“Risk, concentration and market power in the banking industry: evidence from the Colombian system (1997-2006)”

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Risk, concentration and market power in the banking industry: evidence from the Colombian system (1997-2006)

Abstract

This paper examines the relationship between risk, concentration and the exercise of market power by banking institutions. The authors use monthly balance-sheet and interest rate data for the Colombian banking system from 1997 to 2006. The evidence shows that, in the face of high risk, banks transfer a larger share of risk to customers through higher intermediation margins. The result suggests that risk acts as a "collusion" device for banks: while high concentration is not enough to have collusion, the true effects of high market concentration on interest rates' mark-ups emerge when the system is under stress.

Keywords: banking, market power, risk, concentration, intermediation margins.
JEL Classification: G21, G34, G38, L11.

Introduction

Horizontal mergers are potentially the more anti-competitive type of mergers since they necessarily reduce the number of competitors and may induce rises in prices – an indication of the exercise of market power[1]. However, the integration of productive facilities brings also the possibility of cost savings. Whether mergers and acquisitions are socially beneficial remains an empirical question.

Although a wide range of variables are used in the literature to try to capture the potential effects of a merger, antitrust authorities continue to focus mainly on the analysis of market shares. A standard procedure in most industries is to relate prices and market shares econometrically (Carlton, 2007), the strategy followed in this paper[2]. We relate measures of market power with measures of concentration in order to determine whether the merger wave observed over the past decade in the Colombian banking industry had effects on the exercise of market power.

Our paper departs from the standard literature in the way that it takes account of risk, a key control variable when studying the effects of a merger in the banking system. In the spirit of Stiglitz and Weiss (1981), the higher are the interest rates the riskier are the projects that can be financed. Oliver et al. (2006) note that this increased risk is tied in part to moral hazard and adverse selection; it raises the mark-up in intermediation unless one makes suitable corrections. While they propose to adjust the mark-up measure (the Lerner index), we include an explicit measure of risk in our specification, which allows us to explore the effect that risk has on the exercise of market power on the part of banks. There is an important distinction between having market power and exercising it – between having it and using it. We show that risk induces increases in market prices beyond the additional uncertainty costs. Colombian banks seem to take advantage of their market power during crises. Thus, a merger analysis for the banking industry should explicitly take into account risk, market shares, and the effect of risk on the exercise of market power.

Using monthly data for 1997 through 2006, this paper examines the effect of changes in risk on the relationship between concentration and the exercise of market power in the Colombian banking industry. Two fortunate aspects of this data stand out when compared to the extant literature. First, this period of time is characterized by the most important merger wave in this industry to date, and by the first recession in almost 60 years in Colombia, 1999-2001. Second, we use interest rates on loan disbursements and deposits rather than the usual implicit interest rates calculated from interest payments and outstanding loans and deposits. Thus we have direct measures of the price and marginal cost of money as perceived by the banks.

Our econometric analysis then relates a market power proxy, the Lerner index, with measures of concentration and risk. Our results suggest that the correlation is positive with concentration and negative with risk. We also find that an increase in concentration allows for a stronger transmission of risk

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[1] See a discussion on the topic in Viscussi et al. (1998).
[2] The strategy is not without controversy. In a recent article that focuses mainly on market and intellectual property issues, Carlton (2007) explicitly asks whether defining "markets and calculating market shares (should) remain a pillar of antitrust policy".

to the Lerner index (i.e., to the customers): when risk is high firms transfer a larger share of risk to customers through higher risk premiums. This result suggests that risk acts as a collusion device for banks. Thus, while high concentration is not enough to attain collusion, the true effects of high market concentration on interest rates' mark-ups emerge when the system is under stress. An immediate policy implication is that the regulator needs to explicitly account for risk when it evaluates the potential effects of mergers (and increases in concentration in general).

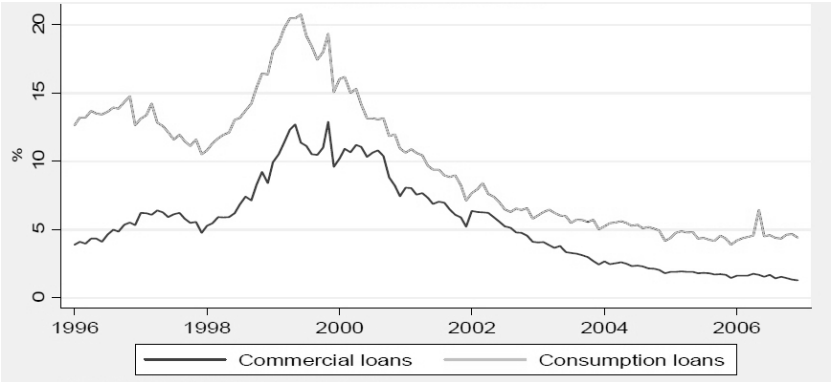
The paper is organized as follows. Section 1 presents brief review of the evolution of the Colombian banking system. Section 2 discusses the relevant literature. The model is presented in Section 3, while an overview of data is given in Section 4. Section 5 discusses and analyses the results ending with the conclusions in the last section.

1. Background

The Colombian banking system changed from a strongly state-owned sector in the mid-1970s to a very open industry in the early 2000s. A major reform in the industry took place in the 1970s, when a type of bank was created with the specific aim of serving the housing market. Besides having a monopoly on this market, these institutions, called *corporaciones de ahorro y vivienda* (CAVs), enjoyed regulated interest rates designed to protect them against inflation spikes[1,2].

The 1980s brought the Latin American crisis and with it the bankruptcy of several banks and financial institutions across the region, including several in Colombia. The Colombian government was forced to take control of a number of institutions which would be privatized later in the 1980s and 1990s. However, except for the creation of deposit insurance, no major reforms took place at the time. The next reform came in the early 1990s with the explicit aim to promote a universal banking system and to encourage competition, foreign ownership restrictions were eliminated so foreign investors could own 100% of any Colombian bank.

