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Abstract

This paper analyzes the evolution of competition in the Mexican banking system in the period 1993-2005, a period of deregulation, liberalization and consolidation of the sector. For this purpose we use two indicators of competition from the theory of industrial organization (the Lerner index and the Panzar and Rosse's *H*-statistic). The empirical evidence does not permit us to reject the existence of monopolistic competition. The Lerner index shows a decrease in competitive rivalry in the deposit market and an increase in the loan market, a cross subsidization strategy being observed. The results obtained call into question the effectiveness of the measures implemented hitherto, aimed at increasing the competition of the Mexican banking system.

Key words: banking, competition, deregulation JEL: G21, L10

1. Introduction

In recent years the Mexican banking system has undergone major changes, such as its nationalization in 1982, privatization in 1991, the financial crisis of December 1994 and its gradual opening-up to foreign investment, beginning in 1994. It was not until December 1998 that the restrictions on banking activity were completely lifted.

In this context, several studies have analyzed the effect on the Mexican banking system of the events occurring during this period. Thus, in the case of privatization, Unal and Navarro (1999) show that the Mexican government was very careful to ensure due process and transparency through the entire bank privatization process. However, the lack of a legal and regulatory framework and lax oversight shadowed the success of the technical process. Haber (2005) analyzes the privatization of the banking system and argues that the government's objective was to privatize an oligopolistic banking industry and maximize its revenue.

In relation to the opening-up of the Mexican banking market to foreign capital, and with the sole exception of Haber $(2005)^1$, the literature on emerging countries does not show any conclusive results. On the one hand, authors such as Levine (1996), Demirgüç-Kunt *et al.* (1998) and Claessens *et al.* (2000) offer arguments and evidence favorable to opening-up, while other authors (such as Kaminsky and Reinhart, 1999) show arguments against.

The events described above can affect the degree of competition in the Mexican banking markets, and consequently the country's economic development. In this respect, the analysis of competition in the banking sector is important, since the exercise of market power brings with it a social inefficiency that translates into a loss of social welfare (the so-called Harberger triangle), an increase in financial intermediation costs, and consequently slower growth of investment and production.

Conscious of the importance of the analysis of banking competition, other studies have focused on the analysis of the effect of the events described on the evolution of competition in the specific case of the Mexican banking system. Thus, Gruben and McComb (2003) estimate an index of market power with aggregate data and identify a change in competitive behavior due to privatization. The results obtained by the authors suggest bank behavior that is consistent with competition before the privatization but with "supercompetition" after privatization in which banks run at levels of output where marginal costs exceed marginal revenues. Dueñas (2003) measures competition and banking profitability in Mexico following the entry of foreign capital (Jan97-Sept02), using the Panzar and Rosse *H*-statistic. Their results indicate deterioration in competition in the banking system and a corresponding increase in the profitability of financial institutions as a result of the opening-up to foreign banks. Finally, Solís and Maudos (2008) estimate the social costs of market power

¹ Haber (2005) analyzes the effects of foreign banks entering the Mexican market.

(Harberger's triangle) in the Mexican banking system over the period 1993-2005. It also tests the so-called "quiet life" hypothesis which postulates a negative effect of market power on bank management efficiency. Their results show that the social cost attributable to market power in 2005 is 0.15% of GDP, while that deriving from the cost (profit) inefficiency of banking management is 0.021% (0.075%) of GDP. The results allow the authors to reject the quiet life hypothesis in the deposits market, whereas market power in the setting of the interest rate on loans has a negative effect on cost efficiency.

In the field of measurement of banking competition, other studies referring to emerging countries include Mexico in their samples. Thus, Gelos and Roldós (2004) find that their results are compatible with the existence of monopolistic competition in the period from 1994 to 1999, and that there was no change in the competition following the process of consolidation².

In this context, the objective of the paper is to measure the degree of competition in the Mexican banking system in the period between 1993 and 2005, a longer period than that analyzed in previous studies and one that covers the processes of deregulation, liberalization and consolidation of the sector. For this we use two indicators taken from the so-called new empirical industrial organization: the Lerner index and the *H*-statistic.

In relation to other studies referring to the Mexican banking system, the novelties of this study are as follows. Firstly, the Lerner index is used to measure the evolution of market power. The advantage of using it is that it permits the evolution of competition to be analyzed annually, and allows market power to be measured separately for the loans and deposits markets. Secondly, the analysis covers a period long enough to be able to observe whether the measures adopted (both privatization and opening-up to foreign investment) increased competition in the Mexican banking system. It has to be taken into account that studies carried out before now have analyzed only the consequences of privatization (Gruben and McComb, 2003) or the opening-up to foreign investment (Dueñas, 2003). And thirdly, banking competition is analyzed using two indicators (the *H*-statistic of Panzar and Rosse, and the Lerner index). Additionally, our paper is one of the few applications which analyzes developing countries in depth.

The results obtained permit us to conclude that the measures adopted and the transformations experienced by the Mexican banking system during recent years have not in general translated into greater competitive rivalry. Specifically, the results indicate that once the sale of the commercial banks to the private sector had been completed, the intensity of competition increased. Subsequently, the exchange rate crisis had an adverse effect on inflation and on interest rates, inducing an increase in

 $^{^{2}}$ However, this result is not robust as it uses 1997 as the start of the second sub-period and considers an unscaled revenue equation, since for these cases a decline in competition is found.

market power in loans and deposits. Finally, once the restrictions on the entry of foreign capital had been completely eliminated in 1998, and as a competitive response of the Mexican banking sector to the credit crisis in a context of high risk aversion, market power increased in deposits, while it decreased in the loans market, consolidating the following of a cross subsidization strategy. Consequently, it is possible that part of the recent growth of the profitability levels of the Mexican banking system is due to a decrease in competitive rivalry in the banking markets, which would permit us to call into question the efficacy of the measures so far implemented.

Given the current international crisis that started in the summer of 2007 in the USA (the subprime crisis), we believe it is important to draw lessons from the Mexican banking sector's past response to the crisis of the mid-nineties and its implications. To this end, we analyze the reaction of relative banking margins and the evolution of bank competition in loan and deposit markets.

