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Bank Market Power and Firm Finance: Evidence from Bank and Loan Level Data*

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Abstract

We present new measures of market power for the banking industry in Colombia and estimate their effect on the cost of credit for non-financial firms. Our results suggest that bank competition increased during the 2006-2008 period–even as concentration increased–but decreased thereafter. Using a unique combination of loan, firm and bank-level datasets we are also able to show that banks loosing overall market power –measured by the average price-cost margin– decrease interest rates to small firms, but increase rates to firms with which they have the oldest credit relationships. This suggests (i) the existence of market power that is specific to the bank-firm relationship (i.e., informational lock-in and hold-up problems due to switching costs), and (ii) that size may be capturing other firm attributes such as observable risk, scale effects or implicit collateral.

Keywords: Bank competition, market power, Boone, Lerner, Colombia, cost of firm finance, loan-level data.

JEL Classification Numbers: G21, D22, O16

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1 Introduction

High interest rate spreads in developing countries have concerned economists and policy-makers for a long time. This has been particularly true in Latin America, where countries have traditionally exhibited spreads well above those observed in other developing countries. In all likelihood the causes of such abnormally high intermediation margins are varied; limited enforcement of contracts, scale economies, high risk from volatile industries (such as commodity producers), may all play a role. Nonetheless, low bank competition has often been viewed as an important determinant of high cost of credit in this region of the world (Gelos (2009), Haber (2009)).

The relationship between bank competition and the conditions under which firms can access credit is rather complex. On the one hand, basic industrial organization economics would suggest that if intermediaries can exercise market power, they will extract rents from borrowers, increasing the cost of credit and limiting access to finance. On the other hand, however, some market power may be necessary to allow intermediaries to recover the cost of information acquisition in an environment of asymmetric information (Petersen and Rajan (1995)).

Since competition is for the most part unobservable, applied economists have always relied on proxy measures to capture its evolution. Unfortunately, this means that the use of different proxies for capturing competition has resulted in a wide array of conclusions about the underlying relationship between competition and interest rate spreads.

With this paper, we make two main contributions to the understanding of bank competition in credit markets. First, we provide up-to-date measures of bank market power in a developing country (Colombia) using recently developed methods–such as the Boone profit and market share elasticity regressions–and primary sources for bank financial data. Second and most important, we provide estimates of the effect of bank market power on the cost of firms bank finance.

Our study of the effect of bank market power on firm interest rates introduces two methodological improvements with respect to the extant literature. First, we construct and use four measures of bank market power: two Lerner indices, a profit Boone indicator and a market share Boone indicator. By constructing our own market power measures from primary sources, we aim to diminish measurement error that is sometimes attributed to large data aggregators. In using both the profit and market share Boone elasticities, we are able to detect if banks are exercising market power in either margin. Moreover, the use of these four market power indicators allows us to compare our results with most of

the recent studies of bank competition.

Second, we build a unique dataset that matches individual loans with firm and bank-level data, including market power and other bank characteristics. This allows us to overcome some of the limitations found in recent studies of this type. In particular, we can: (i) directly observe interest rates from each loan rather than derive them implicitly from accounting data, (ii) control for loan-specific characteristics such as term, size or collateral, and (iii) properly account for time-varying, unobserved firm-level heterogeneity (like demand-side shocks), and bank characteristics.

Our results suggest that bank competition was relatively low in 2004-2005, increased during 2006-2008 and has decreased systematically ever since. By most measures, bank competition today (2014) is close to its relatively low level of 2004-2005. Interestingly, the increase in bank competition during 2006-2008 occurred as the industry became more concentrated, highlighting the importance of distinguishing between concentration and competition measures.

Our results also indicate that, conditional on the length of a credit relationship, banks that loose average (or objective) market power do raise interest rates for small firms (and lower them for large firms). However, and most importantly, conditional on firm size, banks that loose average (or objective) market power *lower* interest rates to firms with which they have short credit histories, but increase them for firms with which they have long-standing relationships. This is suggestive of the existence of (subjective) market power that is specific to the bank-firm relationship, and of informational lock-in and hold-up problems due to switching costs. It also suggests that size may be capturing other firm attributes such as observable risk, scale effects or implicit collateral.

The reminder of the paper is organized as follows. Section 2 provides a literature review on bank competition and points to the main gaps that this paper intends to fill. Section 3 presents a brief overview of the banking system in Colombia. Section 4 presents the bank competition measures and discusses the methodological details. The fifth section details our study on the relationship between bank market power and the cost of firm finance. Section 6 concludes.

2 Related Literature

Early empirical studies of bank competition found that U.S. banks in more concentrated local markets, as measured by the Herfindahl Index, charge higher rates on SME loans and

pay lower rates on retail deposits (e.g., Berger and Hannan (1989)), and that their deposit rates are slow to respond to changes in open-market interest rates (e.g., Neumark and Sharpe (1992)). Beyond the U.S., Beck et al. (2004) argued that in a sample of 74 countries, concentration appeared to constraint access to finance, although this effect seemed to apply only to countries with low levels of economic and institutional development. The results from these studies that relied on concentration measures were quickly contested by researchers who argued empirically in favor of the efficient structure hypothesis: the idea that high concentration endogenously reflects the market share gains of efficient firms (e.g., Smirlock (1985)).

In recent years, a myriad of papers have made it clear that using concentration as a measure of competition can be misleading (see e.g., Carbo-Valverde et al. (2009)). In fact, a number of authors have shown that concentration and competition may be uncorrelated or even positively correlated (Kroszner and Strahan (1999); Claessens and Laeven (2004)). In light of these developments, more recent studies have focused on non-structural measures of competition, i.e., measures that do not rely on the link between structure and conduct to infer market power. In general, these non-structural measures extract conclusions about competitive pressure by directly observing the conduct of firms in the market.

One such measure that has attracted a lot of attention from researchers is the Lerner index. In this index, market power of a firm is identified by the divergence between the firm's price and its marginal cost. Another example of non-structural measures of competition is the Panzar and Rosse (1987) H-statistic which captures the transmission of input prices on firms' revenues; weak transmission is indicative of the exercise of market power. More recently, Boone (2008) proposed a new measure based on the idea that efficient firms are more highly rewarded in more competitive markets. In practice, this idea is captured as the elasticity of profits or market share to marginal costs.

A number of studies have used these two measures of competition to investigate a variety of issues such as access to finance, cost of funds or financial stability. For instance, Hainz et al. (2013) uses the Lerner index and data from a sample of loans from 70 countries to conclude that more competition reduces the incidence of collateral in loan contracts. Casu and Girardone (2009) uses the Lerner index and a sample of European Union countries to conclude that increases in banks' monopoly power does not translate into a decrease in cost efficiency. For Latin America, Tabak et al. (2015) uses the H-statistic to examine the competitive behavior of the Brazilian banking industry; the paper finds that market power of Brazilian banks is negatively related to their risk-taking behavior.