A housing asset price and loan bubble in the second half of the 1990s lead to a second major crisis in the banking industry. Colombian GDP fell in 1999 for the first time since the great depression (a fall of 4.2%), while the unemployment rate rose to a peak of 20.5% in the third quarter of 2000. The associated risk increase to the banking system was reflected by the large deterioration in the quality of loans depicted in Figure 1. As in the 1980s, the government had to step in, assisting both private and publicly owned financial institutions. In part as a consequence of the crisis, the regulation of the financial market changed again, this time to include new types of institutions and to allow banks to issue mortgage loans[3]. The reforms continued to promote a more competitive and universally oriented banking system, and today most institutions are commercial and mortgage banks at the same time[4].

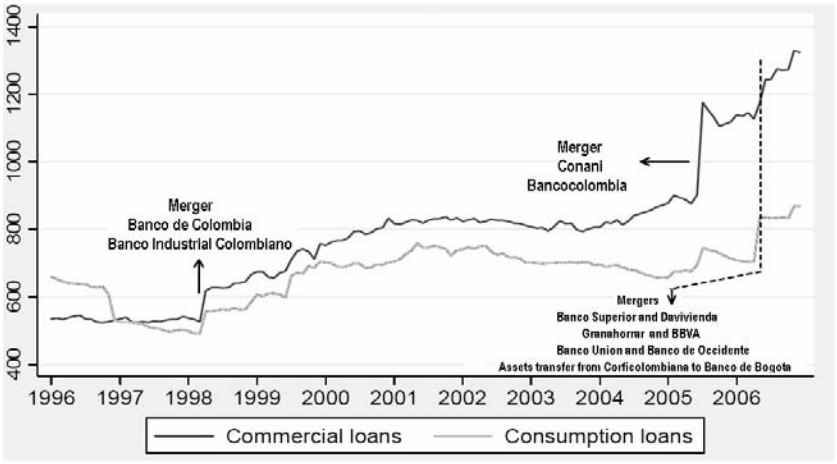


Note: Overdue loans/total loans.
Source: PUC financiero (own calculations).

Fig. 1. Loans portfolio quality

The data we examine in this paper spans the period from 1997 through 2006, when the banking system witnessed an unprecedented wave of mergers and acquisitions. In December 1997 there were 34 banks and 7 CAVs, in December 2006 only 17 multipurpose banks. Consequently, concentration of the loan portfolio, as measured by the Herfindahl-Hirschman Index (HHI), steadily increased over the period (see the evolution of the HHI in Figure 2).

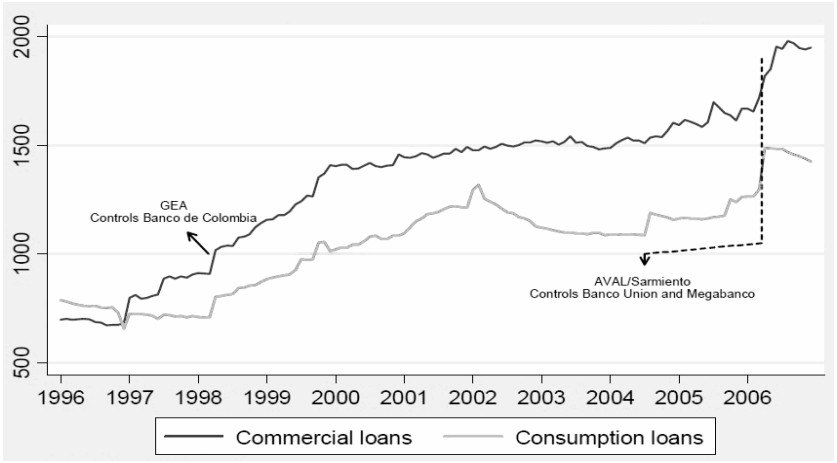
[1] A complete historical review of the evolution of the banking sector in Colombia during the 20th century is available in Caballero and Urrutia (2006).
[2] The literal translation of CAV would be *housing and savings corporation*.
[3] The other institutions in the financial market are the financial cooperatives, which focus on investment banking, and commercial financial companies – essentially leasing and niche specialized institutions. This work focuses on banks and CAVs which by December 2006, held 95.7% of the commercial loans portfolio and 92% of the consumption loans portfolio.
[4] Commercial banks are referred to those whose main activity is receiving and allocating resources. Mortgage banks refers to those specialized in the housing market. These are essentially what we refer in the text to banks and CAVs respectively.



Notes: Only banks and CAVS were included.
Source: PUC financiaro (own calculations).

Fig. 2. HHI

Individual bank mergers are only part of the picture, however, much of the story of the Colombian banking system has to do with how financial conglomerates evolved over the decade. For example, by December 2006, the *Sarmiento/AVAL* group controlled 27.8% of the consumption and 31.9% of the commercial loans portfolio through 4 of the 17 multipurpose banks in the system. We thus graph the HHI evolution grouping banks by financial conglomerates in Figure 3, which shows a higher concentration index.



Note: Only banks and CAVS were included.
Source: PUC financiaro (own calculations).

Fig. 3. HHI. Financial Conglomerates. Covernment is concidered as a group

2. Literature review

2.1. Recent performance of the Colombian banking system. The government implemented in the 1990s important reforms to promote competition in the Colombian banking sector. Whether the regulatory reforms succeeded is a matter of debate. Carrasquilla et al. (1997), for instance, argue that they have failed: savings remain low and investments are still financed based on their collateral –not on expected return and risk. Others, like Janna (2004), find that bank investments are now more efficient.

The analysis of the intermediation margin – the difference between lending and deposits interest rates – shows mixed results. Barajas, Steiner and Salazar (1999a) show that the margin remained constant before and after the 1990s reforms, but that the composition changed. Decomposing the margin, they find that the Colombian banking system was not competitive at all during the 1970s and 1980s. However, although (private) banks retained significant levels of market power, they argue that the situation was reversed during the 1990s. In a related study, Barajas, Steiner and Salazar (1999b) find that the entrance of foreign banks slightly reduced the intermediation margin, the financial costs (i.e., interest expenses and similar costs) and improved the portfolio quality. Finally, Castro and Steiner (2002) show that the margins did fall and that their level depended significantly on risk and market structure.