Although there are significant differences between the current financial turmoil and the credit crisis suffered in Mexico in the mid nineties, some interesting conclusions can be drawn from the Mexican case analyzed in the paper. Our results suggest that in response to the crisis, the configuration of the banking sector is focused on capturing deposits which are invested in the money market. The low spreads in the loan markets seems to indicate that the loan activity is reduced, possibly as banks' risk adverse response to the tequila crisis. In this sense, given the context of the present situation of world financial markets characterized by increasing bad loans and solvency problems, the Mexican experience is useful to analyze the competitive response of banks to a credit crisis.

The structure of the rest of the paper is as follows. Section 2 describes the recent evolution of the Mexican banking system. Section 3 details the instruments used to measure banking competition. Section 4 specifies the variables and sample used, and presents the empirical results. Finally, section 5 presents the conclusions.

2. The evolution of the Mexican banking system

The Mexican commercial banking system was nationalized in 1982 in the context of a macroeconomic crisis. Fifty eight banks were nationalized, and only eighteen of these remained in 1990, when the process of privatization began. Specifically, privatization began with the reform of articles 28 and 123 of the constitution, so that the private sector once more had the possibility of participating in banking activities. The government sold its 18 banks in 14 months (June 91-July 92) at a high price compared to their book value (ratio: 3.49)³.

³ A detailed description of the process of privatization of the Mexican banking system can be found in Gruben and McComb (1997 and 2003) and Haber (2005).

López de Silanes and Zamarripa (1995) suggest that private financial groups paid high prices because they expected limited competition among banks. At that time the entry of foreign capital was not permitted. Haber (2005) defends another position, arguing that although bankers faced a risk of expropriation (since previously the government had already expropriated the banks) they accepted that price because much of the money that they risked was not their own, but came from Mexican small investors, commercial paper, foreign banks, other Mexican banks and in some cases the same bank that had been purchased.

With the privatization of the banking system, the public deficit was reduced, and with it the funding requirements of the public sector, enabling more resources of the banking system to be devoted to financing the private sector. Total loans to the private sector thus increased after the privatization and decreased following the crisis.

Throughout 1994 and particularly at the start of 1995, macroeconomic conditions deteriorated. Foreign investment, in particular portfolio investment, decreased, which given the high level of deficit of the balance of payments, occasioned the devaluation of the exchange rate. This collapse caused two problems in the Mexican banking system: on the one hand, since loans in dollars represented approximately a third of the total loans made by Mexican banks and many of them were taken out by firms without dollar revenue, the non-performing loans grew 156% in a single year, representing approximately 15% of the total loan portfolio (Source: *Asociación de Banqueros Mexicanos*). The peso value of their debts nearly doubled in a few days once the exchange rate was allowed to float; in addition, foreign investors pulled their funds out of Mexico. Consequently the banks became insolvent, so the financial authorities of Mexico had to implement various programmes to prevent a banking crisis⁴.

One of the programmes implemented was the Temporary Capitalization Programme (PROCAPTE) aimed at guaranteeing in the Mexican banking system indices of capitalization of at least 8 per cent of assets with risk. The banks with a level of capitalization below the limit established issued convertible debentures that were acquired by the Fund for the Protection of Bank Savings (known by its Spanish acronym FOBAPROA, created in 1990). A special dollar credit window was also implemented since the majority of the banks had problems for the renewal of their credits in foreign currency.

Additionally, the programme of capitalization with purchase of portfolio was implemented for the following entities: BBV, Banca Serfín, Bancomer, Banamex, Banco del Atlántico, Banca Bital, Banca Promex, Bancrecer, Banorte, Banco Confía and Banco Mexicano.

⁴ Haber (2005) points out that many of the Mexican banks already had problems before the crisis. The reason is that in Mexico institutions and property rights were weak.

Also, the commercial banks' portfolio of credits was restructured into Investment Units (UDIs). This unit of account reflects the behavior of the consumer price index, so the amount of the credits denominated in the new currency remains constant in real terms. In this way, the banks transferred the credits that could be converted into UDIs to funds that they themselves managed. These funds, thanks to the loans granted by the government, converted the credits to the new currency; thus the government assumed the interest rate risk, while the banks retained only the risk of default. In exchange, the commercial banks took up bonds issued by the government⁵.

The National Banking and Securities Commission (known by its Spanish acronym CNBV), through FOBAPROA, intervened in some banks with solvency problems and capitalized them; in others it only cleaned the bank's balance sheets of non-performing loans⁶. The total cost to the taxpayer associated with the bailout programs was 19.3 % of the Gross Domestic Product (GDP).

For a long time the Mexican banking system was protected from foreign competition. With the signing of the North American Free Trade Agreement (NAFTA), a gradual opening-up to foreign investment was established. Foreign banks could not buy Mexican banks whose market share exceeded 1.5%. Moreover, the total participation of foreign banks had to be less than 8%, though this was gradually increased to a ceiling of 15%. Subsequently, the laws were modified in 1995 with the aim of increasing the limits of foreign participation established in the NAFTA. The individual limit rose from 1.5% to 6% and the final aggregate limit of 15% to 25% (Murillo, 2002).

In December 1998, the Mexican Congress approved modifications to allow the foreign investment in Mexican banks to reach 100%, thus permitting the largest banking institutions (Bancomer, Banamex and Serfin) to be acquired by foreign groups. As a consequence of the change in the rules, foreign investment entered the market, establishing new banks in Mexico or merging with Mexican banks. This led to foreign participation rising from 5.5% in 1993 to 52.4% in 1996 and 67.2% in 2000 (see Murillo, 2002). Also, there were other reforms in the financial sector⁷.

⁵ Other debtor support programmes are: Agreement for Immediate Support to Bank Debtors (ADE), Complementary Programme of Support for Mortgage Credits, Programme of Support for the Agriculture Livestock and Fisheries Sector (FINAPE), Programme of Support for Medium, Small and Micro Firms (FOYME) and the "Full Stop" Programme. See Murillo (2002) for more detail on the programmes for the reorganisation of the banking system.

⁶ The CNBV implemented three schemes for the sale of banks with financial problems: sale of branches of the bank in question to commercial banks; whole or part sale of the bank to commercial banks; and part sale of the intervened bank to commercial banks with the option for the latter to subsequently increase their shareholding.

