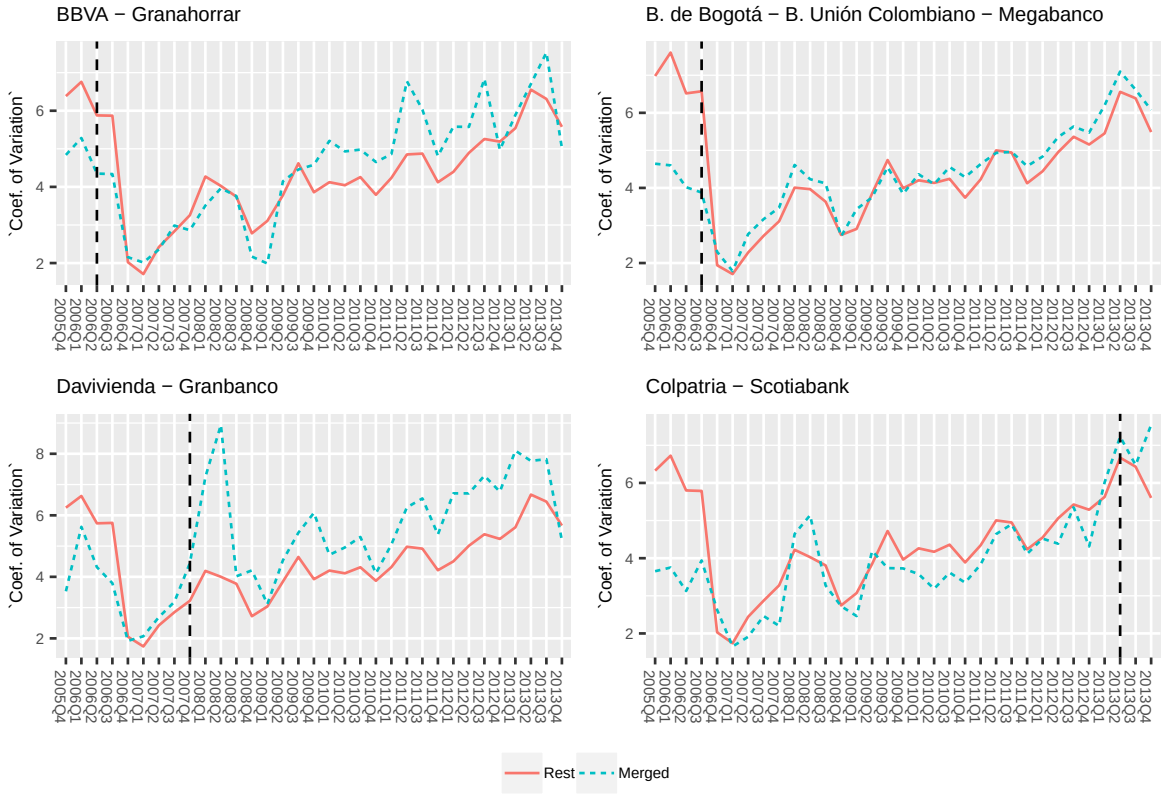

Figure 6: Dispersion over time

right panel, portraying similar information but in this case the treatment is the wave of mergers around 2006 -2007. Because so many mergers happened in such a short period, almost overlapping, it is hard to find a proper control group. We tried alternative definitions of *treated* and *control* groups. In this case, we assume that the treatment was the wave of mergers, and consequently, any loan granted by one of the banks that merged between 2006Q2 and 2007Q3 is considered to belong in the treatment group.

Just for the sake of symmetry we also show the average spread for loans affected by the mergers wave and for other banks. The mean rates of treated and control groups seem to follow the desirable parallel trend, while the evolution of the coefficients of variation are less promising. Also, there seems to be an increase in dispersion for the treated spreads after the Colpatria - Scotiabank merger, but it is harder to say it emphatically because there aren't enough periods after it.