2.2. Strategy for analysis. Three strands in the literature are relevant for our purposes. One connects economies of scale with size, risk and costs, and with the advantages of universal banking. Another focuses on the link between concentration and market power; it relates market structure with prices and the degree of competition in the system. This is closely related to our approach in this paper. Finally, a third line of research asks how to adjust for risk when measuring market power. Our results add to this literature by measuring how concentration affects these risk adjustments.

De Nicoló (2000) gives a detailed review of the literature on economies of scale in the banking sector. He examines empirically the relationship between size and operational diversification of banks, their risk levels and their market value. Controlling for regulation and market structure, he finds that in developed financial systems risk and bank size are positively correlated, while risk and market value are negatively correlated.

The second relevant strand of literature focuses on the relationship between concentration and market power. Bikker and Haaf (2002) use the *H*-statistic, proposed by Panzar and Rosse (1987), to examine the competitiveness of the banking sector in a variety of countries, mostly European. Based on how the firms' revenue changes when prices factor change, this model assesses whether the firms behave like a cartel, monopolistic competitors or competitively. Its main limitation is that it does not account for strategic interaction among firms or barriers to entry. Moreover, the tests for monopolistic competition and perfect competition are valid only in long-run equilibrium.

Bikker and Haaf also examine the econometric relationship between the Herfindahl-Hirschman (HHI) index and the *H*-statistic. Their results suggest that the number of banks is negatively correlated with the degree of competition. Further analysis suggests that in markets with a few large banks, the small banks have little effect on the degree of competition. The authors conclude that there is a relation between market structure and competition driven by the presence of large banks.

Nathan and Neave (1989) look at a different aspect of market power. They argue that concentration may generate conditions for market power, but it does not necessarily imply the exercise of such power. Specifically, they study the possibility that market power is not exercised when entry is relatively easy and sunk costs are not significant. Using a dataset of Canadian banks for the period of 1982-1984, they use the *H*-statistic as a measure of competition, controlling for wages, input costs and interest payments. The paper rejects the hypotheses of monopolistic or oligopolistic behavior in every market considered. Contrary to Bikker and Haaf (2002), they do not find that bank size matters.

Prager and Hannan (1998) examine the effects of mergers over market prices and find evidence of the exercise of market power in the U.S. financial system for the period of 1991-1994[1]. To identify the effect on prices, they consider markets where horizontal mergers took place and use markets without mergers as control groups. They take deposit interest rates to be the relevant prices, define the markets geographically and take into account product differentiation. Their findings suggest exercise of market power, as deposit rates offered by participants in horizontal mergers declined by a greater percentage than did deposit rates offered by banks not operating in markets in which such mergers took place. Moreover, in markets where mergers occurred, they find that merged and non-merged banks behave in a similar way. They interpret this as evidence against the argument that quality improvements of merged banks are responsible for the observed price changes.

So far, the discussion points out a well studied relationship between market power and concentration in the literature. Nevertheless, even though more firms in the market do not necessarily imply less "static and dynamic efficiencies" (Oliver et al., 2006), a traditional regulatory objective is to promote competition to bring prices towards marginal costs.

The last strand of literature relates risk and market power. This relationship is theoretically less clear, but particularly relevant in the banking industry. Risk and market power are related through various channels. First, Levine (2003) supports the idea that bank governance could be improved if powerful official supervisors were appointed. This should lower the risk-taking behavior allowed for banks and simultaneously affect competition – and the possibility to exercise market power.

Second, strong capital requirements can impose entry barriers for newcomers. Banks can then strengthen its requirements for granting new loans (Bolt and Thieman, 2004) or, given an sufficiently large capital requirement, there may be an equilibrium in which individual banks choose to invest efficiently but the aggregate result is Pareto inefficient (Hellman et al., 2000). In either case the regulation influences risk management, although the direction is not clear.

[1] They use data from the Federal Reserve's Monthly Survey of Selected Deposits. Data covers between 500 and 550 banks for a period of 25 months.

The usual measure of market power in this literature is the Lerner index. However, Oliver et al. (2006) point out that the standard calculation of the Lerner index does not take into account that risk is a marginal cost (moral hazard and adverse selection situations increase the probability of default). As a result, even with effective regulation, prices do not have to equal marginal cost, and the standard Lerner index overstates the exercise of market power. Oliver et al. propose an adjustment to the Lerner index using a bank-level *ex-post* indicator of default risk (the percentage of non-performing loans over a given time period). Thus, while they show that the standard Lerner index depends on risk (as we do), they assume that this risk is fully incorporated by the bank into its marginal cost. As one should expect, the adjusted Lerner index of Oliver et al. suggests less exercise of market power than the usual Lerner index.

One interesting aspect of the adjusted Lerner index in Oliver et al., however, is that, for limited periods of time it is negative for some loan types in some banks (banks do occasionally charge interest rates below the risk-adjusted marginal cost). The authors argue that banks put up with the resulting losses in order to avoid certain informational costs. In any case, this result shows that the level of exercise of market power does change with the risk (measured as arrears) faced by the banks.

Summarizing, the evidence suggests that there is possibly a link between market structure and market power – albeit higher concentration does not always imply the exercise of such power – and, in developed financial systems, a further link between market structure and the efficiency in dealing with risk. Specifically for Colombia, there seems to be a link between higher efficiency, foreign-owned banks and mergers. However, whether this higher efficiency translated into more competition is controversial. There is also evidence that the determinants of bank efficiency may be different when the financial system is in crisis. The approach suggested by the literature in this case is to include risk adjustments in the calculation of marginal costs, which in turn makes evident that the exercise of market power changes with risk – precisely the link that we explore in this paper.

3. The model

Our objective is twofold. First we want to establish comparable market power indicators for the period of 1997-2006. Second, we want to calculate the effect that changes in concentration had (if any) over the exercise of market power, taking into account the effect of risk in this relationship.

We assume, as in Prager and Hannan (1998) that the relevant prices for the financial sector are the interest rates. We use this approach to construct Lerner index, which we use to link econometrically market power with concentration, as measured by the HHI.

3.1. Concentration and market power measurement. The measure for concentration we use is the HHI. Because some banks are controlled by the same conglomerate, we construct the HHI by bank and by financial conglomerate. For the latter, we aggregate the data of the banks controlled by each conglomerate. To link concentration with market power, we carry out an exercise in the spirit of the structure-conduct-performance paradigm discussed in detail in Salinger (1989). Following Prager and Hannan (1998) we use the interest rates on current period disbursements and deposits as prices, taking the latter as the equivalent of marginal costs[1].