⁷ In 1997 new accounting criteria and rules were implemented, relating mainly to the recognition of inflation in the financial statements of banks, very similar to international norms. In 1998, the Law on Protection of Bank Savings was passed, establishing the Institute for the Protection of Bank Savings (IPAB). New criteria were issued for calculating the capital requirements of financial institutions, consistent with international standards, as well as new accounting principles and rules relating to greater

The mergers and acquisitions caused an increase in market concentration, which had decreased following the privatization⁸ and the banking crisis. As can be observed in Figure 1, there is a downward trend from 1993 to 1996 and a subsequent increase from 1997 onwards. The participation of the three biggest banks (CR3) during 1993-2005 varies between 52 % and 62 %.

[Insert Figure 1 here]

In order to analyze the effect of the changes described above on the behavior of the Mexican banking system, it is of interest to analyze the evolution of costs, banking margins and profitability in the period analyzed. In the first case, the high personnel costs, and those necessary to endow the banks with advanced technology, heavily influence the increase in average operating costs from 1997 to 2000, although consolidation has translated into increased labor efficiency, with the number of staff being reduced by more than 10% between 1997 and 2000. Nevertheless, the increase in margins permitted the rise in average costs to be absorbed, thus improving operating efficiency (Figure 2).

[Insert Figure 2 here]

In the case of banking margins, the Mexican banking system is characterized by its high margins. In the years following privatization (or prior to the crisis of the peso), the Mexican commercial banks experienced a reduction in margins and an increase in non-performing loans, in spite of the fall in operating expenses (see Figure 2). The net effect of the evolution of margins and operating costs is a deterioration in profitability, reaching a negative value in 1996 (see Figure 3). Subsequently, an increase in margins is observed in 1998 due to the rise in the price of money (Figure 3).

[Insert Figure 3 here]

Once the banking system had recovered from the crisis, profitability showed an increasing trend, reaching a maximum value in 2005. This increase was due, firstly, to the increase in gross income as a consequence of the growth of fees and commissions

financial transparency of banking institutions. In 2000 the Law on Protection and Defence of Users of Financial Services and the Mexican Commercial Insolvency Law were passed, aimed at regulating the relationship between debtors and creditors, among others.

⁸ Mexico began to open its markets to new domestic entrants in 1993, and in 1995 the operation of 13 new foreign subsidiaries was authorized.

(from 1.1% to 2% of total assets)⁹, though financial revenue decreased from 2000 onwards, in part as a result of the low levels of lending (a slight reduction being observed in net interest income). At the end of the period analyzed (2004-2005), we continue to observe a tendency for the interest margin to increase, propitiated by a context of rising interest rates (see Figure 3). Second, the non-performing loans decreased considerably, reaching 5.8% and 1.8% of the total credit portfolio in 2000 and 2005, respectively.

The overall view of the recent behavior of the efficiency and the profitability of the Mexican banking system shows that gains in efficiency may have translated into extraordinary profits for the banks and not necessarily into benefits for the rest of the economy. As the Governor of the Bank of Mexico has affirmed¹⁰, this situation points to the existence of an uncompetitive banking system with high margins that prevents the economy from attaining the rates of growth that the gains in efficiency would have permitted. Consequently, it is of great importance to evaluate the intensity of competition in financial services.

3. The measurement of banking competition

The instruments for measuring banking competition can be classified into two groups. The first includes the use of structural indicators (market concentration) and the estimation of the well-known Structure-Conduct-Performance (SCP) vs. the efficient structure hypothesis. The second approach, known as New Economics of Empirical Industrial Organization, includes the *H*-statistic of Panzar and Rosse (1987) and the Lerner index of market power. Of the two groups of instruments, this paper focuses on the second, since they are indicators of competition derived from problems of banking optimization, and therefore present a solid theoretical basis.

3.1 Panzar and Rosse's H-Statistic

The essence of the Panzar and Rosse test is to analyze the elasticity of revenue to variations in the prices of the factors of production, by estimating a reduced revenue equation. Specifically, Panzar and Rosse (1987) show that the sum of the revenue elasticities of a firm, relative to the price of its inputs (habitually known as the *H*-*s*tatistic) provides an evaluation of the competitive structure of a market. It is important to point out that the validity of the test depends crucially on being in a situation of long

⁹ Net commissions have been a very important source of revenue in the commercial banking system, which have increased and are the second most important source of revenue after the net interest income margin. However, when Maudos and Solis (2009) estimate its economic impact, it is low. The net interest margin therefore has not decreased (unlike in developed countries), given that the effect of market power and of average operating costs predominate, causing the margin to continue with high levels compared to international standards.

¹⁰ The words of Dr. Guillermo Ortiz, Governor of the Bank of Mexico, at the 69th banking convention held in Acapulco, Gro., March 24th 2006.

⁽http://www.banxico.gob.mx/gPublicaciones/FSPublicaciones.html).

term equilibrium, where rates of return should not be correlated statistically with input prices.

Let *R* be the reduced form of a revenue function that depends on the price of inputs (w) and exogenous variables (z):

$$R = R(w, z) \tag{1}$$

The *H*- statistic is defined as:

$$H = \sum \frac{\partial R}{\partial w_i} \frac{w_i}{R_i}$$
(2)

Panzar and Rosse demonstrate that the *H*-statistic is non-positive for monopoly, collusive oligopoly or conjectural variation oligopoly; equal to unity for perfect competition; and between 0 and 1 for monopolistic competition.

In empirical applications, the rejection of the null hypothesis that $H\leq0$ eliminates the possibility that a monopoly exists. Rejection of the null hypothesis that $H\leq1$ implies rejection of the three models, while rejection of both hypotheses ($H\leq0$ and H=1, but not $H\leq1$) implies that only monopolistic competition is consistent with the data. As mentioned above, the validity of the test requires the condition of long term equilibrium. A simple way to test this condition is to replace the dependent variable by ROA in equation (3), so that if the sum of the elasticities of the inputs prices is not statistically different from zero the existence of long term equilibrium cannot be rejected.