Four papers that appear highly relevant for the current study are Love and Martinez-

Peria (2015), Leon (2015), Ryan et al. (2014) and Alvarez and Jara (2016). The first of these papers uses firm-level data from the Enterprise Surveys and conclude that low competition–as measured by the Lerner index and the Boone indicator–constraints access to finance where the latter is measured by a dummy variable that takes the value of 1 if the firm had some kind of credit line with a financial institution. Leon (2015) conducts a similar exercise but uses instead a measure of financial constraints that includes not only if the firm had a credit line or not, but also information about whether the firm was denied credit or was discouraged from applying for a loan. The results in this latter paper are also suggestive of a negative effect of market power on access to finance. Ryan et al. (2014) also finds that higher bank market power–captured by the Lerner index–tends to increase firm financing constraints in a large sample of SMEs from 20 European countries. Finally, Alvarez and Jara (2016) uses a sample of *listed* firms from six Latin American countries to investigate the relationship between bank competition–measured by the Boone indicator–and financial constraints. In contrast to the previous three papers, the authors present evidence that higher bank competition results in more stringent financial constraints for firms.

Perhaps the two papers most closely related to ours are Fungacova et al. (2017) and van Leuvensteijn et al. (2013). Fungacova et al. (2017) uses a large dataset of firm-level data from the Euro area to conclude that competition–measured using the Lerner indices and the H-statistic–*increases* the cost of credit, and observe that the positive influence of bank competition is stronger for smaller companies. These results are somewhat in conflict with those from van Leuvensteijn et al. (2013) which uses the Boone indicator to find, also in a sample of European banks, that higher competition *reduces* interest rate spreads for most loan products.

There are a few limitations worth pointing out in these studies. To begin with, the paper by Fungacova et al. (2017) uses either concentration measures, the Lerner Index or the H-statistic. These measures may have important flaws specially when compared with the Boone indicator which is not used. Moreover, the paper can only approximate the cost of credit at the firm-level using accounting data. The papers by Love and Martinez-Peria (2015), Leon (2015) and Alvarez and Jara (2016) make use of the Boone indicator but rather than looking at interest rate spreads are forced to use a dichotomous measure of financial constraints due to data limitations. Alvarez and Jara (2016) has the additional disadvantage that only listed firms were used in the study. Ryan et al. (2014) does construct a continuous variable of financial constraints but uses only the Lerner index. Finally, while van Leuvensteijn et al. (2013) uses the market-share version of the Boone indicator and studies the impact on interest rates, the dependent variable in the main regressions comes

from the banks themselves. That is, they use segment-wide (mortgage, short-term, deposit accounts) averages of interest rates rather than the actual rates faced by individual firms. All of these studies also have to deal imperfectly with unobserved heterogeneity as they all use country-level competition measures (i.e., cannot use country level fixed effects).

3 The Banking Industry in Colombia 2004-2014[1]

The 2004-2014 period in Colombian banking was characterized by a number of legal and regulatory innovations that brought about important changes in the industry. First, as a (belated) response to the 1999 financial crisis that caused the largest macroeconomic recession in the country, a new law was introduced in 2004 ("Ley 795 de 2003") which advanced the consolidation of the regulation and supervision of the financial industry. The follow-up regulation of this law came with a decree put forth in 2005 ("decreto 4323 de 2005") in which banking and capital markets supervision–previously carried out by Superbancaria and Supervalores, respectively–was centralized into a single institution, Superfinanciera. Additional secondary regulation introduced in 2009 ("circulares externas 14 y 28 de 2009") required banks to adopt internal control systems aimed at effectively controlling risks, while in 2012 a new decree increased both liquidity and capital requirements for banks.

These regulatory changes helped the Colombian financial system cope with the 2007-2009 global financial crisis relatively well. Non performing loans (NPLs) reached a maximum of 4% during this period, which was significantly below the 10% experienced during the 1999 crisis. Moreover, the profitability indicators of the banking system (return over assets, ROA, and return over equity, ROE) remained relatively stable during 2007-2009.

Two main features characterize the evolution of the banking sector in Colombia during 2004-20014. First, banks that had been bailed out during the 1999 crisis and ended up in government hands were privatized. By 2008, there was only one state-owned commercial bank remaining (Banco Agrario). Instead, the government has focused its participation in the financial industry through second-tier (development) banks which service some specific sectors of the economy (e.g., Finagro which is mostly agriculture-oriented, Bancoldex which has a substantial SME component, FDN which specializes in infrastructure finance). Secondly, during 2005-2007, Colombia moved from a specialization model (where, e.g., banks were chartered with a specific purpose such as housing finance), toward a "multibank" or "universal banking" model; one in which banks are able to offer bank a wide array of

[1] A comprehensive review of the Colombian financial system history can be found in Ocampo (2015).

financial services under the same roof.[2] Although special purpose banks were in principle allowed to operate, these were mostly absorbed by larger multi-purpose banks. This brought about a marked increase in concentration within the banking industry, which is captured vividly by the evolution if the market share of the 3 largest banks, as well as by the Herfindahl-Hirschman index depicted in Figure 1. A subsequent trend toward more concentration has prevailed since, with the three largest individual banks (bank holding companies) currently controlling around 60% (70%) of the commercial loan market.

A complete list of mergers and acquisitions that took place in the Colombian banking sector during this period is presented in Table 7 of Apendix 7.1, along with a list of new bank entries. Most of these new entrants are special-purpose banks such as Banco Falabella, which offers consumer credit for Falabella's retail business, and Bancoomeva which is also focused on small-scale financial services (mostly consumer credit) and has limited or null participation in the productive (commercial) credit market.

4 Measuring Bank Competition in Colombia

As discussed in section 2, the new empirical industrial organization literature has developed and used measures of competition that are directly related to market conduct. Accordingly, in this section we estimate two measures of bank-level price-cost margins–Lerner indices–and two measures of marginal cost elasticities–Boone indicators. The first measure and the one most widely used in our subsequent firm-level analysis (section 5) is the original Lerner index developed by Lerner (1934), which captures the ability of an individual bank to charge a price above marginal cost, assuming both profit and cost efficiency:

$$L_{bt} = \frac{P_{bt} - MC_{bt}}{P_{bt}} \tag{1}$$

where P_{bt} and MC_{bt} are, respectively, the price charged by bank b in period t, and its marginal cost. Higher values of the Lerner index suggest higher market power. Since this paper is concerned with competition in the credit market, our price measure is the ratio of financial income (i.e., interest income, fees) to total net loans. Obtaining a measure of marginal cost requires estimating a total operating cost (TOC) function which we do below.

[2]This reform push was partly inspired by a kind of consensus within academic and policymaker circles that the banking industry in Colombia could become much more efficient and profit from economies of scale (Clavijo (2000); Ferrufino (1991)) .

Our second measure of market power is the simple adjustment to the Lerner index suggested by Koetter et al. (2012). The idea is none other than to control for possible profit or cost inefficiency such that the adjusted Lerner index is found as:

$$AdjL_{bt} = \frac{\pi_{bt} + TOC_{bt} - MC_{bt}Q_{bt}}{\pi_{bt} + TOC_{bt}} \tag{2}$$

where π_{bt} stands for predicted profits, TOC_{bt} is predicted TOC and Q_{bt} is total output. In our measures, we use actual figures for profits, output and cost, instead of predicted ones.

