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Abstract

This paper estimates the social costs of market power (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. 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 us to reject the quiet life hypothesis in the deposits market. However, market power in the setting of the interest rate on loans has a negative effect on cost efficiency.

Key words: banking, market power, cost efficiency, profit efficiency, welfare loss
JEL: G21, L10

1. Introduction

During recent years the Mexican banking system has faced major transformations. In a context of macroeconomic crisis, the commercial banks were nationalized in 1982 and subsequently (re)privatized in 1991 following the reform of the constitution. The revenue obtained from the privatization of banks permitted the Government to reduce its public deficit, and therefore its need for financing, which led to an increase in the resources available for the financing of the private sector.

Macroeconomic conditions subsequently deteriorated, and foreign investment diminished, which together with the high level of the balance of payments deficit, caused the devaluation of the exchange rate in December 1994. In parallel, the Mexican banking system experienced a steep growth of bad debt as a consequence of the increase in non-performing loans. These factors, along with others, caused fragility in financial institutions, and made it necessary for them to be capitalized. With this aim, the process of a gradual opening-up to foreign investment that had begun in 1994 with the North American Free Trade Agreement (NAFTA) was accelerated. In December 1998, the restrictions on banking activity were totally eliminated, and thus began a period of consolidation in the banking industry as a result of the mergers and acquisitions that took place[1].

The events described above can affect competitive conditions in banking markets, and therefore the economic development of a country. The exercise of market power means, on the one hand, that banks can set the prices of financial products and services above their marginal costs, causing a loss of social welfare. On the other hand, there are inefficiencies in the management of banks that are transferred to the intermediation costs and banking margins, and therefore to the growth of investment and employment. These reasons explain the importance of analyzing competition in the banking sector, and measuring the impact market power has on social welfare and the efficiency of banking management.

In this context, the objectives of the study are as follows. First, to measure the degree of competition in the Mexican banking system in the period 1993 to 2005. Second, to estimate the loss of welfare associated with market power and inefficiency in banking management. And third, to analyze the relationship between cost efficiency and market power (*quiet life* hypothesis).

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[1] See a recent summary of the evolution of the Mexican banking system in Hernandez-Murillo (2007).

In relation to other studies referring to the Mexican banking system, the novelties of this paper are the following. First, the Lerner index is used to measure the evolution of market power, and is estimated separately for the loans and deposits markets. Second, the loss of welfare associated with market power is estimated as a result of setting prices above their marginal cost (the so-called Harberger's triangle) and also as a consequence of the managerial inefficiency (cost and profit inefficiency). The welfare loss is calculated using the methodological approach employed by Oroz and Salas (2003), and Maudos and Fernández de Guevara (2005 and 2007).The sensitivity of the results is analyzed using the approach of Berger and Hannan (1998). Third, the relationship between cost efficiency and market power (*quiet life* hypothesis) is studied for the first time in the Mexican banking system. Although other studies have analyzed its efficiency, none have investigated the possible effect of market power on efficiency in the management of banks. Finally, an additional novelty of the study is that for the first time we consider the endogeneity of the Lerner indices when testing the quiet life hypothesis, as well as the possibility that current values of efficiency may be determined by previous values.

The results obtained indicate that once banks had been sold to the private sector, the intensity of competition augmented. Subsequently, the exchange rate crisis had an adverse effect on inflation and interest rates, inducing an increase in market power in loans and deposits, which caused an increase in the loss of social welfare (Harberger's triangle) to reach its maximum value. Finally, once the restrictions on the entry of foreign capital had been completely eliminated in 1998, market power increased in the deposits market, while it decreased in the loans market, consolidating the following of a cross-subsidization strategy. In this last period, we can observe a fall in the loss of social welfare.

The results show that the loss of social welfare associated with the exercise of the banks' market power is greater than that deriving from cost and profit inefficiency which, for the year 2005, represents 0.15%, 0.021% and 0.075% of Gross Domestic Product (GDP), respectively. The results also show that there is a negative relation between the market power of setting the prices of loans and cost efficiency. However, the relation is positive in the deposit market, rejecting the quiet-life hypothesis. The principal economic policy implication of these results is that the Mexican financial authorities should orientate their policies towards increasing competition in the banking sector, since the gain in social welfare attributable to the reduction of market power is greater than the loss of cost efficiency.