One way of estimating the *H*-statistic is by using a log-linear regression of the revenue function, the dependent variable being the interest revenues¹¹:

$$\ln(R_{it}) = \alpha + \sum_{J=1}^{3} \beta_{j} \ln w_{it}^{J} + \sum_{k=1}^{3} \gamma_{j} \ln E_{it}^{k} + \varepsilon_{it}$$
(3)

for t=1,...,T, where *T* is the number of periods observed and i=1,...,I, where *I* is the total number of banks. Subscripts *i* and *t* refer therefore to bank *i* at time *t*. *R* denotes the interest revenues, *w* is the price of the factors of production (labour, lendable funds and physical capital), and E_{it}^{k} are bank-specific control variables. Specifically, E_{it}^{I} are the net loans as a proportion of total assets, E_{it}^{2} the deposits as a proportion of total assets and E_{itt}^{3} is the ratio of equity to total assets which captures the leverage reflecting differences in the risk preferences across banks.

This instrument for measuring competition is used in various studies: Nathan and Neave (1989) for the Canadian financial system; Molyneux et al. (1994) for 12 European countries; Shaffer (2002 and 2004) for a bank that has a monopoly in Kent County, Texas; and for four banks: two in Texas and two in Kentucky, respectively; Carbó et al. (2003a, b and c) use the test to measure competition in the Spanish banking

¹¹ Bikker, Spierdijk, and Finnie (2006) demonstrate that using the ratio of revenues to total assets as a dependent variable, instead of the unscaled bank revenues, overestimates the values of the *H*-statistics and, therefore, leads to an upward bias regarding the level of competition. In any case, robust results are obtained by using scaled revenues as the dependent variable in equation (3).

system; Gelos and Roldós (2004) for emerging countries from 1994 to 1999 (including Mexico); and Claessens and Laeven (2004) for 50 countries (including Mexico). For the case of Mexico, Dueñas (2003) uses the test for the period between Jan97 and Sep02.

3.2 Lerner Index

The model most widely used to calculate the Lerner index of market power in the specific case of banking firms is the Monti-Klein model. This model analyzes the behavior of a monopolistic bank that is facing a demand curve for loans with a negative slope $L(r_L)$ and a supply of deposits with a positive slope $D(r_D)$. The decision-making variables are the quantity of the loans (L) and the quantity of the deposits (D). These variables influence their interest rates (r_L and r_D , respectively) and their level of capital is taken as given. Another case considered in this model is that the bank is price –taker in the inter-bank market (r).

The profit of bank π is the sum of the intermediation margins of loans and deposits minus operating costs (*C*).

$$\pi = \pi(L, D) = (r_L - r)L + (r - r_D)D - C(D, L)$$
(4)

Given a value of the elasticities of the demand for loans ε_L and of the supply of deposits ε_D , the first order conditions of the problem of optimization are as follows:

$$\frac{r_{L}^{*} - r - mc_{L}}{r_{L}^{*}} = \frac{1}{\varepsilon_{L}(r_{L}^{*})}$$

$$\frac{r - r_{D}^{*} - mc_{D}}{r_{D}^{*}} = \frac{1}{\varepsilon_{D}(r_{D}^{*})}$$
(5)

Equations (5) are simply the adaptation to the banking sector of the equalities between the Lerner index (price minus marginal cost -mc- divided by the price) and the inverse elasticity. We observe that the lower the elasticity the greater the intermediation margin, i.e. the greater the Lerner index of market power.

As shown by Freixas and Rochet (1997), it is possible to reinterpret the Monti-Klein model as a model of imperfect competition (Cournot) among a finite number (N) of banks. In this case, the Cournot equilibrium of the banking sector is an N-tuple of vectors $(D_n^*, L_n^*)_{n=1,\dots,N}$, such that for every *n*, each bank maximizes its profit given the volume of deposits and of loans of the other banks:

$$\max_{D_n,L_n} \left[r_L \left(L_n + \sum_{m \neq n} L_m \right) - r \right] L_n + \left[r - r_D \left(D_n + \sum_{m \neq n} D_m \right) \right] D_n - C \left(D_n, L_n \right)$$
(6)

so that there is a single equilibrium where each bank sets $L_n = \frac{L}{n}$ and $D_n = \frac{D}{n}$.

From the first order conditions of the optimization problem (6) we obtain:

$$\frac{\left[r_{L}^{*}-r-mc_{L}\right]}{r_{L}^{*}} = \frac{1}{N\varepsilon_{L}(r_{L}^{*})} \qquad \qquad \frac{\left[r-r_{D}^{*}-mc_{D}\right]}{r_{D}^{*}} = \frac{1}{N\varepsilon_{D}(r_{D}^{*})} \qquad (7)$$

When N=1, it represents the case of a monopoly and when N= ∞ it is perfect competition.

The estimation of the Lerner index has been applied, among others, in the studies by Angelini and Cetorelli (2003) for the Italian banking sector; Maudos and Pérez (2003) and Carbó *et al.* (2003a and b, and 2009) for the Spanish banking sector; Fernández de Guevara *et al.* (2005) for the case of five European countries; and Maudos and Fernández de Guevara (2007) for 15 European countries.

4. Empirical approach and results

4.1 Variables, sample and empirical approach

The sample used is formed by an unbalanced panel data from 303 annual observations corresponding to 47 commercial banks for the period between 1993 and 2005, which represent an average 94% of the total assets of the Mexican commercial banking system during the period of study¹². The data is obtained from the Statistical Bulletin of the Multiple Banking system of the National Banking and Securities Commission and from the Basic Banking Information System of the Bank of Mexico.

Given the unavailability of information on interest rates at bank level, these are estimated as the ratio of financial revenues (costs) to the volume of loans (deposits). Thus the problems of availability of data oblige us to work with average interest rates instead of marginal rates.

The variables used in the estimation of the *H*-statistic and the Lerner index are as follows (see descriptive statistics in table 1):

- a) Interest revenues and total revenues (dependent variable in equation 3).
- b) Price of labour (w_I) , obtained as the ratio of personnel expenditure to the number of workers.
- c) Price of lendable funds (w_2) , proxied as the ratio of financial costs to deposits.
- d) Price of physical capital (w_3) , proxied as the ratio of operating expenses other than personnel costs to fixed assets.
- e) Interest rate on loans (r_L) , calculated as the ratio of financial revenue to the value of loans.
- f) Interest rate on deposits (r_D) , calculated as the ratio of financial costs to the volume of deposits. Observe that by construction r_D is equal to the price of lendable funds w_2 .