Our third and fourth measures are Boone indicators that capture the elasticity of profits and market shares to changes in marginal costs. Boone (2008) shows that there is a continuous and monotonically increasing relationship between relative profit differences and the level of competition. This implies that when competition is more intense, efficient banks gain more in profits or market shares with respect of the inefficient ones. To capture this profit and market share elasticity to changes in marginal costs, we estimate the following regressions:

$$\ln \pi_{bt} = \alpha + \beta^{\pi}_{bt} \ln MC_{bt} + \vartheta_{bt} \tag{3}$$

$$\ln MS_{bt} = \alpha + \beta^{MS}_{bt} \ln MC_{bt} + \vartheta_{bt} \tag{4}$$

where estimates of β^{MS}_{bt} and β^{π}_{bt} capture bank-specific, time-varying profit and market share elasticities with respect to marginal costs. Notice that marginal cost elasticities are expected to be negative, so larger β^{MS}_{bt} and β^{π}_{bt} (i..e., smaller $\mid \beta^{MS}_{bt} \mid$, $\mid \beta^{\pi}_{bt} \mid$) are suggestive of higher market power.

The computation of all four measures requires estimates of bank-specific marginal costs, MC_{bt}. In order to obtain these, we estimate a multi-product TOC function using a parametric approach. We follow much of the empirical banking literature (Koetter et al. (2012), van Leuvensteijn et al. (2013), Tabak et al. (2012)), and estimate a translog cost function, which is a second order Taylor-series approximation to an unknown cost function. In particular, our estimated TOC function is:

$$\begin{aligned} \ln C_{bt} = \alpha_b + \sum_{p=1}^{2} \theta_p (\ln y_{pbt})^2 + \sum_{p=1}^{2} \gamma_p \ln y_{pbt} + \sum_{i=1}^{3} \zeta_i (\ln w_{ibt})^2 + \sum_{i=1}^{3} \chi_i \ln w_{ibt} + \kappa_{12} \ln y_{1bt} \ln y_{2bt} \\ + \sum_{i<k} \sum \eta_{ik} \ln w_{ibt} \ln w_{kbt} + \sum_{i=1}^{3} \sum_{p=1}^{2} \lambda_{pj} \ln w_{ibt} \ln y_{pbt} + \sum_{t=1}^{T-1} \nu_t d_t + \delta \ln z_{bt} + \varepsilon_{bt} \end{aligned} \tag{5}$$

where α_b is a bank fixed effect, y_{1bt} and y_{2bt} are, respectively, loans and securities; w_{1bt} is the labor unit cost or wage (personnel expenses/total assets), w_{2bt} represents the cost of funding for the bank (interest expenses/deposits), w_{3bt} is computed as other expenses/fixed assets, and the time dummy $d_t \in \{0, 1\}$ is intended to capture aggregate shocks. Finally, we follow Mester (1996) and also include bank equity (as a share of total assets), z_{bt}, since it can be used to fund loans and reflects different risk attitudes of banks. We impose homogeneity of degree 1 on input prices by dividing all factor prices and TOC by w_3.

Marginal costs can then be computed by taking the partial derivative of (5) with respect to loans:

$$MC_{bt} = \frac{\partial C_{bt}}{\partial y_{1bt}} = \left(\gamma_1 + 2\theta_1 lny_{pbt} + \kappa_{12} lny_{2bt} + \sum_{i=1}^{3} \lambda_{1i} lnw_{ibt}\right) \frac{C_{bt}}{y_{1bt}}.$$

We estimate equation (5) using a quarterly dataset of 15 banks over the period 2004q1-2014q4. These 15 banks represented over 98.8% of total commercial loans in 2014. A complete description of the variable definitions and data sources, as well as the results from the estimation of equation (5) are presented in Appendix 7.2.

Table 3 presents some descriptive statistics about our sample of banks. It is worth noting that for the average and median bank in Colombia, commercial (business) loans represent around 53%-54% of their loan portfolios, over 10 percentage points more than what they represent for U.S. banks (44% in 2016). This is particularly important for our subsequent exercise in which we estimate the impact of bank market power on the cost of business loans. Also worth noting is the fact that banks in Colombia rely more heavily in equity as their equity to asset ratio stands at 14.3%, compared with 11% in recent years in the U.S. (used to be well below 10% in the U.S.).

Equipped with estimates of marginal costs, we are in a position to compute Lerner indices, and estimating equations (3) and (4). Estimating the latter two models is not straightforward, however, since we need to estimate models with coefficients that vary over time and across banks (panels). We do so by estimating the fixed-effect ANOVA model of Hsiao (2003), in which $\beta^{\pi}_{bt} = \beta^{\pi} + \beta^{\pi}_{b} + \beta^{\pi}_{t}$ and $\beta^{MS}_{bt} = \beta^{MS} + \beta^{MS}_{b} + \beta^{MS}_{t}$. This method requires that we use a balanced panel which means that our sample reduces to 11 banks.[3]

Figure 2 below depicts the estimated Lerner indices and Boone indicators. The plots include the unweighted averages (black line), as well as the median (blue) for the Lerners.[4]

[3] As with equation (5), we estimate the profit and market share elasticities using time fixed-effects.

[4] Given the fixed coefficient nature of the Hsiao (2003) model, the mean and the median of the Boone indicators only differ in their intercepts.

All measures of bank market power suggest the same broad temporal patterns.[5] Market power decreased substantially as the system moved from specialization to universal banking during 2005-2007. Notice that this happened at the same time that concentration was intensifying (see Figure 1). Bank market power then increased sharply during 2008-2011, in the wake and aftermath of the global financial crisis. This is consistent with the data provided by Clerides et al. (2015) showing that bank market power increased worldwide during this period, and with available evidence from other countries and industries that price markups (i.e., the Lerner index) are mostly countercyclical (Wilson and Reynolds (2005)). During 2011-2012 bank market power fell again, but has been increasing moderately since.

Table 2 presents pairwise correlations between (unweighted) average market power and concentration measures. Overall, correlations among our four market power are fairly high and comparable to those found in Clerides et al. (2015).[6] Interestingly, the correlations between the market power and the concentration measures are either negative or very low and not statistically significant at the 5% confidence level. This is consistent with previous evidence that highlights the potential divergence between market power and concentration measures, and cautions against the use of concentration as a proxy for bank competition (Fernández et al. (2005)).

5 Bank Market Power and the Cost of Credit

We now turn to the second and more important contribution of this paper: the estimation of the effect of market power on the cost of credit to non-financial firms. To do so, we assemble a unique dataset that links loan, firm and bank-level data from separate sources. While we lack a strict identification strategy, our rich dataset allows us to control for many sources of firm and bank –observed and unobserved, fixed and time-varying– heterogeneity, so that our estimations are suggestive in terms of causality. Our results indicate that, once bank characteristics and unobserved firm-heterogeneity are properly accounted for, banks loosing overall market power –measured by the average price-cost margin– decrease interest rates to small firms, but increase rates to firms with which they have the oldest credit relationships.

[5] Detailed behavior of the Lerner indices for banks in our sample is provided in Figure 4

[6] Clerides et al. (2015) report correlations between market share weighted averages. They report a correlation between the Lerner and Adjusted Lerner indices of 0.86, between Lerner and Profit Bone of 0.33 and between Adjusted Lerner and Profit Boone of 0.31 (they do not compute Market Share Boone indicators).