Our measure of market power is the adjusted Lerner index proposed by Oliver et al. (2006). However we make the risk term explicit in our specification so that we can move it to the right-hand side of the regressions and thus estimate how much changes in risk are transferred to prices.

One problem with the risk adjustment in this index, already pointed out by Oliver et al., is that one needs to include in its calculation: (1) the non-performing loans; and (2) the amount of the face value of the loan that the bank cannot collect from the defaulted loan (LGD). However, there is no detailed information regarding LGD. Oliver et al. use as proxies for LGD those values set by the Basel Committee of Banking Supervisors (Basel II agreement). Besides not having time variation, this solution is not suitable for Colombia because Basel II covers only the 23 (mostly developed) countries and it is not clear that its standards reflect those of Colombian banking during the financial crisis.

3.2. Estimation. Our specification then is as follows. We start with a risk-adjusted Lerner index $\frac{i^*_{jk}(1-\gamma_k)-i^c_k}{i^*_{jk}}$ with a risk premium $f_k = \gamma_k i^*_{jk}$ for type j credit in bank k and (omitted for simplicity) period t[2]. Then we separate the risk premium and account for it separately in the regression, using as proxy on the right-hand side each bank's ratio of non-performing loans to total loans in every period

[1] The indicator would be a perfect measure of market power if in fact the bank's only lending business is deposits. In reality it is not (though it is an important component) and so we take that into account when constructing the right hand variables.

[2] j refers to total, commercial and consumption loans.

of time, γ_k. Thus, our dependent variable is the standard Lerner index[1]:

$$L_{jk} \equiv \frac{i^*_{jk} - i^c}{i^*_{jk}},$$

where i^*_j refers to the lending interest rate for type *j* credit in bank *k* and i^c is the weighted average by amount of the fixed term deposit interest rates. Once we have the Lerner index, we estimate the following equation:

$$\ln L_{jkt} = a + b * \ln HHI_{jt} + c * \ln \gamma_{jkt} + \\ + e * Others_t + Fe_k, \quad (1)$$

ln*L* is the natural logarithm of the Lerner index, ln*HHI* is the natural logarithm for the concentration index and $\ln \gamma$ is the natural logarithm for the risk measure. *Others* are control variables: the natural logarithm for an industrial production index, quarterly dummies intended to capture economic activity and a monthly trend intended to measure technological changes. We estimate these regressions in two ways: (1) using individual bank data; and (2) taking conglomerates of banks as single institutions. *Fe* represents fixed effects by bank or conglomerate as the case may be.

γ_k is a measure of *ex post* risk. Contrary to an ideal *ex ante* risk measure, it captures only risk issues related to the chances of default. Suppose that the coefficient on γ_k reflects exclusively the relationship between non-performing loans and the risk premium of each financial institution. In such a case, which corresponds to the implicit assumption of Oliver et al. (2006), one would expect that in equation (1). *c* = 1 as long as markets value *ex ante* risk correctly and banks are risk neutral. Values of *c* greater than one would be indication of risk aversion among banks. In such a case, one should ask why these banks remain in the market: in a competitive market, such risk aversion implies higher marginal costs; such banks should not be able to survive competition[2].

In our case the estimate of *c* also reflects that γ_k is an imperfect measure of risk. If γ_k systematically overestimates (underestimates) risk, the value of the coefficient will be biased towards zero (away from zero). Also, if γ_k is simply a noisy proxy for risk, the estimate of *c* will have attenuation bias. Hence, if in fact *c* contains information about market power, it may not be possible to separate it from those effects.

Since we cannot use the coefficient on γ_k to identify the exercise of market power, we focus on a subtler form of it. In accordance with the discussion above, we expect that the actual exercise of market power differ depending on the level of risk that the system faces. Which way should this effect go? If it is the case that crises act as a coordination (or collusion) device, banks may compete less aggressively when in danger. Thus, one would find that an increase in risk implies a higher rise in the Lerner index when the market is concentrated: the increase in rates would include both a higher risk premium and higher collusive prices. In other words, in more concentrated markets banks would transfer to their customers a higher share of the risk. To capture this effect, we include an interaction between risk and *HHI* on the right-hand side of the regression:

$$\ln L_{jkt} = a + b * \ln HHI_{jt} + c * \ln \gamma_{jkt} + \\ + d * \left(\ln HHI_{jt} * \ln \gamma_{jkt}\right) + \\ + e * Others_t + fe_k. \quad (2)$$

A positive coefficient on the interaction term is then indication of an increase in the exercise of market power when risk is high.

4. Data

The estimations in this paper use monthly data from May 1997 through December 2006. This information was provided by the *Superintendencia Financiera de Colombia* (*Superfinanciera)*, the Colombian agency in charge of banking supervision and regulation.

Concentration and quality of portfolio were built based on the monthly balance sheet and income and expenses information reported by the banks to the *Superfinanciera*. This data includes information for the entire banking system, i.e., banks, saving corporations, financial corporations and commercial financial companies.

Our analysis focuses on commercial and consumption loans, and only those administered by banks and CAVs[3]. There are other relevant institutions in the financial market, namely financial cooperatives – essentially leasing and niche specialized institutions, and commercial financial companies –devoted

[1] Strictly speaking, in the construction of the Lerner index we ignore the fact that banks products typically are differentiated. Data on products by banks are unavailable at the time in Colombia. We thus, work under the implicit assumption that banks do offer different products, but they decide jointly about them.

[2] Note that if all banks are assumed to be risk averse, then one can hardly argue that a risk-averse bank is unable to survive banking competition.

[3] We follow the classification by type of portfolio that appears in the balance sheet: commercial, consumption and mortgage. By regulation, banks report microcredits separately starting in 2002.