¹² Observations whose information is of doubtful reliability, and banks that did not report information for some of the variables necessary for estimating the indicators of competition, were eliminated from the sample.

g) Money market interest rate (r), calculated as the annual average of the inter-bank interest rate (TIIE) at 28 days¹³.

[Insert Table 1 here]

Given the availability of a panel data, the estimation of revenue function (3) includes individual fixed effects in order to capture the influence of specific variables of each bank and time effects that capture the influence of factors common to all the banks and specific to the different years of the period analyzed.

The Lerner index is estimated separately for loans and deposits, according to the left hand side of expressions (7). Likewise, marginal operating costs are estimated separately for loans and deposits on the basis of the estimation of a translogarithmic cost function:

$$\ln c_{ii} = \sum \gamma_{h} \ln w_{hit} + \gamma_{L} \ln L_{ii} + \gamma_{D} \ln D_{ii} + \frac{1}{2} \sum \sum \gamma_{hm} \ln w_{hit} \ln w_{mit} + \gamma_{LD} \ln L_{ii} \ln D_{ii} + \frac{1}{2} \gamma_{LL} (\ln L_{ii})^{2} + \frac{1}{2} \gamma_{DD} (\ln D_{ii})^{2} + \sum \gamma_{hL} \ln L_{ii} \ln w_{hit} + \sum \gamma_{hD} \ln D_{ii} \ln w_{hit} + \mu_{1}T + \frac{1}{2} \mu_{2}T^{2} + \mu_{L}T \ln L_{ii} + \mu_{D}T \ln D_{ii} + \sum \mu_{h}T \ln w_{hit} + u_{ii}$$
(8)

where c are the operating costs, w the prices of the two inputs (labor and capital), L the loans and D the deposits, T is a trend that captures the effect of technical progress. The restrictions of symmetry and grade one homogeneity in input prices are imposed in the estimation. As with the estimation of the revenue function, the estimation of the cost function includes individual fixed effects.

On the basis of the estimation of equation (8), marginal operating costs are calculated for loans and deposits for each bank and year of the period analyzed according to the following equations:

$$mc_{L_{it}} = \frac{\partial c_{it}}{\partial L_{it}} = \left[\gamma_L + \gamma_{LL} \ln L_{it} + \sum \gamma_{hL} \ln w_{hit} + \gamma_{LD} \ln D_{it} + \mu_L Trend \right] \frac{c_{it}}{L_{it}}$$
$$mc_{D_{it}} = \frac{\partial c_{it}}{\partial D_{it}} = \left[\gamma_D + \gamma_{DD} \ln D_{it} + \sum \gamma_{hD} \ln w_{hit} + \gamma_{LD} \ln L_{it} + \mu_D Trend \right] \frac{c_{it}}{D_{it}}$$
(9)

¹³ The results are robust if we use the annual average of the interest rate on Federation Treasury Certificates (CETES).

4.2 Results

4.2.1 Panzar and Rosse's H- Statistic

Table 2 shows the results of the estimation of the revenue function and the H-statistic. The value of the H-statistic (0.36) is statistically greater than zero and less than one at 1% significance, reflecting the existence of market power compatible with a situation of monopolistic competition. This result is consistent with that obtained by Dueñas (2003) for the period between 1997 and September 2002, Claessens and Laeven (2004) for the period 1994 to 2001 and Gelos and Roldós (2004) from 1994 to 1999.

[Insert Table 2 here]

As commented earlier, the validity of the test requires the existence of long term equilibrium. For this, following Molyneux *et al.* (1994) and Claessens and Laeven (2004), we re-estimate equation (3) replacing the dependent variable by the return on assets (ROA). As Table 2 shows, it is not possible to reject the hypothesis that the sum of the elasticities of ROA to the prices of inputs is equal to zero, so the condition of long term equilibrium is guaranteed. Nevertheless, since the period analyzed is a period of major transformations in the Mexican banking system, this "equilibrium" result does not mean that competitive conditions are not allowed to change, it only implies that changes in banking are taken as gradual (see De Bandt and Davis, 1999; and Drakos and Konstantinou, 2005)¹⁴.

4.2.2 Lerner Index

Figure 4 shows the evolution of the Lerner index and of its determining factors. In the case of the interest rates on loans and deposits, the evolution is in turn determined by the behavior of the inflation rate, with a steep rise until 1995 and a fall thereafter¹⁵. The spread between the interest rate on loans and the inter-bank interest rate (r_L-r) increases from 1993-95, decreases from 1996-98, and is practically nil from then onwards¹⁶. On the liabilities side, the spread $(r-r_D)$ is always positive and decreases in the sub-periods 1996-97 and 2000-03, as can be observed in Figure 4. The marginal

¹⁴ In addition, although the estimation shows that the condition is satisfied, it is difficult to assume that Mexico's banking sector is in the long term equilibrium for the whole period, taking into account all the event described in sections 1 and 2.

¹⁵ The evolution of asset and liability interest rates calculated with data at bank level using the information from the CNBV is similar to the aggregate interest rates reported by the Bank of Mexico [commercial paper weighted average interest rate and 2 month fixed term deposits opening rate (rate before tax)].

¹⁶ It is important to point out that r_L represents an average interest rate on loans. However, there may exist some financial products where this relationship does not hold. Unfortunately, it is not possible to make a more disaggregated study due to the lack of information.

operating cost of loans increased from 0.025 in 1993 to 0.032 in 2005, while the marginal operating cost of deposits decreased from 0.028 in 1993 to 0.026 in 2005.

[Insert Figure 4 here]

In the case of absolute margins (numerator of the Lerner index), the temporal evolution is very different in loans and in deposits. Thus, the absolute margin of loans is positive only in 1995 and 1996, grows from 1993 to 1995, decreases in the sub-period 1996-98, and remains relatively stable until the end of the period analyzed. The absolute margin on deposits, on the other hand, is always positive from 1994 onwards. Absolute margins, both on loans and on deposits, reach their maximum value in 1995 as a consequence of the high inflation rate in that year.