The structure of the rest of the paper is as follows. Section 2 describes the literature that analyzes the relation between market power and efficiency. Section 3 details the methodology used in the estimation of market power and in the quantification of the loss in social welfare, and cost and profit efficiency. Section 4 specifies the variables and the sample used, as well as the empirical results. Finally, section 5 concludes.

2. Literature review

This section reviews the literature that analyzes the relationship between market power and efficiency, as well as the empirical evidence available for the case of Mexico. It also contains a brief description of the studies carried out on the estimation of the loss in social welfare as a consequence of market power.

According to Berger (1995), the hypotheses that explain the relationship between profitability and measures of market structure (concentration or market share) can be divided into two categories: market-power hypotheses and efficient-structure hypotheses.

Three hypotheses are related to market power. The traditional structure-conduct-performance (SCP) hypothesis, the relative-market-power hypothesis, and the quite life hypothesis. The SCP hypothesis, first enunciated by Bain (1956), posits that certain market conditions, such as market concentration, affect banks' conduct and therefore their profitability. Thus, in highly concentrated markets, banks are able to collude to increase prices and their profitability. Under the relative-market-power hypothesis, banks with high market shares, and well differentiated financial products and services are able to set higher prices, and consequently to attain extraordinary profits. Finally, the quiet life hypothesis establishes that managers of the banks which enjoy market power do not have incentives to behave efficiently given that they pursue goals other than the minimization of costs. This hypothesis therefore posits the existence of a negative correlation between market power and cost efficiency (Berger and Hannan, 1998).

As detailed by Berger and Hannan (1998), several reasons explain the possible negative effect of market power on management efficiency: managers may have less incentives to minimize costs in the presence of market power, which permits them to use part of these extraordinary profits to work with less effort, *i.e.* to behave in accordance with the so-called *quiet life* hypothesis. Furthermore, in a context of market power, managers may pursue objectives other than the minimization of costs, consequently neglecting management efficiency.

On the other hand, under the efficient structure hypothesis, the most efficient banks are more competitive and gain market share, thus increasing the concentration of the market (Demsetz, 1973). The positive relationship between market concentration and profitability is therefore spurious, with efficiency being the variable determining profitability.

Among the studies that have found empirical evidence in favor of the traditional SCP hypothesis are Berger and Hannan (1989) for local banking markets; Lloyd-Williams *et al.* (1994) for Spanish banking (1986-88); Molyneux and Forbes (1995) for European banking (1986-1989); and Molyneux *et al*. (2004) for commercial, savings, and co-operative banks from five major European Union countries (mid-1990s). Smirlock (1985) on the other hand, upholds the hypothesis of efficiency for the seven-state area of Kansas City for the years 1973 and 1978. Goldberg and Rai (1996) analyze 11 European countries (1988-91) and find evidence to support the X-efficient-structure hypothesis for banks located in low concentration countries. Vander Vennet (2002) found evidence that operational efficiency is the major determinant of bank profitability for European banks (1995-96). Finally, the empirical results obtained by Berger (1995) for U.S. banks in three different competitive environments (unit banking, limited branching, and statewide branching states) in the 1980s indicate limited support for the X-efficiency version of the efficient-structure hypothesis and the relative market power hypothesis.

As far as we know, only three studies have analyzed the relationship between market power and cost efficiency in banking management. Berger and Hannan (1998) find evidence in favor of the quiet life hypothesis for U.S. banks and that the loss in cost efficiency is greater than the loss in social welfare. Maudos and Fernández de Guevara (2007) find, on the other hand, that the loss in social welfare is greater than the loss caused by cost inefficiency for the EU-15 banking sectors, and reject the quiet life hypothesis. For the Spanish case, Maudos and Fernández de Guevara (2005) obtain evidence in favor of (against) the quiet life hypothesis in the loans (deposits) market.

In the specific case of the Mexican banking system, some studies have analyzed the evolution of competition. 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 these authors suggest bank behavior that is consistent with competitiveness before the privatization but with super-competitiveness after privatization. Dueñas (2003) measures competition and banking profitability in Mexico following the entry of foreign capital (Jan97-Sept02) using the Panzar and Rosse´s *H*-statistic. His 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.