5.1 Loan and Firm Level Data

Our most comprehensive data source in the "Formato 341" (341 form) from Colombia's financial supervisor (Superintendencia Financiera) which contains loan-level data on the universe of loans granted by banks. From this source we obtain a total of 3.058.160 loans; a full set of descriptive statistics is presented in Table 3. The median-sized loan in this dataset is of USD29,516, while the maximum loan size if USD131.1 million.[7] Most loans –about 80% of them– are floating rate and do not post collateral. The average loan maturity is 2.2 quarters, but over half of the loans in our dataset are very short term (one quarter); the longest maturity is approximately 11.5 years.

With this dataset we are also able to measure the length of a credit relationship, which is on average 12 quarters. Finally, from this loan-level data, it can be seen that the typical firm is usually current in its financial obligations (median of current delinquencies is zero) and only 17% of firms has ever been delinquent on a loan (average of "previous delinquencies to a bank is 0.17). Figure 3 shows how real interest rates evolved over the period we study for loans in the main industries of the economy.

Our second source of data is a firm-level dataset collected from ORBIS Americas (Colombia). From this source we obtain data on firm assets (as a measure of size) from 474,154 non-financial firms, for a total of 1.66 million observations (3.5 observations per firm on average). Mean and median assets reported in this dataset are, respectively, USD2.6 million and USD56,426.

These two data sources are combined with the bank-level dataset that we constructed in Section 4, and whose descriptive statistics are provided in Table 1.

5.2 Bank Market Power and the Cost of Credit: Baseline Results

We now turn to the estimation of the effect of bank market power on the firm's cost of credit. Our dependent variables is the real interest rate charged on each loan. In this sense, our empirical exercise is closest to that found in Fungacova et al. (2017). However, since we know the identity of the bank which granted each loan, we are able to match our firm and loan level dataset with our previously constructed bank-level (instead of country-level) market power measures as well as with bank-specific characteristics. With this bank-firm-loan dataset at hand, we are in a position to study the impact that market power may have on the cost of accessing credit for non-financial firms. In particular, we estimate the

[7] All figures here and in what follows are expressed in USD at 2015 current exchange rates

following model:

$$ir_l = \mu + L_l\Psi + X_l\mathbf{\Theta} + v_l \tag{6}$$

where: ir_l is the real interest rate of loan l (given by bank b in period t), L_l is the Lerner index of bank b in period t (i.e., the market power of the bank which gave the loan at the time it did so); X_l is a vector of loan, bank and firm characteristics; and μ and $\mathbf{\Theta}$ are vectors of parameters.[8] Or main interest is in the parameter estimate associated with bank market power,Ψ, as well as some interactions that are introduced afterwards. Equation (6) is *estimated as a large cross-section for the full sample of matched loans*, under different sets of time, firm and bank fixed effects (and the combinations therein), and with standard errors clustered at the firm-bank level to capture the potential credit relationship dependent structure of errors.

We begin by estimating a "naive" model in which we include firm, bank, and time fixed effects, but not firm-time or firm-bank (pair/match) fixed effects, and do not control for the length of credit relationships. The first column of table 4 presents the results.

In this model, all coefficients pertaining loan, firm and bank characteristics appear to be statistically significant and of the expected sign, although some of them seem much more important than others. For instance, interest rates are lower for fixed-rate loans, but the difference is rather small: floating-rate loans are only 0.6 percentage points more expensive on average. On the other hand, posting collateral is associated with substantially –up to four percentage points– lower interest rate on a loan. As expected, longer term loans are more expensive, while loans granted to larger firms are cheaper. Interestingly, interest rates increase with the size and profitability of the bank making the loan, even after conditioning on the bank's market power. Loans granted by banks concentrated on commercial loans tend to have lower interest rates.

Finally, the coefficient on the Lerner index suggests that, on average and at first glance, lower market power is associated with higher interest rates. The effect appears to be small though: a drop in market power like that experienced by the typical bank in 2006-2007 –the largest drop in the sample period– is associated with interest rates that are 0.4 percentage points higher.

Next, we exploit the additional information available in our matched dataset, and study

[8] In some cases we also include some firm characteristics as additional controls. However, when we use firm-time fixed effects, these absorb any time-varying, firm-specific variables.

the effects of (i) the length of credit relationships,[9] and (ii) the potential heterogeneity in the effect of bank market power according to firm size. That is, we estimate the model:

$$ir_l = \mu + L_l\Psi + X_l\mathbf{\Theta} + L_l \times FirmSize_l\Phi + L_l \times LengthRel_l\Omega + v_l, \tag{7}$$

where firm size is captured by (the log of) firm assets, and the length of relationship is computed as the difference between the date of loan l, and the period in which the firm-bank pair appeared for the first time in the loan-level dataset. The inclusion of this variable capturing credit history is a conceptual and methodological contribution of this paper, since it is not available from the kind of firm- and bank-level datasets used by previous studies like Fungacova et al. (2017), Alvarez and Jara (2016) and van Leuvensteijn et al. (2013). We view the length of a credit relationship as a better measure of asymmetric information for a specific bank-firm pair than other measures used in previous work such as firm size.

Now the total effect of bank market power on the cost of firm finance is defined as:

$$\frac{\partial i_l}{\partial L_l} = \Psi + FirmSize_l\Phi + LengthRel_l\Omega \tag{8}$$

The results from this exercise, shown in column (2) of Table 4, paint a nuanced picture of bank competitive behavior. First, the positive coefficient (point estimate of 0.07) associated with the *level* of $LengthRel_l$ shows that extending a credit relationship for an additional year (four quarters) tends to increase the interest rate charged on loans by about 0.28 percentage points. This result may be suggestive of switching costs and hold-up problems, and supports the existence of a specific firm-bank market power (i.e., banks appear to gain bargaining power with firms as they stay longer together).

Next, as captured by the coefficient on the interaction $L_l \times FirmSize_l$, and shown graphically in the left panel of Figure 5, banks loosing market power tend to increase interest rates to small firms (for a firm with the median length of relationship): a drop in market power like that experienced by the typical bank in 2006-2007 (0.2 points in Lerner index) can reduce loan interest rates by up to 0.8 percentage points for the smallest firms. This is precisely what Fungacova et al. (2017) reports as its main result. However the right panel of Figure 5 shows that as banks loose market power, they lower interest rates to firms with which they have shorter credit relationships and increase them to firms with

[9]This variable is constructed by measuring the time distance between the period in which the loan was granted, and the first period in which the firm has a loan with that same bank in the sample.

which they have longer credit relationships (for a median-sized firm): a drop of 0.2 points in Lerner index can increase interest rates by up to 1 percentage point for the firms with the longest banking relationships.

In our view, this last result does not conform well with the so-called "information hypothesis". According to this theory, more bank competition (lower bank market power) should induce banks to charge higher interest rates to firms with short credit histories as they require more investment in information acquisition. Instead, our results show that banks compensate losing *objective* market power –as measured by the Lerner index– by extracting informational rents from their *existing* credit relationships. This is consistent with an established literature on banking switching costs that increase with the duration of credit relationships, and lead to informational lock-in and hold-up problems (Kim et al. (2003); Egarius and Weill (2016); Ioannidou and Ongena (2010)).