The decomposition in the period analyzed of the change in the absolute margin on loans into a spread with respect to the inter-bank interest rate (r_L-r) , minus the change in the marginal cost, indicates that the increase of 0.16 percentage points (p.p.) in the absolute margin is due to an increase in the spread of 0.85 p.p. and to an increase of 0.69 p.p. in the marginal cost. In the case of deposits, the spread $(r-r_D)$ increased 4.55 p.p. and the marginal cost fell 0.18 p.p. so the absolute margin increased 4.73 p.p. Consequently, the change in the absolute margin, in both loan and deposit markets, is due more to the change in the spread with respect to the inter-bank interest rates than to the change in marginal costs.

In terms of relative margins, market power increased in the deposits market while it decreased in that of loans. This conclusion arises from (Figure 4). In the subperiod 1993-97, the evolution of Lerner indices in the loans and deposits markets is similar, rising 1993-95 and falling until 1997. From that year onwards, the evolution is different for the two relevant markets. Thus, in deposits (loans), market power increases (decreases) until 1999 (2003) and then decreases until 2003. Finally, in both banking markets the Lerner index again rises from 2003 to 2005.

One notable feature is that, from 1997 to 2005, cross-subsidies exist in the services offered by Mexican banks, as they grant loans with very small and even negative margins with the aim of attracting or keeping clients, recuperating this loss by setting higher margins in the deposits market. This result is in line with those obtained by Carbó et al. (2005) and Maudos and Fernández de Guevara (2007) who find evidence of a loss-leader strategy in the European banking sectors. However, the strategy observed in these two papers is completely the opposite: market power in loans and low margins in deposits.

Following the privatization of the Mexican banking system in 1991 and 1992, it can be observed that market power is negative in the loan market as a consequence of the strong growth of bank credit, the loans/GDP ratio rising from 19.9% in 1991 to

32.8% in 1995, thus increasing credit risk¹⁷. Since the banks incurred high risks, the ratio of non-performing loans to total credit rose from 7.7% in 1995 to 11.3% in 1998.

After the crisis, there was a period of restructuring and beginning to consolidate the Mexican banking system (with gradual opening-up to foreign investment), producing a severe contraction of credit (the loans/GDP ratio fell from 27.6% in 1996 to 19.7% in 1999, and non-performing loans decreased to 8.9% of the total credit portfolio in 1999). In this period market power in loans was reduced. Finally, once restrictions on foreign investment were totally removed and the most important banks were acquired by foreign groups, market power in loans was reduced by 11.35% from 2000 to 2005.

It is important to point out that given the low and even nil margins with which banks operate in the loans market, it is logical that there should have occurred a decrease in the relative importance of financial revenue and an increase in activity with repos. Thus, the ratio of revenue from repos to financial revenue increased from 7.8% in 1993 to 27.8% in 2005.

In the case of deposits, the results show that the banks pay a very low premium for the capture of resources, obtaining a high differential over the inter-bank interest rate (see Figure 4). Furthermore, in the period analyzed, competition in the deposits market is observed to decrease¹⁸.

The evolution of the Lerner index shows that the changes undergone by the Mexican banking system in recent years have had diverse effects on market power. Thus, the results allow us to conclude that, once the sale of the commercial banks to the private sector had been completed, an increase in competition took place¹⁹. During the exchange rate crisis and the period of recuperation, the level of competition presents certain stability. Finally, once the restrictions on the entry of foreign capital were completely lifted and the main banking institutions were acquired by foreign groups, competitive rivalry decreased though with differential behavior in the markets for loans (where it decreased) and deposits (where it increased), perhaps as a consequence of the mergers of the principal banks. This result is consistent with the evidence presented by Dueñas (2003) who finds deterioration in competition and an increase in the profitability of Mexican financial institutions as a consequence of the opening-up of the banking sector to foreign banks.

The strategy of cross-subsidization between loans and deposits that can be seen in the evolution of the Lerner Index in the period 1997-2005, shows how bank margins reacted to the events which started in 1997 when governments allowed foreign banks to

¹⁷ Since the deposits were guaranteed by the FOBAPROA, the banks incurring a higher credit risk aggravating the problems of moral hazard.

¹⁸ The variations in the Lerner index for deposits can be explained to a greater extent by changes in margins relative to the inter-bank interest rate than by changes in marginal costs.

¹⁹ The fall in the Lerner index in the period following privatization is consistent with the supercompetition found by Gruben and McComb (2003) for the same period.

purchase controlling interests in restructured banks. The outcome of the "liberalization experiment" (in the words of Haber, 2005) was profitable and stabilized the banking sector, but it was risk averse and therefore reluctant to expand the loan activity. Several data support this result. First, loans reduced their importance in the balance sheet from 71.1% in 1997 to 51.3% in 2005²⁰ and both securities (from 14.1% to 18.3%) and interbank (6.8% to 10.3%) activities increased²¹. Second, non-interest income was very important in this period (32% of total net-income on average). Third, the solvency ratio increased from 13.6% in 1997 to 14.2% in 2003. And fourth, the non-performing loans ratio (as percent of total loans) decreased from 11.3% in 1997 to 1.8% in 2003. In parallel, the net provisions on loans (as % of loans) reduced from 2.4% in 1997 to a value of 1.5 in 2005.

In this context of risk aversion, banks refused to finance high-risk borrowers who were prepared to pay a higher interest rate. Consequently the low and even negative bank margins that the Mexican banking sector applied over this period are consistent with the risk of growth aversion pointed out by Harber (2005), which then had a negative effect on the growth of the real economy.

4.2.3 Robustness test

With the aim of testing the sensitivity of the results obtained, we analyze whether the inclusion of non-financial revenues (using therefore total revenues) affects the robustness of the results obtained so far in terms of financial revenues. To this end, we use total revenue as the dependent variable in equation (3) instead of financial revenues (Table 3). Results show that the *H*-statistic is statistically greater than zero and less than one, results compatible with the existence of monopolistic competition. It is not possible to reject the hypothesis that the sum of the ROA elasticities to the price of inputs is equal to zero, guaranteeing long term equilibriums.

[Insert Table 2 here]

5. Conclusions

The Mexican banking system has been subjected to major transformations as a consequence of the processes of nationalization (1982), privatization (1991), exchange rate crisis (December 1994), gradual opening-up to foreign investment (starting in 1994), and its consolidation from 2000 onwards with mergers among the principal banks.

²⁰ The National Banking and Securities Commission (CNBV).

 $^{^{21}}$ And the total (private) loans as % of GDP decreased from 21% (15%) in 1997 to 14% (11%) in 2003. See Haber (2005).