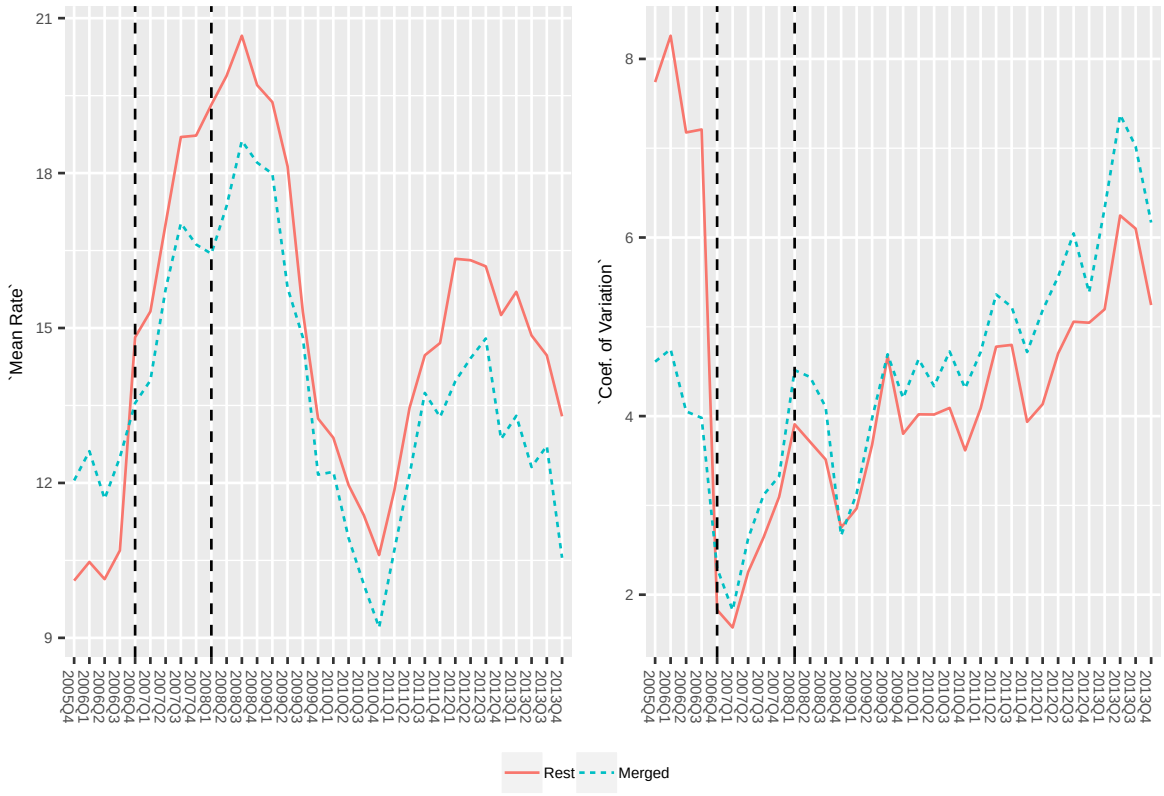

Figure 7: Supermerger

In table 6 we show the estimates for the effect of the wave of mergers on the level and the dispersion of the interest rates of commercial loans. We find evidence of a drop in interest rates after the mergers. This results confirms the findings of Sarmiento et al. (2018) who estimate the changes in efficiency caused by the mergers and acquisitions that happened between 2005 and 2006. Similarly Galán, Veiga, and Wiper (2015), analyzing all mergers that happened between 2000 and 2009 conclude that, after an initial drop in efficiency, eventually the mergers led to beneficial changes for the customers of the merged banks.

Table 6: Dif - dif regression

	Dependent variable:	
	Rate	Coef. of Variation
	(1)	(2)
Loan Term (months)	-0.002^{***}	
	(0.0003)	
Loan Amount (log)	-1.948^{***}	
	(0.054)	
Debt	0.00000	
	(0.00000)	
Post	10.451^{***}	0.168
	(0.300)	(0.725)
Treated	4.194^{***}	0.128
	(0.332)	(0.163)
DiD	-4.901^{***}	0.303
	(0.469)	(1.026)
Constant	45.978^{***}	3.422^{***}
	(0.991)	(0.115)
Observations	3,475	1,111
R^2	0.434	0.001
Adjusted R^2	0.433	-0.002
Residual Std. Error	6.784 (df = 3468)	2.680 (df = 1107)
F Statistic	443.975^{***} (df = 6; 3468)	0.398 (df = 3; 1107)
Note:		*p<0.1; **p<0.05; ***p<0.01