Finally, in columns (3) and (4) of Table 4 we study the implications of being able to control for firm-time and firm-bank unobserved heterogeneity; that is, we estimate equation (6) under firm-time and firm-bank fixed effects, which, importantly, helps us capture firm-specific demand shocks and features that are idiosyncratic to the firm-bank match. Results show remarkably stable coefficients for the loan-level controls (size of loan, maturity, collateral, fixed/floating) and some of the bank-level controls. A notable exception is the coefficient associated with bank size and to some extent bank profitability. That is, once we control for firm-specific demand shocks, larger banks and more profitable banks appear to charge higher interest rates.

Turning to the coefficients on the Lerner index and its interactions with firm size and bank-firm credit history, we confirm that relationship between market power and loan interest rates is critically mediated by firm size and the length of firm-bank relationships, although the actual size of the coefficients changes in some cases. Notice, however, that once we include firm-bank fixed effects, the coefficient on the level of relationship length is very imprecisely estimated. This is due to the fact that a large number of firms have only one loan in the sample, and, for these, the firm-bank fixed effect is highly colinear with the length of the credit relationship.

5.3 Potential Market Power and the Cost of Credit

We now estimate the baseline model of section 5.2 using the approach of Koetter et al. (2012) of capturing potential –rather than actual– market power. That is, we replace L_l with the efficiency-adjusted Lerner index computed in section 4. Results from this exercise

are shown in Table 5.

The first thing to notice is that the sign, size and statistical significance of all coefficients are all remarkably similar to those of Table 4. This is not entirely surprising given the high correlation between the Lerner and Adjusted Lerner indexes (0.82, see Table 2). However, the results from the adjusted Lerner show two noteworthy differences with respect to the Lerner exercise: (1) The average effect of bank market power on interest rates is somewhat smaller, (2) this effect is less sensitive to firm size and more sensitive to the length of credit relationships. In other words, for the average-sized firm, the informational lock-in effect or hold-up problem is somewhat stronger.

5.4 Alternative Firm-level Dataset

As a final check on our results we conduct the exercises of sections 5.2 and 5.3 using a smaller sample of Colombian firms coming from a dataset that is more readily available to researchers. The source of these data is a government body (Superintendencia de Sociedades) that collects accounting firm-level data from 41,249 firms in Colombia. In this dataset firms are typically larger (compared to our more comprehensive dataset from ORBIS) and the industrial sector is overrepresented. These two features imply that this dataset is precisely biased toward the firms that have several credit relationships.[10]

The results from this estimation are consistent with the aforementioned size bias. In particular, the marginal effect of market power as a function of size becomes flatter and, in contrast to our previous results, is at all times positive, since it corresponds to the far right portion of Figure 5. On the other hand, the marginal effect of market power as a function of credit history appears remarkably stable.

6 Conclusion

In this paper we have provided an in-depth analysis of competition behavior in the corporate credit market by Colombian banks during the last decade. Our estimates of market power, using four popular measures from the new empirical industrial organization literature, show that average market power fell dramatically in the mid-2000s, rose again in the early 2010s and has been fairly stable since.

[10]This is why even though this dataset contains about a tenth of the total number of firms found in the ORBIS dataset, we are left with over 50 percent of the observations.

When using detailed bank, firm, and loan-level data to estimate the effect of bank marker power on the cost of firm finance, we obtain a rather nuanced picture of bank competitive behavior. In particular, it appears that as banks loose market power, they reduce interest rates for firms with which they have shorter credit histories, and do the opposite with firms with which they have had a longer relationships. This is suggestive of the existence of switching costs and hold-out problems that has been documented before.

As noted before, our analysis must be taken with care, since we lack a proper identification strategy that could allow for a strictly causal interpretation of our results. And yet, our rich dataset enabled us to introduce conceptual and methodological innovations that make these results strongly suggestive of causal effects. This kind of data could also be used to establish events of collusion or characterize entry/expansion episodes that can help understand better how the distribution of market power affects access to credit, especially in economies with underdeveloped credit markets.

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Tables and Additional Figures

Table 1: Bank-Level Descriptive Statistics

	Mean	**Stand. Dev.**	**25 %**	**50%**	**75%**
Total Cost/Total Assets	10.55	4.21	7.76	9.75	11.88
Loans/Total Assets	60.23	18.02	52.44	62.07	68.97
Securities/Total Assets	22.80	17.88	13.32	19.73	32.28
Interest Expenses/Deposits	12.30	7.99	8.49	10.85	13.84
Other Expenses/Fixed Assets	18.77	25.58	1.80	8.01	23.88
Personnel Expenses/Total Assets	1.84	1.91	0.52	1.24	2.34
Equity/Total Assets	14.46	10.41	9.36	12.00	15.16
ROA (%)	2.29	2.57	1.70	2.61	3.52
Commercial Loans/Net Loans	55.67	25.83	40.33	54.86	76.53
Housing Loans/Net Loans	7.42	12.53	0.00	0.73	10.96
Consumption Loans/Net Loans	34.32	24.53	16.52	30.46	47.42

Table 2: Bank Market Power and Concentration Correlation Matrix

	Lerner	Adj. Lerner	MS Boone	Profit Boone	Top-3 loans	HHI loans
Lerner	1.00					
Adj. Lerner	0.82**	1.00				
MS Boone	0.35**	0.67**	1.00			
Profit Boone	0.58**	0.44**	0.34**	1.00		
Top-3 loans	-0.25	-0.68**	0.02	-0.77*	1.00	
HHI loans	-0.14	-0.52**	0.20	-0.66	0.87**	1.00

Note: ** denotes statistical significance at the 5% level.

Table 3: Loan-Level Descriptive Statistics

	Mean	**S.D.**	**50 %**	**Min**	**Max**
Ln Loan Amount	4.16	2.86	4.41	-6.07	12.79
Loan's Maturity (Quarters)	2.18	2.43	1.00	1.00	46.00
Fixed Interest Rate (%)	0.20	0.40	0.00	0.00	1.00
Collateral	0.21	0.41	0.00	0.00	1.00
Previous Delinquency to Bank	0.17	0.38	0.00	0.00	1.00
Number of Delinquencies to Bank	2.11	4.85	0.00	0.00	72.00
Length of the Banking Relationship	12.16	11.00	9.00	0.00	43.00

Table 4: Bank Market Power and Firm Finance: Lerner Index

VARIABLES	(1) Real Interest Rate	(2) Real Interest Rate	(3) Real Interest Rate	(4) Real Interest Rate
Lerner	-1.809***	-9.874***	-0.803***	-7.846***
	(0.154)	(0.604)	(0.197)	(1.665)
Ln Loan Amount	-1.032***	-1.035***	-0.998***	-1.045***
	(-0.006)	(0.006)	(0.009)	(0.011)
Loan's Maturity	0.079***	0.082***	0.079***	0.085***
	(0.002)	(0.002)	(0.004)	(0.005)
Fixed	0.620***	0.612***	0.467***	0.480***
	(0.016)	(0.016)	(0.022)	(0.025)
Collateral	-4.010***	-3.992***	-4.049***	-4.301***
	(0.021)	(0.021)	(0.027)	(0.033)
Bank's Ln(Assets)	0.345***	0.468***	1.701***	2.250***
	(0.093)	(0.093)	(0.125)	(0.156)
Bank's Roa	0.144***	0.209***	0.285***	0.273***
	(0.019)	(0.019)	(0.023)	(0.027)
Bank's Leverage	-0.132***	-0.154***	-0.099***	-0.175***
	(0.008)	(0.008)	(0.011)	(0.013)
>70 % Commercial Loans	-0.160***	-0.070	-0.151**	-0.054
	(0.051)	(0.051)	(0.065)	(0.084)
Ln(Assets)	-0.209***	-0.423***		
	(0.013)	(0.019)		
Length of Relationship		0.070***		2.521
		(0.003)		(1.3e5)
Ln(Assets) x Lerner		0.635***		0.647***
		(0.041)		(0.110)
Length of Relationship x Lerner		-0.109***		-0.179***
		(0.007)		(0.014)
Observations	1,555,043	1,555,043	1,282,816	918,391
R-squared	0.545	0.546	0.756	0.757
Firm Fixed Effects	✓	✓	✓	✓
Time Fixed Effects	✓	✓	✓	✓
Bank Fixed Effects	✓	✓	✓	✓
Firm-Time Fixed Effects			✓	✓
Firm-Bank Fixed Effects			✓	✓