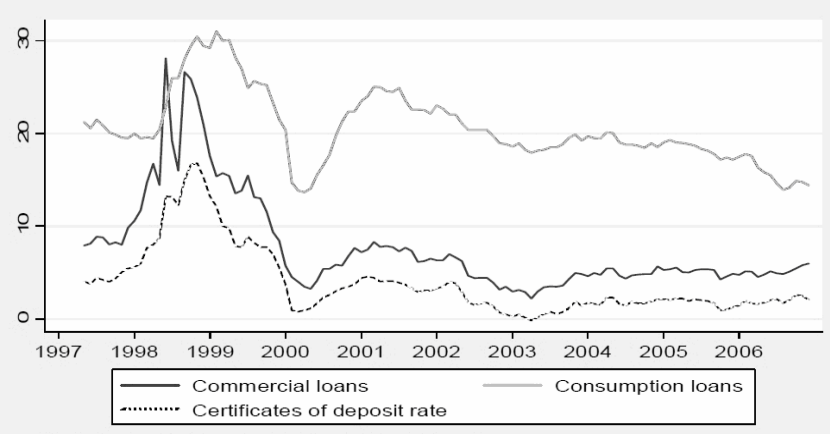
mainly to investment banking. We exclude them because their interest rate data is not available for the whole sample, but in any case their share of the market is small when compared with banks and CAVS. For example, banks held 95.7% of the commercial loans portfolio and 92% of the consumption loans portfolio in December 2006.

S*uperfinanciera* also provided us with interest rates on loan disbursements and deposits by bank and type of credit, so our Lerner index is calculated directly from actual marginal costs, rather than implicit average rates. The amount that each bank lent or received at any given interest rate on a particular month is also available, so we are able to calculate a weighted average of the rates when necessary. Our deposit interest rate is then a weighted average of fixed-term certificates of deposit. The reported interest rate by financial conglomerate is a weighted average of the interest rates of the banks in the conglomerate.

We include the industrial production index as a proxy of the level of economic activity. It is constructed every month from a sample of manufacturing companies in Colombia by the *Departamento Administrativo Nacional de Estadística (DANE*), the national statistics department.

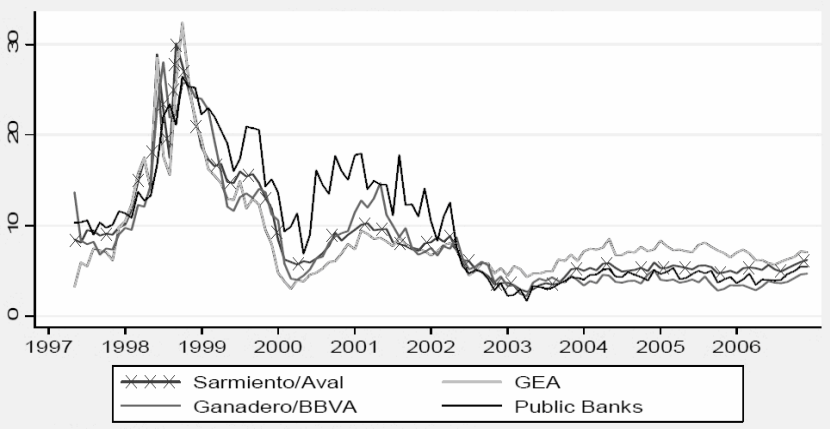
Finally, the history of mergers, acquisitions and bankruptcies was built using data from *Superfinanciera*, the banks' websites and the magazine *Dinero*.

4.1. Interest rate evolution. Figure 4 shows the evolution of both deposit and lending interest rates. Colombia passed from a period of very high interest rates to one of lower, less volatile rates around 2001. Figure 4 and Figure 5 show the evolution of the consumption and commercial interest rates for the three main financial conglomerates and the public banks. The level and evolution are, of course, similar to those shown in Figure 4. Overall, dispersion does not seem particularly large, with the exception of specific periods. The higher rates charged and paid by public banks during the crisis are not necessarily explained by particularities in their pricing behavior. Rather, non-random intervention by the government could be the explanation: banks with liquidity problems were more likely to be intervened and also to charge and pay higher interest rates.



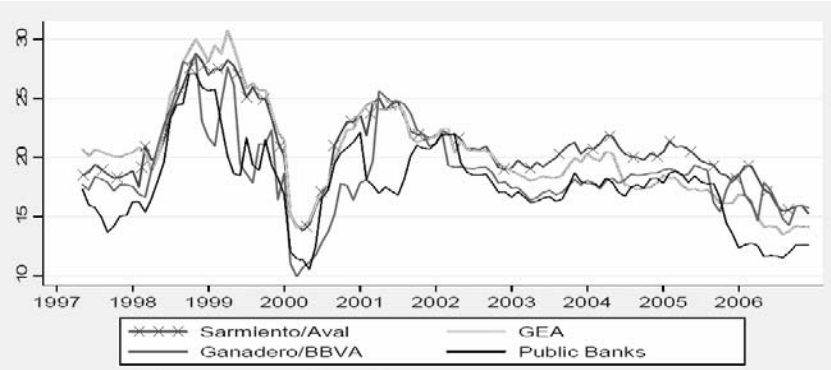
Source: Superintendencia Financiera (own calculations).

Fig. 4. Real interest rates



Source: Superintendencia Financiera (own calculations).

Fig. 5. Commercial lending rates



Source: Superintendencia Financiera (own calculations).

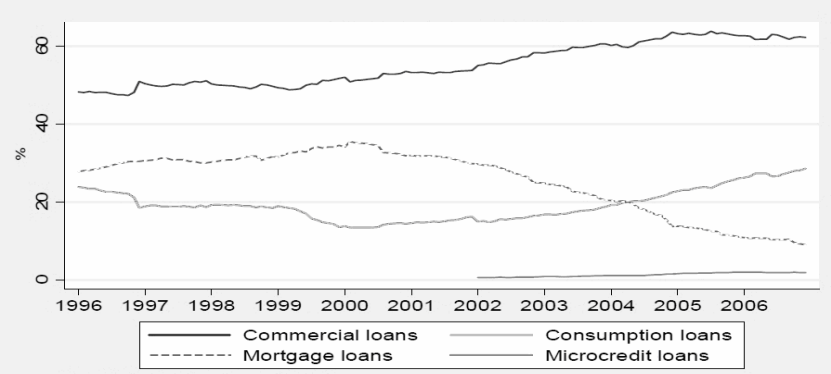
Fig. 6. Consumption lending rates

5. Results and analysis

We report our results first by bank and then by financial group. Figure 7 shows the share of each type of credit in total loans. Two things stand out: (1) commercial loans are the most important type of credit in the Colombian banking system; and (2) the effect of the late 1990s recession shows strongly in mortgage loans – as one might expect from the change in their regulation and the rapid increase in their risk.