6. Conclusions

This paper provides evidence of sizable price dispersion on the interest rates that Colombian manufacturing firms pay for their loans. First, we document the extent of interest rate dispersion for loans taken by Colombian manufacturing firms between 2005 and 2013. One of the most interesting findings, that hints at the existence of important switching costs, is the fact that loyal borrowers pay higher interest rates at their home-banks than at different banks. We do a variance analysis and finding that consumer-based pricing has increased over time. The loans characteristics *Term* and *Amount* are important variables in explaining the dispersion of interest rates. Although conversely, the importance of the market structure in explaining the price dispersion falls over time.

Second, we characterize the impact of borrower, bank and market characteristics on the ability to obtain discounted rates. One exercise is a reduced-form that relates interest rates spread -the difference between the negotiated rate and lender's opportunity cost- with those features. The results shows that firms whose credit history is flawed or firms which stay loyal to one bank, pays on equilibrium higher interest rates spreads. Despite adding a profuse set of controls, there is still a lot of cross sectional price dispersion, suggesting the presence of non-negligible search/switching costs for borrowers.

We also estimate quantile regression and find the estimated effects are different over distribution of interest rate spread. Conditional on rates being high a marginal increase on revenue is associated with large spreads.The QR estimated on Home-bank shows that lenders have reduced the ability to extract surplus when spreads are really small or large. However, borrowers asking for longer Term loans get smaller spreads. But the relation between term and spread is positive from 10th percentile to 60th. Similar, the estimated effect of Debt is positive only with spreads below to median. Further, banks in more concentrated markets can extract larger spreads.

Finally we looked into the effects of the wave of mergers of 2005-2006 on rates and

dispersion, finding evidence of a decrease in the interest rates granted by the merged banks but no evidence of changes in the patterns of rate dispersion. There was a general reduction in the dispersion of interest rates, but it didn't affect differentially loans granted by the merged banks.

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Appendix

Table 7: Interest rate determinants, only loans of same-day term

	Dependent variable:			
	Margin			
	(1)	(2)	(3)	(4)
Bad CS ever	1.024*	1.069**	1.115**	0.942*
	(0.556)	(0.537)	(0.535)	(0.534)
Number of bad CS	−0.011	−0.015	−0.014	−0.007
	(0.019)	(0.018)	(0.016)	(0.015)
Current bad CS	0.548	0.322	0.378	0.378
	(0.527)	(0.496)	(0.454)	(0.462)
Amount (log)	−1.355***	−1.383***	−1.350***	−1.356***
	(0.111)	(0.106)	(0.105)	(0.108)
Home bank	0.990	1.237**	1.244**	1.200**
	(0.603)	(0.572)	(0.533)	(0.533)
Productivity	−0.001	−0.001	−0.001	−0.001
	(0.005)	(0.004)	(0.004)	(0.005)
Revenue (log)	0.026	0.010	−0.006	0.001
	(0.207)	(0.206)	(0.191)	(0.202)
Leverage	−0.181	−0.078	−0.034	−0.071
	(0.206)	(0.136)	(0.100)	(0.111)
HHI	0.001	0.001	0.002	−0.006
	(0.005)	(0.006)	(0.005)	(0.020)
Employees (log)	−0.054	−0.064	−0.008	0.148
	(0.156)	(0.157)	(0.153)	(0.528)
Constant	35.983***	36.454***	35.153***	34.773***
	(4.241)	(4.370)	(4.343)	(6.292)
Bank FE	Yes	Yes	Yes	Yes
Quarter FE	No	Yes	Yes	Yes
City FE	No	No	No	Yes
Sector FE	No	No	Yes	Yes
Observations	1,999	1,999	1,999	1,999
Adjusted R^2	0.323	0.408	0.418	0.433
Note:				*p<0.1; **p<0.05; ***p<0.01
				Clustered SE


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