Standard errors are clustered at the firm-bank level.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Bank Market Power and Firm Finance: Adjusted Lerner

VARIABLES	(1) Real Interest Rate	(2) Real Interest Rate	(3) Real Interest Rate	(4) Real Interest Rate
Adjusted Lerner	-1.545***	-8.804***	-1.504***	-6.923***
	(0.176)	(0.653)	(0.241)	(1.861)
Ln Loan Amount	-1.032***	-1.034***	-0.998***	-1.045***
	(0.006)	(0.006)	(0.009)	(0.011)
Loan's Maturity	0.078***	0.081***	0.079***	0.085***
	(0.002)	(0.002)	(0.004)	(0.005)
Fixed	0.616***	0.606***	0.466***	0.479***
	(0.016)	(0.016)	(0.022)	(0.025)
Collateral	-4.008***	-3.991***	-4.049***	-4.305***
	(0.021)	(0.021)	(0.027)	(0.033)
Bank's Ln(Assets)	0.249***	0.383***	1.702***	2.136***
	(0.091)	(0.091)	(0.125)	(0.153)
Bank's Roa	0.143***	0.214***	0.331***	0.290***
	(0.021)	(0.021)	(0.025)	(0.029)
Bank's Leverage	-0.126***	-0.151***	-0.100***	-0.179***
	(0.008)	(0.008)	(0.011)	(0.013)
>70 % Commercial Loans	-0.107**	-0.014	-0.151**	-0.090
	(0.051)	(0.051)	(0.065)	(0.084)
Ln(Assets)	-0.209***	-0.411***		
	(0.013)	(0.020)		
Length of Relationship		0.084***		2.910
		(0.003)		(1.3e5)
Ln(Assets) x AdjLerner		0.616***		0.616***
		(0.044)		(0.121)
Length of Relationship x AdjLerner		-0.151***		-0.229***
		(0.008)		(0.016)
Observations	1,555,043	1,555,043	1,282,816	918,391
R-squared	0.545	0.546	0.756	0.757
Firm Fixed Effects	✓	✓	✓	✓
Time Fixed Effects	✓	✓	✓	✓
Bank Fixed Effects	✓	✓	✓	✓
Firm-Time Fixed Effects			✓	✓
Firm-Bank Fixed Effects			✓	✓

Standard errors are clustered at the firm-bank level.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Bank Market Power and Firm Finance: Alternative Dataset

VARIABLES	(1) Lerner	(2) Lerner	(3) Adj Lerner	(4) Adj Lerner
Market Power	0.818***	0.024	0.214	2.628***
	(0.273)	(0.806)	(0.330)	(0.926)
Ln Loan Amount	-1.019***	-1.018***	-1.019***	-1.017***
	(0.013)	(0.013)	(0.013)	(0.013)
Loan's Maturity	0.052***	0.051***	0.052***	0.052***
	(0.006)	(0.006)	(0.006)	(0.006)
Fixed	0.292***	0.289***	0.294***	0.288***
	(0.031)	(0.031)	(0.031)	(0.031)
Collateral	-3.663***	-3.661***	-3.663***	-3.667***
	(0.042)	(0.042)	(0.042)	(0.042)
Bank's Ln(Assets)	2.378***	2.361***	2.409***	2.279***
	(0.173)	(0.171)	(0.172)	(0.169)
Bank's Roa	0.145***	0.205***	0.168***	0.187***
	(0.031)	(0.031)	(0.034)	(0.034)
Bank's Leverage	-0.185***	-0.236***	-0.189***	-0.242***
	(0.015)	(0.015)	(0.015)	(0.015)
>70 % Commercial Loans	-0.173*	-0.114	-0.229**	-0.200**
	(0.099)	(0.097)	(0.100)	(0.099)
Length of Relationship		-16.319		-17.53
		(2.27e5)		(2.27e5)
Ln(Assets) x Lerner		0.321***		0.139
		(0.081)		(0.091)
Length of Relationship x Lerner		-0.180***		-0.246***
		(0.017)		(0.019)
Observations	580,811	580,072	580,811	580,072
R-squared	0.726	0.727	0.726	0.726
Firm Fixed Effects	✓	✓	✓	✓
Time Fixed Effects	✓	✓	✓	✓
Bank Fixed Effects	✓	✓	✓	✓
Firm-Time Fixed Effects	✓	✓	✓	✓
Firm-Bank Fixed Effects	✓	✓	✓	✓

Standard errors are clustered at the firm-bank level.
*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1: Bank Concentration in Colombia