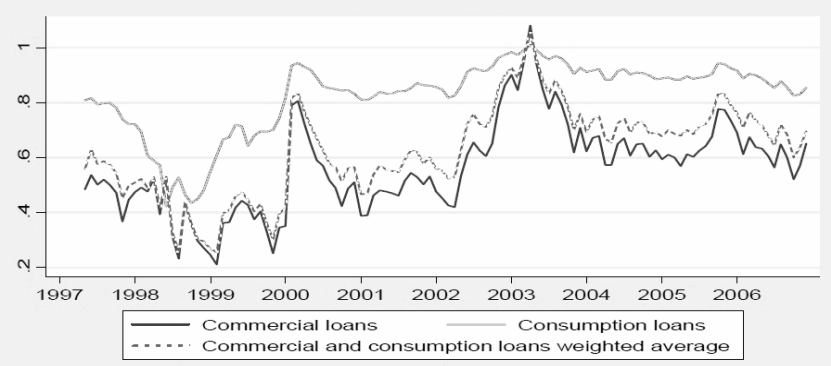
The evolution of the Lerner index calculated using real interest rates is presented in Figure 8. Its level increased until 2003 and fell afterwards. Values above one in 2003 are due to negative real deposit rates in some months. For the aggregate system, this only happens in April 2003.

Colombia experienced a substantial reduction of the inflation rate throughout the sample period. For our regressions, we use a real Lerner index – the Lerner index based on real rather than nominal rates. The effect of this decrease in inflation on our measured market power can be seen by comparing Figure 8 (calculated with real rates) with Figure 9 (with nominal rates). Measured market power increases when inflation is low through a reduction in the real deposit rate, which is the denominator in the Lerner index. Since the intermediation margin is a difference in rates, the increase is apparent only if market power is measured with the real Lerner index.



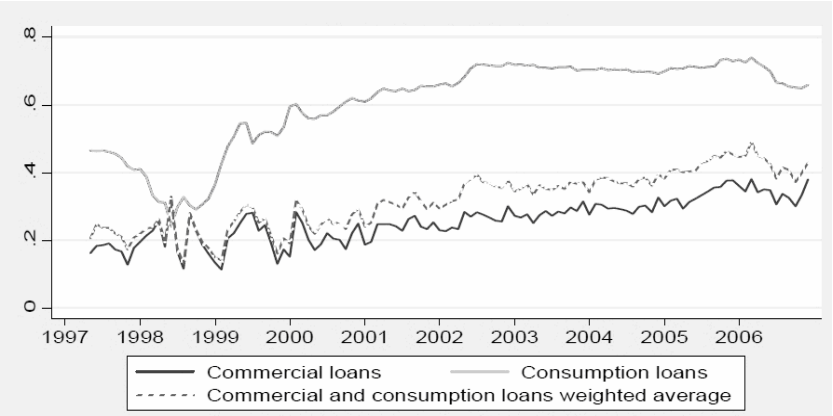
Source: Superintendencia Financiera (own calculations).

Fig. 7. Loans portfolio composition



Note: Real Lerner index.
Source: Superintendencia Financiera (own calculations).

Fig. 8. Market power



Note: Nominal Lerner index.
Source: Superintendencia Financiera (own calculations).

Fig. 9. Nominal market power

The results of the estimations following equation (1) and equation (2) by institution are reported in Table 1 (Columns 1 and 3 omit the interaction term between concentration and risk; all other columns include it). Beside the main variables of our model, all regressions include bank fixed effects, a trend, the logarithm of the industrial production index (IPI) and quarterly dummies that control for fluctuations in economic activity. The analysis in Columns 1 and 2 uses a HHI constructed using total assets. In Columns 3 and 4 the HHI is based on total loans excluding mortgages, in Column 5 on consumption loans, and in Column 6 on commercial loans.

Table 1. Lerner index determinants (by institution)

	1	2	3	4	5	6
Dep. var: Lerner index	Total loans+	Total loans+	Total loans+	Total loans+	Consumption loans	Commercial loans
HHI by:	Total assets	Total assets	Total loans+	Total loans+	Consumption loans	Commercial loans
Risk in:	Total loans+	Total loans+	Total loans+	Total loans+	Consumption loans	Commercial loans
ln(HHI)	-0.75	0.75	-0.222	1.701	1.705	0.065
	[0.094]***	[0.424]*	[0.090]**	[0.425]***	[0.489]***	[0.343]
ln(Risk)	0.007	-2.574	-0.013	-3.928	-3.769	-0.847
	[0.022]	[0.719]***	[0.024]	[0.811]***	[1.194]***	[0.531]
ln(HHI)*ln(Risk)		0.407		0.6	0.571	0.127
		[0.113]***		[0.124]***	[0.183]***	[0.081]
ln(IPI)	0.171	0.299	0.151	0.267	0.125	0.146
	[0.097]*	[0.093]***	[0.103]	[0.091]***	[0.077]	[0.139]
Trend	0.007	0.006	0.004	0.004	0.002	0.005
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.000]***	[0.001]***
Q2	0.031	0.026	0.029	0.026	-0.008	0.043
	[0.010]***	[0.010]**	[0.010]***	[0.010]**	[0.005]	[0.014]***
Q3	0.001	-0.008	-0.003	-0.009	-0.025	0.014
	[0.012]	[0.012]	[0.013]	[0.013]	[0.008]***	[0.015]
Q4	-0.044	-0.055	-0.049	-0.056	-0.039	-0.033
	[0.018]**	[0.017]***	[0.019]**	[0.018]***	[0.009]***	[0.021]
Constant	1.977	-8.103	-1.09	-14.245	-12.202	-2.219
	[0.602]***	[2.785]***	[0.711]	[2.840]***	[3.130]***	[2.379]
R2	0.517	0.527	0.501	0.524	0.561	0.421
Number of observations	2837	2837	2837	2837	2674	2789

Notes: Standard errors in brackets. * Significant at the 10% level, ** at the 5% level, *** at the 1% level. +Only includes commercial and consumption loans
Source: Superfinanciera (own calculations).