In this context of structural change, this paper analyzes the evolution of the degree of competition in the Mexican banking system from 1993 to 2005 using two instruments from the theory of industrial organization: the Panzar and Rosse *H*-statistic and the Lerner index of market power. Compared to other studies of the Mexican banking system, this one presents various novelties. Firstly, it uses the Lerner index to measure the evolution of market power. The advantage of using it is that it permits the evolution of competition to be analyzed with greater precision, and market power to be measured separately for the loans and deposits markets. Second, the analysis covers a long period, over which it can be observed whether the measures adopted (both privatization and the opening-up to foreign investment) have increased competition in the Mexican banking system. Previous studies have analyzed the consequences only of privatization (Gruben and McComb, 2003) or of the opening-up to foreign investment (Dueñas, 2003). And thirdly, banking competition is analyzed using two indicators (the *H*-statistic of Panzar and Rosse, and the Lerner index).

The empirical evidence offered by the *H*-statistic does not permit us to reject the existence of monopolistic competition, a result that is consistent with those of Dueñas (2003) for the period from January 1997 to September 2002, Claessens and Laeven (2004) for the period 1994 to 2001 and Gelos and Roldós (2004) from 1994 to 1999. Results are robust when total revenues are considered (including therefore financial and non-financial revenues).

The separate evolution of the Lerner index for each of the two banking markets analyzed shows that, from 1993 to 2005, market power decreased in the loans market while it increased in the deposits market. By sub-periods, with the crisis there occurred an increase in inflation and in interest rates, leading to greater market power both in loans and in deposits.

Following the crisis, there was a decrease in credit activity, asset margins being practically nil. On the other hand, in this period the banks worked with very high liability margins. From 1997 to 2005, there was cross-subsidization in the services offered by the Mexican banking system, granting loans with very small and even negative margins (with the aim of attracting or keeping clients), recuperating this loss by setting higher margins on deposits. Results show that the net effect of this cross subsidization strategy, together with the increase in activity with repos, was highly profitable for the banks, as shown by the fact that the levels of profitability (ROA) have increased substantially since 1998.

The results obtained permit us to conclude that the measures adopted and the transformations experienced by the Mexican banking system during recent years have not in general translated into greater competitive rivalry. Specifically, the results indicate that once the sale of the commercial banks to the private sector had been completed, the intensity of competition increased.

Subsequently, the exchange rate crisis had an adverse effect on inflation and on interest rates, inducing an increase in market power in loans and deposits. Finally, once the restrictions on the entry of foreign capital had been completely eliminated in 1998, market power increased in deposits, while it decreased in the loans market, consolidating the following of a cross subsidization strategy. Consequently, it is possible that part of the recent growth of the profitability levels of the Mexican banking system is due to a decrease in competitive rivalry in the banking markets, which would permit us to call into question the efficacy of the measures so far implemented.

The results relating to the period which started in 1997 with reforms designed to improve monitoring and recapitalize the banks (new accounting standards, increase in the capital requirements, reforms in the deposit insurance, removal of restrictions on foreign bank acquisitions of Mexican banks, etc.) increased the level of banks' risk aversion. This in turn was a disincentive to finance activities which were more profitable (but riskier). In this climate of risk-aversion, banks preferred to finance safer investments with lower and even negative margins, whose unprofitability was subsidized by applying higher margins on passive operations. Therefore the results in terms of competition can be interpreted as the Mexican banking sector's reaction to the credit crisis of the mid-nineties.

One lesson derived from the results of our paper is the importance of adequately assessing banks' reaction to the reforms implemented. The experience of the reforms adopted during the liberalization experiment (which took place in 1997) shows that banks were reluctant to extend credit to the private sector and decided to finance only the less risky borrowers with low returns (with a loan interest rate close to the money market rate). In the current economic crisis, possible measures to adopt should avoid any significant increase in the level of banks' risk aversion, given that in this case recovery from the crisis will be much slower. However, the reforms implemented during the last ten years after the 1995 crisis to improve the legal framework, financial regulation and supervision processes have indeed shown results, although given the severity of the current crisis the Mexican banking sector faces some important challenges.

Acknowledgements

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Source: Calculations were made using data from Comisión Nacional Bancaria y de Valores.





Source: Own elaboration with data from Comisión Nacional Bancaria y de Valores.





Source: Own elaboration with data from Comisión Nacional Bancaria y de Valores.



Figure 4. The evolution of the Lerner index and its components



Source: Own elaboration based on data from Comisión Nacional Bancaria y de Valores and Banco de México.



Source: Own elaboration based on data from Comisión Nacional Bancaria y de Valores and Banco de México.



Source: Own elaboration based on data from Comisión Nacional Bancaria y de Valores and Banco de México.



Source: Own elaboration based on data from Comisión Nacional Bancaria y de Valores and Banco de México.

Table 1: I	Descriptive	statistics
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		Financial	Total	r _L : Financial	r _D : Financial	Lerner indices		Interbank
Year	Banks	Income / TA	income / TA	revenues / Ioans ^{1/}	costs / deposits ^{1/}	Loans ^{1/}	Deposits ^{1/}	interest rate
1993	13	0.18	0.20	0.18	0.17	-0.09	-0.16	0.17
1994	14	0.15	0.16	0.19	0.15	0.06	-0.10	0.16
1995	25	0.30	0.32	0.59	0.40	0.03	0.33	0.55
1996	33	0.20	0.21	0.36	0.26	0.02	0.19	0.34
1997	32	0.26	0.27	0.22	0.16	-0.12	0.17	0.22
1998	27	0.30	0.32	0.26	0.15	-0.13	0.56	0.27
1999	27	0.29	0.32	0.24	0.12	-0.14	0.83	0.24
2000	24	0.25	0.27	0.17	0.08	-0.18	0.71	0.17
2001	24	0.19	0.22	0.13	0.06	-0.23	0.65	0.13
2002	21	0.15	0.17	0.08	0.04	-0.35	0.47	0.08
2003	22	0.12	0.15	0.07	0.03	-0.41	0.41	0.07
2004	21	0.13	0.15	0.07	0.03	-0.39	0.75	0.07
 2005	20	0.20	0.22	0.10	0.03	-0.29	1.03	0.10

¹⁷Weighted mean (Weight= total assets) Source: Own elaboration based on data from *Comisión Nacional Bancaria y de Valores* and *Banco de México*.