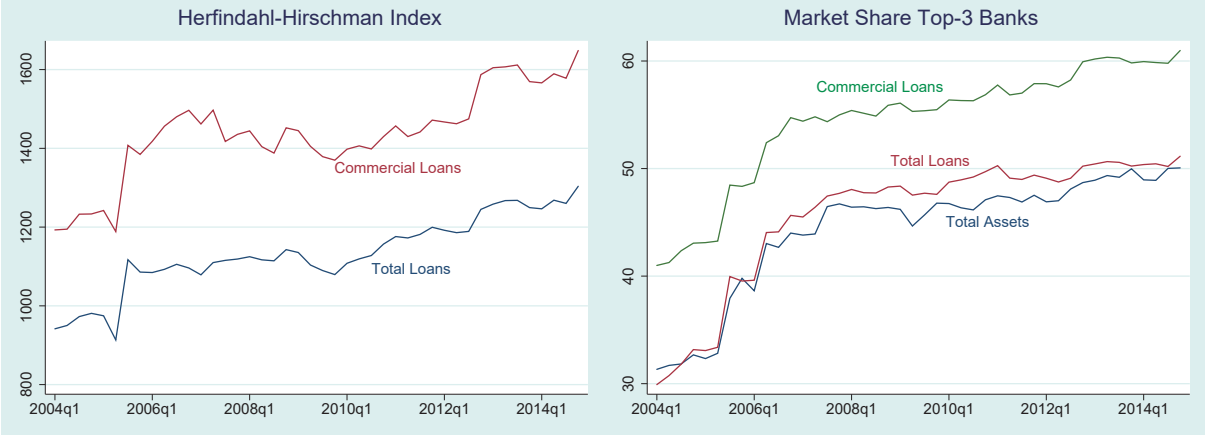
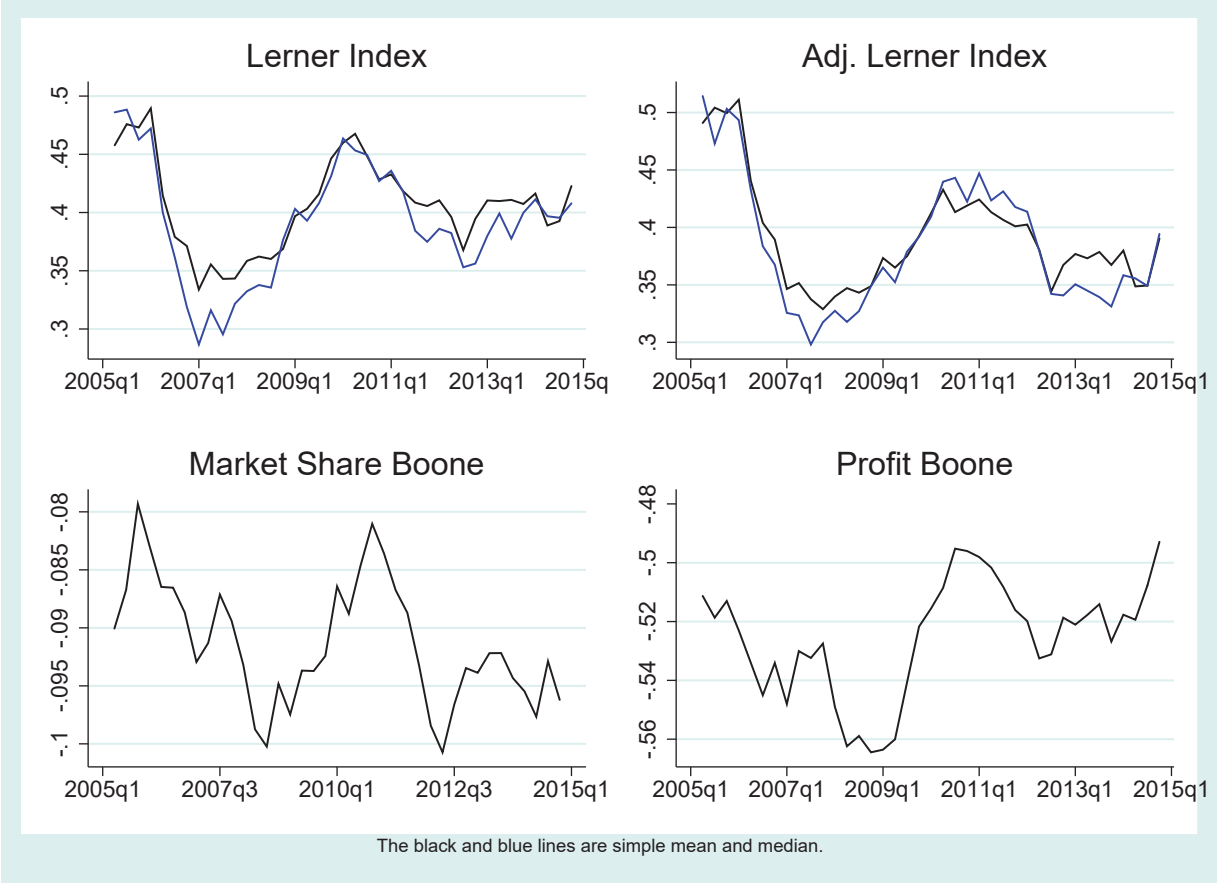


Figure 2: Lerner and Boone Measures



The black and blue lines are simple mean and median.

Figure 3: Real Interest Rates by Industry

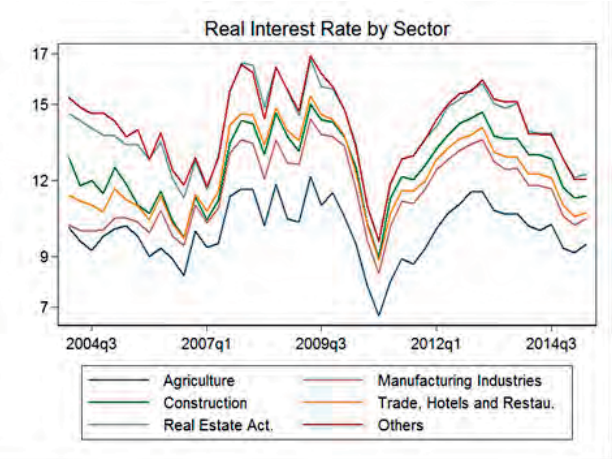


Figure 4: Lerner Indices - Banks in the Sample

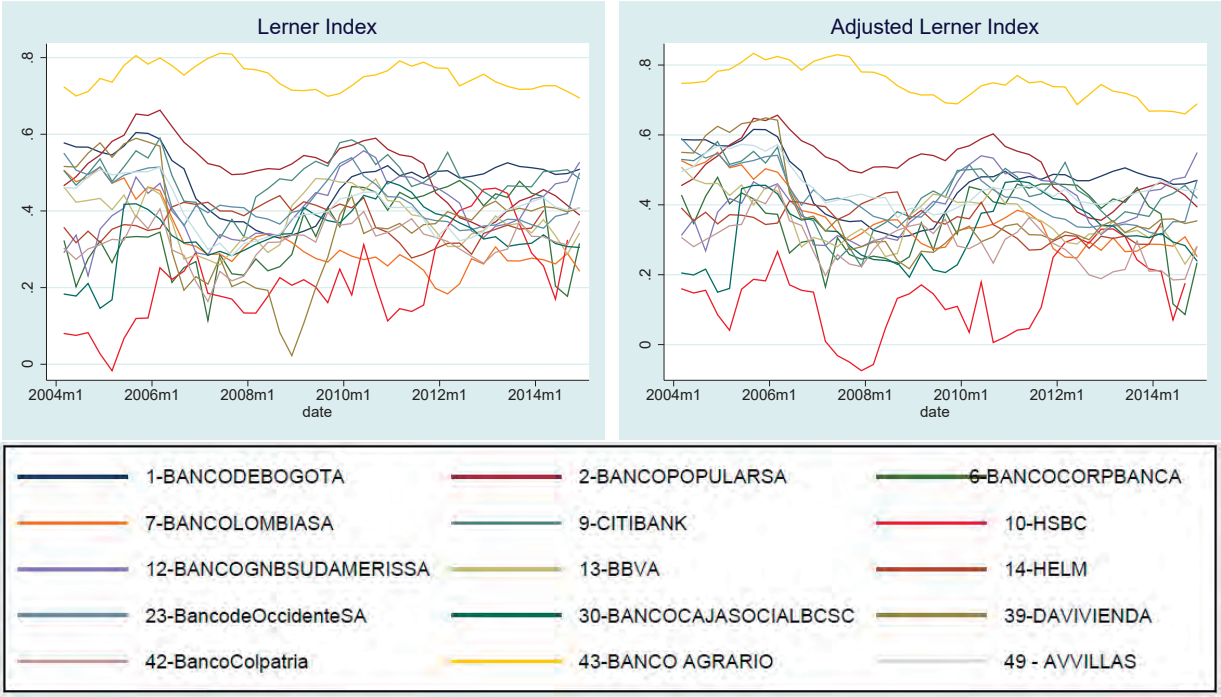
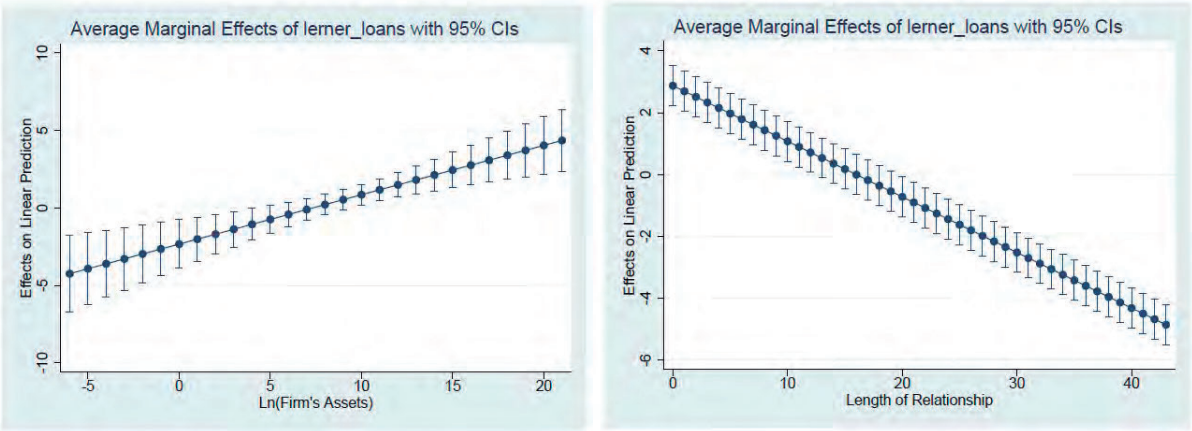