Other studies applied to the Mexican banking system have focused on the analysis of the profit-market structure relationship, *e.g.* Arteaga (2001) who finds evidence for the SCP hypothesis over the period 1995-99. Rodríguez (2003) concludes that both the SCP and the efficiency structure hypotheses help to explain the source of profitability for the period 1986-89. The economic policy implication deriving from their results is that regulatory authorities must limit mergers between large banks if efficiency gains are low and market entry does not ensure more competition. If these mergers are allowed, the market power created by a more concentrated industry may reduce consumer surplus.

Guerrero *et al.* (2005), basing themselves on Berger (1995), use specific measures of economic and scale efficiency to test the four hypotheses that explain the profit-structure relationship in the Mexican banking system for the period between 1997 and 2004. The authors find evidence in favor of the market power hypothesis, since the market share of banking institutions maintains a positive relationship with their own profitability. Conversely, industry concentration, and economic and scale efficiency do not present any significant relationship. However, the relationship between cost efficiency and market power in the Mexican banking industry is not analyzed in this study.

The efficiency of the Mexican banking sector has also been analyzed in several papers. Taylor *et. al.* (1997) estimate the efficiency and profitability potential in the years 1989-91, a period when the banks belonged to the Federal Government. The average efficiency for each of the years analyzed is 0.75, 0.72 and 0.69. Guerrero and Negrín (2005) study the evolution of efficiency in the Mexican banking system during the period 1997-2004, using both static and dynamic models. The evidence from this study indicates that efficiency levels decreased from 1997-2001, and increased thereafter. The authors argue that the fall in efficiency is probably related to adjustments following the tequila crisis and that the recent recovery may be related to the new institutional and regulatory framework, as well as to greater participation of foreign institutions in the Mexican banking system.

3. Methodology

3.1 The measurement of market power: the Lerner index

Market power is the capacity of banks to set the prices of their products and services above their marginal cost. The indicators used to measure this power can be classified into two groups. The first uses measures of concentration as proxies of market power, *e.g.* the market share of the *n* most important banks CR(n), the Herfindahl-Hirschman index (HHI) and the Dominance index. In the second group, indicators based on the New Empirical Industrial Organization (NEIO) approach are used, including the Panzar and Rosse's *H* statistic[2], conjectural variation models[3], and the Lerner index of market power[4].

Given the objectives of our study, we use the Lerner index because an index of market power can be calculated for each bank and year, which allows us to analyze the relationship between market power and cost efficiency (quiet life hypothesis). In addition, given that competition may differ depending on markets and banking products, the Lerner index enables market power to be measured separately in the deposits and loans markets.

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. 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 $\left(D_n^*, L_n^*\right)_{n=1,\ldots N}$, so that for every *n*, each bank maximizes its profit given the volume of deposits (*D*) and of other banks' loans (*L*):

[2] The *H*-statistic has been used by 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 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 and Maudos and Solís (2007) for the period 1993-2005.

[3] See Shaffer (1993) for the Canadian banking industry; Shaffer (2001) for 15 industrialized countries; and Carbó *et al.* (2005) for Spain. In the case of Mexico, Gruben and McComb (2003) for the period from 1987 to 1991.

[4] The Lerner index has been applied by Angelini and Cetorelli (2003) for the Italian banking sector; Maudos and Pérez (2003), Carbó *et al.* (2003a and b) and Fernández de Guevara and Maudos (2007) for the Spanish banking sector; Fernández de Guevara *et al.* (2005) for the case of five European countries; Maudos and Fernández de Guevara (2007) for 15 European countries; and Maudos and Solís (2007) for the Mexican banking system.

$$\max_{D_n, L_n}\left[r_L\left(L_n + \sum_{m \neq n} L_m\right) - r\right]L_n + \left[r - r_D\left(D_n + \sum_{m \neq n} D_m\right)\right]D_n - C(D_n, L_n) \qquad (1)$$

where r is the money market interest rate (it is assumed that banks are price-takers in this market) and *C(D,L)* are the operating costs. 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 (1) we obtain:

$$\frac{\left[r^*_L - r - mc_L\right]}{r^*_L} = \frac{1}{N\varepsilon_L(r^*_L)} \qquad \frac{\left[r - r^*_D - mc_D\right]}{r^*_D} = \frac{1}{N\varepsilon_D(r^*_D)} \qquad (2)$$

The lower the elasticity (ε), the greater the intermediation margin, *i.e.* the greater the Lerner index of market power. When N=1, it represents the case of a monopoly and when N=∞ it is perfect competition.