The results without the interaction term are counter-intuitive. Risk has no statistically significant effect on mark-ups. This result is surprising. Since our Lerner index is not risk adjusted, risk premiums should increase it, even if banks are competitive, unless either (1) the loan demand elasticity or the savings offer elasticity is very large, or (2) banks ration credit when risk is high, so that only very safe

loans are assigned for which the risk premiums are actually lower. The first explanation would imply that risk is always irrelevant for our Lerner index. The second would imply that risk may have a positive or a negative effect on the Lerner index, depending on the extent of credit rationing.

When the interaction term is included risk becomes relevant with a negative sign. This result suggests extensive credit rationing. But something else happens as well: the increases in concentration imply now increases in market power, regardless of the way risk is measured. This is in line with the theoretical predictions. While the coefficients of both concentration and the interaction term are positive in the last four columns, the coefficient of the interaction is statistically significant only in the aggregate market and in the consumption market. What about the market for commercial loans? The results there are not altogether surprising: companies have better access to external credit than consumers.

Next we repeat the exercise, but this time we aggregate the balance-sheet data by financial conglomerates – that is, we treat all banks in a conglomerate as a single institution able to make joint or closely coordinated decisions. The evolution of the corresponding Lerner index, shown in Figure 10, is similar to that in Figure 8. The trend is similar, although the levels of mark-ups of the financial conglomerates are slightly higher than those of the aggregate market.

Table 2 reports the results of the model estimations by financial conglomerates: the assets and loans of all banks belonging to the same conglomerate were added as if it were a single institution. Otherwise, the Table is organized in the same way as Table 1. This time, however, we include fixed effects only for the conglomerates; banks that do not belong to a conglomerate have no associated dummy. For conglomerates the effect of the latter on market power is non-negative, regardless of the inclusion of an interaction between risk and concentration. If the interaction is included, the coefficient on the concentration measure is always positive and statistically significant. The coefficient on risk stills suggests strong credit rationing when risk is higher. Finally, the coefficient on the interaction term is always positive and significant regardless of the market.

Table 2. Lerner index determinants (by financial conglomerate)

	1	2	3	4	5	6
Dep. var: Lerner index	Total loans+	Total loans+	Total loans+	Total loans+	Consumption loans	Commercial loans
HHI by:	Total assets	Total assets	Total loans+	Total loans+	Consumption loans	Commercial loans
Risk in:	Total loans+	Total loans+	Total loans+	Total loans+	Consumption loans	Commercial loans
ln(HHI)	0.343	1.105	-0.09	0.913	0.98	0.356
	[0.139]**	[0.280]***	[0.154]	[0.312]***	[0.256]***	[0.263]
ln(Risk)	0.106	-1.955	0.113	-2.481	-2.502	-1.225
	[0.031]***	[0.594]***	[0.031]***	[0.641]***	[0.740]***	[0.373]***
ln(HHI)*ln(Risk)		0.289		0.365	0.358	0.178
		[0.081]***		[0.088]***	[0.106]***	[0.053]***
ln(IPI)	0.59	0.531	0.295	0.281	0.025	0.116
	[0.160]***	[0.160]***	[0.157]*	[0.145]*	[0.077]	[0.200]
Trend	0.003	0.004	0.006	0.007	0.003	0.006
	[0.001]**	[0.001]***	[0.001]***	[0.001]***	[0.000]***	[0.001]***
Q2	0.004	0.011	0.018	0.024	-0.009	0.047
	[0.014]	[0.014]	[0.014]	[0.014]	[0.006]	[0.019]**
Q3	-0.054	-0.044	-0.026	-0.019	-0.02	0.001
	[0.016]***	[0.016]**	[0.017]	[0.017]	[0.008]**	[0.021]
Q4	-0.109	-0.101	-0.077	-0.071	-0.037	-0.051
	[0.027]***	[0.027]***	[0.026]***	[0.025]***	[0.011]***	[0.029]*
Constant	-5.557	-10.772	-1.271	-8.391	-7.438	-3.909
	[1.071]***	[1.884]***	[1.223]	[2.176]***	[1.755]***	[2.098]*
R2	0.305	0.323	0.301	0.325	0.423	0.199
Number of observations	2203	2203	2203	2203	2041	2184

Note: Standard errors in brackets. * Significant at the 10% level, ** at the 5% level, *** at the 1% level. +Only includes commercial and consumption loans
Source: Superfinanciera (own calculations).

To summarize, we identify three effects. First, there is a direct positive effect of concentration on the Lerner index as shown by the HHI coefficient. This may be a sign that higher concentration leads to the exercise of market power, or that mergers occur when for external reasons risk premiums are high.

However, we are explicitly controlling for risk in the regression, so either those mergers are undertaken to achieve medium-term cost reductions (i.e., their benefits are to come later), or they are undertaken to be able to raise mark-ups quickly (that is, their benefit comes from the extra market power), or both.

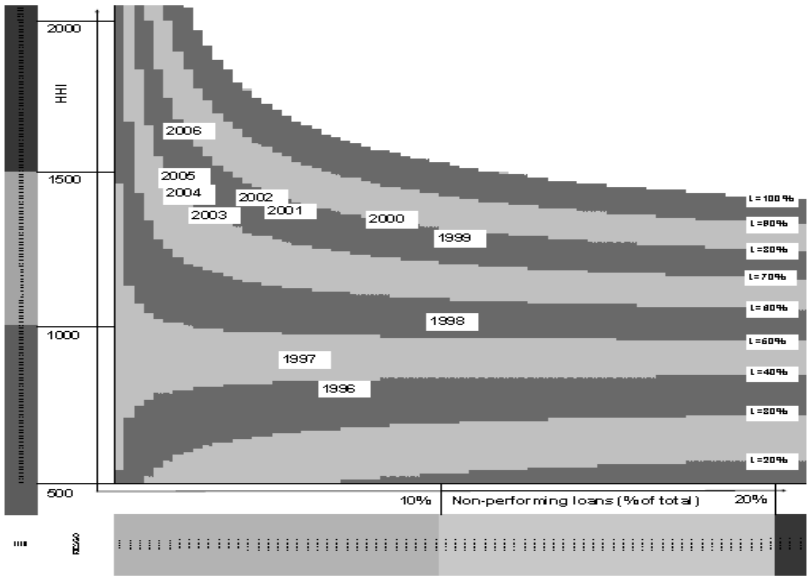
The second effect is that the Lerner index falls when risk increases, which is consistent with strong credit rationing in the market. Finally, an increase in concentration allows for a stronger transmission of risk to the Lerner index. This last result suggests that our hypothesis that risk acts as a collusion device for banks is correct.