Figure 5: Heterogeneous Effects of Bank Market Power



Note: The figures plot marginal effects obtained using the coefficients from column 5 in tables 3 and 4.

7 Apendix

7.1 Mergers and Acquisitions in the Colombian Banking System

Table 7: M&A in the Colombian Banking Industry 2004-2014

Mergers and Acquisitions	**New Entrants**
Banco Sudameris acquires Banco Tequendama (2005)	Bancamia (2008)
Davivienda acquires Banco Superior (2004)	Banco WWB (2010)
BBVA acquires Banco Granahorrar (2005)	Bancoomeva (2011)
Banco Colmena merges with Banco Caja Social (2005)	Banco Finandina (2011)
Banco Conavi merges with Bancolombia (2005)	Banco Falabella (2011)
Banco Union Colombiano merges with Banco de Occidente (2006)	Banco Pichincha (2011)
Banco de Bogota acquires Megabanco (2006)	Banco Cooperativo Coopcentral 2013
Davivienda acquires Bancafe-Granbanco (2006)	Banco Santander de Negocios 2013
Scotiabank acquires controlling ownership of Colpatria (2011)	

7.2 Data sources, variable definitions and TOC estimation

7.2.1 Bank-level data

All of our bank-specific measures come from the financial supervisor in Colombia, Superintendencia Financiera. In particular, we access the excel workbooks provided by SuperFinanciera under the link https://www.superfinanciera.gov.co/publicacion/60776 ("Estados Financieros - Moneda total - COLGAAP"). These spreadsheets contain both balance sheet and income statement accounts. Our variable definitions are as follows:

- Total bank assets: is taken as account number 100000 ("Activo").
- Fixed Assets: is taken as account number 180000 ("Propiedades y equipos").
- Total bank investments: is taken as account number 130000 ("Inversiones").
- Equity: is taken as account number 300000 ("Patrimonio").
- Total bank net loans: is taken as account number 140000 ("Cartera de creditos y operaciones de leasing financiero") which records net commercial, consumer, housing, and microcredit loans; and we exclude net financial leasing loans by subtracting account numbers for gross commercial, consumer, housing, and microcredit leasing loans (141183 to 141198; 141983 to 141998; 143283 to 143298; 143383 to 143398; 143683 to 143698 ; 144183 to 144198; 144283 to 144298; 144283 to 144498; 144583

to 144598; 145083 to 145098; 145983 to 145998; 146083 to 146098; 146283 to 146298; 146383 to 146398; 146583 to 146598; 146683-146698; 146783 to 146798; 146883 to 146898; 146983 to 146998; 147083 to 147098) and adding accounts for commercial, consumer, housing, and microcredit leasing provisions (149109, 149114, 149119, 149124, 149149, 149309, 149314, 149319, 149324, 149329, 149508, 149509, 149513, 149514, 149518, 149519, 149523, 149524, 149528, 149529, 149810).

- Net Commercial loans: is the sum of account numbers 145900, 146000, 146200,146300 and 146500 to 147000 which record commercial loans under different risk categories (A to E) and using different collateral ("garantia idonea" and "otra garantia"); and exclude net commercial leasing loans by subtracting account numbers for gross commercial leasing loans (145983 to 145998; 146083 to 146098; 146283 to 146298; 146383 to 146398; 146583 to 146598; 146683-146698; 146783 to 146798; 146883 to 146898; 146983 to 146998; 147083 to 147098) and adding commercial leasing provisions (149508,149509,149513,149514,149518,149519,149523,149524,149528,149529).

- Financial Income: is the sum of the account numbers for interest income (4102000), commissions (4115000), price level restatement (411015), return on investments (410403 + 410404 + 410405 + 410409 + 410421 + 410423 + 410424 + 4123000), dividends (414000), net profit in investment sales (4116000 + 4125000 – 5116000 – 5125000) investment valuation (410700 + 410800 + 410900 + 411100 + 411200 + 411300 – 510600 – 510800 – 510900 – 511100 – 511200 – 511400), other net financial income (410400 + 411005 + 412800 + 412900 – 410403 – 410404 – 410405 – 410409 – 410421 – 410423 – 410424 – 512800 – 512900), and net changes (413500 – 513500).

7.2.2 TOC estimation results

Table 8: TOC Translog Function Estimates

Dependent variable: ln(*operating cost*)	**Coefficient**	***t*-value**	$P > \|t\|$
ln_loans	-0.177	-0.30	0.772
ln_loans_sq	0.118	2.79	0.015
ln_invest	0.637	1.22	0.242
ln_invest_sq	0.081	3.02	0.009
ln_input_price	1.395	2.06	0.058
ln_input_price_sq	0.061	2.99	0.010
ln_input_price2	0.677	3.97	0.001
ln_input_price_sq	0.0012	0.17	0.864
ln_loans_invest	-0.182	-3.12	0.008
ln_loans_input	-0.060	-3.97	0.001
ln_loans_input2	0.007	0.09	0.931
ln_invest_input	0.014	0.94	0.361
ln_invest_input2	-0.066	-1.25	0.236
ln_input1_input2	-0.019	-0.90	0.384
ln_eqty_ass	-0.112	-1.40	0.182
Bank fixed-effects		YES	
Time fixed-effects		YES	
Bank-level clustered std errors		YES	
R2 (overall)		0.983	
Number of panels (banks)		15	
Observations		654	