I able 2: H-statistic				
Variable	93-05			
ln(w ₁)	0.048			
	(1.11)			
ln(w ₂)	0.441 *			
	(5.86)			
ln(w ₃)	-0.128 **			
	(-2.39)			
In(E ₁)	0.148 ***			
	(1.73)			
In(E ₂)	0.251 ***			
	(1.96)			
In(E ₃)	-0.773 *			
	(-10.58)			
Hausman Test	120.98			
p-value	(0.000)			
Observations	303			
R ²	0.612			
H-statistic	0.362 ^{MC}			
H=0 (p-value)	[0.000]			
H=1 (p-value)	(0.000)			
E	0.339 LR			
p-value E=0	(0.402)			

Table 2: *H*-statistic

Dependent variable: In(Financial income)

Estimations with fixed effects and time effects

The reported t-statistics are based on robust standard errors t-statistics are in parentheses

* Significant at 1%, ** significant at 5%, and *** significant at 10%.

E: Sum of the elasticities of ROA to the prices of inputs

MC: Monopolistic Competition (H>0 and H<1 could both not be rejected at the 1% confidence level)

LR: Long Run Equilibrium (Equilibrium test: E=0 could not be rejected at the 10% confidence level)

1 ubic 5.11	statistic. total
Variable	93-05
ln(w ₁)	0.072 **
	(2.02)
ln(w ₂)	0.414 *
	(5.87)
ln(w ₃)	-0.120 **
	(-2.28)
In(E ₁)	0.131
	(1.48)
In(E ₂)	0.286 **
	(2.34)
In(E ₃)	-0.781 *
	(-10.54)
Hausman Test	112.33
p-value	(0.000)
Observations	303
R ²	0.606
H-statistic	0.367 ^{MC}
H=0 (p-value)	[0.000]
H=1 (p-value)	(0.000)
E	(0.339) ^{LR}
p-value E=0	(0.402)

Table 3: H-statistic: total income

Dependent variable: In(Total income)

Estimations with fixed effects and time effects

The reported t-statistics are based on robust standard errors

t-statistics are in parentheses

 * Significant at 1%, ** significant at 5%, and *** significant at 10%.

E: Sum of the elasticities of ROA to the prices of inputs

MC: Monopolistic Competition (H>0 and H<1 could both not be rejected at the 1% confidence level)

LR: Long Run Equilibrium (Equilibrium test: E=0 could not be rejected at the 10% confidence level)

Comments to the referee's report on the paper "Deregulation, liberalization and consolidation of the Mexican banking system: effects on competition".

First of all, we would like to thank the referee for their helpful comments that we are sure have contributed to improving the paper.

The revised version of the paper has incorporated all the referee's comments and suggestions. More precisely, the changes implemented are the following:

- 1. The paper's introduction and conclusions include new paragraphs which aim to improve the motivation of the paper (in terms of its implications of the competitive response of the Mexican banking sector to the crisis of the mid-nineties).
- 2. The referee's second suggestion was to extend the implications of the crosssubsidization evidence between banking products found in the paper. To this end, we have included new comments at the end of section 4.2.2 and also in section 5 of conclusions.
- 3. At the end of page 14, we mention that "This result is in line with those obtained by Carbó et al. (2005) and Maudos and Fernández de Guevara (2007) who find evidence of the existence of a loss-leader strategy in the European banking sectors. However, the strategy observed in these two papers is completely the opposite: market power in loans and low margins in deposits".
- 4. Bikker, Spierdijk, and Finnie (2006) demonstrate that the use of the ratio of revenues to total assets as a dependent variable overestimates the values of the H-statistics (and therefore leads to an upward bias regarding the level of competition) Taking this into consideration, the revised version of the paper reports the results of the H-statistics using un-scaled revenues specification.
- 5. The referee's concern that it is difficult to assume that Mexico's banking sector is in long term equilibrium for the whole period is mentioned in footnote 14. In any case, the previous version of the paper already mentioned that "Nevertheless, since the period analyzed is a period of major transformations in the Mexican banking system, this "equilibrium" result does not mean that competitive conditions are not allowed to change, it only implies that changes in banking are taken as gradual".
- 6. Footnote number 8 of the previous version has been dropped.
- 7. The definition of variables includes the dependent variable of Panzar and Rosse's specification.
- 8. A table with the descriptive statistics has been included (table 1). The table also includes the values of the Lerner indices estimated.
- 9. Figure 4 includes the money market rate (TIIE28).

- 10. Some figures of the previous section have been dropped.
- 11. As suggested by the referee, we have deleted the analysis of the Lerner index's sources of variation.
- 12. The Lerner index of the total banking activity has also been eliminated.
- 13. As stated by the referee, the variation of the Lerner index is driven by variation in prices, not in costs. Consequently, we have eliminated the estimation results of the Lerner index by sub periods. To be consistent with this decision, results of the H-statistic by sub periods have been dropped.

Typo or minor points

All errors have been corrected.

Deregulation, liberalization and consolidation of the

Mexican banking system: effects on competition

Joaquín Maudos^{a,b,*} Liliana Solís^a

Abstract

This paper analyzes the evolution of competition in the Mexican banking system in the period 1993-2005, a period of deregulation, liberalization and consolidation of the sector. For this purpose we use two indicators of competition from the theory of industrial organization (the Lerner index and the Panzar and Rosse's *H*-statistic). The empirical evidence does not permit us to reject the existence of monopolistic competition. The Lerner index shows a decrease in competitive rivalry in the deposit market and an increase in the loan market, a cross subsidization strategy being observed. The results obtained call into question the effectiveness of the measures implemented hitherto, aimed at increasing the competition of the Mexican banking system.

Key words: banking, competition, deregulation JEL: G21, L10

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Dear professor Lothian,

Please find attached the revised version of the paper "Deregulation, liberalization and consolidation of the Mexican banking system: effects on competition", submitted for publication to the JIMF. The revised version of the paper has incorporated all the referee's comments and suggestions.

Yours sincerely,

Dr. Joaquin Maudos Professor of Economics University of Valencia <u>http://www.ivie.es</u> <u>http://www.uv.es/maudosj</u>