3.2 Harberger's triangle

A matter that has constantly aroused the interest of economists is the effect of market power on social welfare. The starting point was the analysis by Harberger (1954) who quantifies the loss in social welfare of the U.S. manufacturing industry over the period 1924-28, on the basis of proxying the loss of consumer surplus (W) caused by monopoly (Hotelling, 1938) defined by the following expression:

$$W = \frac{1}{2}\sum_{i=1}^{n} \Delta p_i \Delta q_i \qquad (3)$$

where Δp_i and Δq_i represent the increase in prices and the consequent fall in volume caused by the monopoly in industry *i*.

The most important assumptions made by Harberger are as follows: i) existence of a long term equilibrium situation; ii) constant costs; iii) unitary elasticity of demand; iv) the average rate of return is the best approximation of the competitive rate. Under these assumptions, the ratio of the price increase caused by imperfections to the competitive price $\Delta p / p$ must be equal to $\prod_i / S_i$ where $\prod_i$ are the economic profits and S_i the sales in industry *i*. The assumption of constant costs implies that $\prod = \Delta pq$ and $S = pq$, so $\prod / S = \Delta pq / pq = \Delta p / p$. Equation (3) can thus be written:

$$W = \frac{1}{2}\left(\frac{\Pi_i}{S_i}\right)^2 S_i \quad (4)$$

Harberger found that the welfare loss in the manufacturing industry of the U.S. is less than 0.10% of Gross National Product (GNP). Stigler (1956) argues that this estimate is very low because its assumptions are questionable. The elasticity of demand facing any monopolist at the point at which they operate will be greater than unity and the welfare losses rise as the elasticity increases. The average profit rate in manufacturing is above the competitive level, since monopoly is concentrated in manufacturing. As monopoly profits are capitalized, earnings statements tend to report only competitive profit rates.

Schwartzman (1960) uses the same model with his own estimate of profits for Harberger's triangle, and assumes that the elasticity of demand is equal to two. He obtains a welfare loss for Canadian concentrated industries in 1954 of less than 0.10% of GNP.

The estimations by Kamerschen (1966) for the U.S. economy (1956-61) indicate that the losses in social welfare as a consequence of monopoly power are greater than those obtained by Harberger and Schwartzman, and vary from 1% to 8% of GNP. For this reason, the author uses different profit rate methods (unadjusted, and adjusted for intangibles, royalties and advertising). The estimates are computed using an elasticity of unity and using industry-by-industry elasticity estimates based upon the Lerner index.

Bergson (1973) criticizes the partial equilibrium approach used by Harberger and establishes a general equilibrium model in which he assumes that social welfare can be captured by a CES-type curve of social indifference, assuming a constant elasticity of substitution. Bergson obtains a series of hypothetical estimations of the loss of welfare by combining two parameters: the elasticity of substitution in consumption, and the difference between the monopoly price and the competitive price.

Tullock (1967) and Posner (1975) consider that Harberger's triangle underestimates the social cost of monopoly. The existence of an opportunity to obtain monopoly profits will attract resources into efforts to obtain monopolies, and the opportunity costs of those resources are social costs of monopoly, too. The cost of obtaining a monopoly is exactly equal to the expected profit of being a monopolist. For this reason, these authors consider that the social cost of monopoly must include both Harberger's triangle and the producer's surplus.

In the specific case of the banking sector, a small number of studies have estimated the social losses due to banks' market power. The first of the studies was that by Berger and Hannan (1998) who estimate the loss in welfare (welfare triangle) for the U.S. case in the 1980s. For this purpose, they give different values to the elasticities of demand (1, 2 and 3) and to the proportional change in price from the exercise of market power (0.05 and 0.10). The loss represents between 0.01% and 0.02% of total banking assets, depending on the assumptions made.

Other more recent studies have quantified the loss in social welfare without needing to make assumptions as to the value of elasticity of demand (or supply in the case of deposits), and the gap between the competitive price and the monopoly price. These studies use the Lerner index, as do Oroz and Salas (2003) and Maudos and Fernández de Guevara (2005 and 2007) and Fernández de Guevara and Maudos (2004).