The results change depending on whether one considers banks individually or aggregated by conglomerate. All three effects discussed above increase their magnitude and become statistically significant when one considers financial conglomerates. For total loans (Columns 3 and 4 in both Tables), all three effects on mark-ups are much smaller in magnitude but still very strong. This is driven by consumption loans, which show a similar pattern. Market power is less evident for commercial loans, suggesting that firms shop more for good credit conditions, so that any exercise of market power in commercial loans requires more control of the market.

For the subsequent analyses in this Section we use the results of Column 4 in Table 2[1]. Our results state that the elasticity of the Lerner index with respect to concentration depends on the level of risk. Figure 11 shows iso-Lerner curves, that is, different combinations of concentration and risk consistent with constant levels of market power. This is a phase space graph: each point corresponds to a possible state of the financial system. The measure of concentration (HHI, on the y-axis) is based on total loans. The risk measure, on the x-axis, is the percentage of non-performing loans. The small squares at the right of the graph show the exercise of market power in the corresponding level curve. For instance, L = 35% indicates the curve where the Lerner index is 0.35. Finally, the boxes with years mark the observed concentration – risk combination in the banking system in each December[2].

To read the graph, consider the effects on mark-ups of a given increase in risk – a horizontal movement to the right, like the onset of an economic downturn. At low levels of concentration, this movement will cause the system to cross few iso-Lerner curves: the exercise of market power does not increase much. At high levels of concentration, in contrast, the increase in mark-ups is larger. Alternatively, consider a vertical move upwards – an increase in market concentration at a given level of risk, like a merger. If current risk is low, the merger won't affect mark-ups by much. However, if risk is high, it will lead to larger increases in the Lerner index.

In summary, Figure 11 suggests that in periods with high risk (as observed in late 1990s and early 2000s in Colombia), a merger would have stronger effects on the Lerner index. On the contrary, in boom periods, with low financial risk, a merger would have lower effects on market power.



Note: Each change of shade marks an iso-Lerner level curve. The value of the Lerner index on each level curve appears on the right of the graph. The boxes with year values indicate the position of the Colombian financial system each December from 1996 through 2006. There are two clear stages: the crisis (1996-1999) and recovery (2000-2006).

Fig. 11. Iso-Lerner curves in risk-concentration space

[1] We choose to focus on total loans, not on assets because the former seem a better indicator on the firms' activity.
[2] Curves are calculated based on the estimates of equation (2). Given that only risk and concentration vary, the rest of variables included are evaluated at their simple average, and are therefore constant.

Conclusions

This paper relates market power with concentration and risk in the financial sector. Using Colombian data we identify three effects. First, a direct positive effect of concentration on the Lerner index, which may be a sign that higher concentration leads to the exercise of market power, or that mergers occur when for external reasons risk premiums are high. Since we are explicitly controlling for risk in the regression, either those mergers are undertaken to achieve medium-term cost reductions that we cannot account for with our empirical specification, or they are undertaken to achieve extra market power, or maybe both.

The second effect is that the Lerner index falls when risk increases, which is consistent with credit rationing in the market. The third effect is that an increase in concentration allows for a stronger transmission of risk to the Lerner index (i.e., to the customers). This last result suggests that risk is an important element to include when examining the link between concentration and market power in the financial system: it seems to act as a collusion device for banks in recent Colombian history. When risk is high firms do transfer a larger share of risk to customers through higher risk premiums. Thus, while high concentration is not enough to have collusion, the true effects of high market concentration on interest rates' mark-ups emerge when the system is under stress.

Why would the banks be more able to transfer risk to customers when risk levels are high? A possible interpretation is that, in good times with strong business, banks compete for borrowers and collusion is hard to maintain. In a recession or a crisis, the increased vulnerability of the system leads banks to fear a run on them started by a bank going bankrupt. Therefore, a financial crisis reduces the incentives to compete in the sector and acts instead as a coordinating signal for cooperation.

When considering banks individually, all three estimated effects are very large – except for commercial loans, where they don't seem important. If the banks that belong to a financial conglomerate are treated as a single institution, all three effects on mark-ups become smaller in magnitude but are still very strong. Moreover, a similar pattern of results appear for commercial loans. This suggests that any exercise of market power in commercial loans requires more control of the market.

Ultimately, the discussion here is not really about the level of market power in itself, but about the circumstances under which banks do exercise their market power. The theory suggests that the ability to exercise market power increases with concentration. Whether firms do it or not remains an empirical issue. Our results suggest that in the past, under bad macroeconomic conditions, the Colombian banks have exercised such market power.

Our results have at least two important implications for bank regulation. First, suppose a merger is proposed in the sector that needs the approval of a regulatory institution. Suppose moreover that risk is low. An *ex ante* assessment of the effect of the merger is then likely to understate its effects on consumers if it does not consider the hypothetical scenario of an increase in risk. A merger that looks convenient in boom times might be, from a social point of view, counterproductive in periods of crisis. This makes the requirements for approval more stringent.

A second implication is more favorable to mergers: if banks argue convincingly that risk will fall with a merger, even a significant increase in concentration might lead to negligible increases in market power.

We use for our analysis non-performing loans – a standard risk measure. However, the exact risk measure adequate for a specific analysis may vary. The analysis may call for instance for an industry or country-level measure instead of a firm-level one. This paper proposes a type of analysis rather than a specific way to carry it out, and shows how this analysis was relevant for the Colombian banking sector in recent years. Further research should explore the role of risk as a collusion signal in other contexts and using different risk and concentration measures.

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