If we assume a linear function of demand for loans (supply of deposits), and a constant marginal cost function (see figure 1), the banking institution with market power that maximizes its profits offers a volume of loans (L^*) and deposits (D^*), and charges a price r_L^* and r_D^* per unit. In relation to competitive equilibrium, a gain occurs in the producer surplus (in the form of extraordinary profits) equal to the area of the rectangle EABD (FGHJ), and a loss in the consumer surplus equal to the area EACD (FIJH). The net loss of social welfare is represented by the Harberger's triangle ACB (GIH) and shows the loss due to increasing the price from a competitive level to a monopoly level. If the loss of social welfare is expressed in terms of financial income $r_L L$ (or in terms of financial costs $r_D D$), the Harberger's triangle is proportional to the Lerner index[5]:

$$\frac{\Delta ACB}{r_L^* L^*} = \frac{1}{2}\frac{r_L^* - r - mc_{L^*}}{r_L^*}$$

$$\frac{\Delta GIH}{r_D^* D^*} = \frac{1}{2}\frac{r - r_D^* - mc_{D^*}}{r_D^*} \qquad (5)$$

The sum of the social loss in the loans and deposits markets (WL) expressed as a percentage of GDP is given by the following expression:

$$\frac{WL}{GDP} = \frac{1}{2GDP}\left[\frac{r_L^* - r - mc_{L^*}}{r_L^*} r_L^* L^* + \frac{r - r_D^* - mc_{D^*}}{r_D^*} r_D^* D^*\right] \qquad (6)$$

[5] See Maudos and Fernández de Guevara (2007).

As indicated by expression (6), the social loss depends i) on the relative weight of financial costs and income in GDP (which in turn depends on the evolution of interest rates and the degree of financial development of the economy measured by the size of loans and deposits in the GDP); and ii) on market power in loans and deposits (Lerner indices).

[Insert fig. 1]

The methodological approach to estimating the social costs of market power based on expression (6) has been applied recently in several studies. Oroz and Salas (2003) calculate the cost of intermediation for the case of Spain (1980-99), measured by the Harberger's triangle and the explicit costs of intermediation (producer surplus), and find empirical evidence that it represents between 3.5% and 9.0% of GDP. It is also estimated for European banks (1993-2000) by Fernández de Guevara and Maudos (2004) and represents between 1.8% and 2.5% of the European Union's GDP[6].

In addition, Maudos and Fernández de Guevara (2005) estimate the loss of social welfare (Harberger's triangle) in the Spanish banking sector from 1986 to 2002 at between 1.5% and 3.9% of GDP. For the EU15 banking sectors, Maudos and Fernández de Guevara (2007) estimate a value for the social inefficiency of monopoly equivalent to 0.27%-0.62% of GDP in 1993 and 2002, respectively.

3.3 X-Efficiency

Since one of the aims of this study is to test the quiet life hypothesis in the Mexican commercial banking system, it is necessary to approach empirically the cost efficiency of management, for which we use the concept of X-efficiency. In addition, considering that profit efficiency is also relevant for a comparison with welfare loss (Hargerber's triangle) associated with market power, we also need to estimate the profit efficiency. It is important to take into account that the evidence obtained in other papers (Berger and Mester, 1997; Rogers, 1998; Maudos *et al.*, 2002, etc.) shows that the levels of profit inefficiency are higher than those of cost inefficiency, indicating the importance of inefficiencies on the revenue side.

The estimation of X-efficiency requires us to estimate a function that will describe the best practices possible in the industry, *i.e.* to estimate the efficient frontier. On the basis of this frontier, it is possible to compare the observed cost (profit) of a

[6] Nevertheless, the studies are not strictly comparable. In the first, the marginal costs do not include operating costs (only financial) so the Lerner indices and the social cost would be over-estimated.

bank in relation to the best (most efficient) banks that define the frontier of reference. The difference of costs (profits) over the minimum (maximum) of the frontier is known as X-inefficiency.

The methodologies available for estimating X-inefficiency can be classified into various groups. One such classification distinguishes between deterministic and stochastic approaches. The disadvantage of the first is its inability to include random disturbances, causing its results to be very sensitive to errors of measurement and specification of the model. Among the stochastic approaches, the so called "distribution free approach" (Berger, 1993) is based on the hypothesis that efficiency is persistent over time, whereas random errors tend to cancel each other out over the course of time.

A second classification groups the methods into parametric and non-parametric. Non-parametric approaches do not assume any functional form for the efficient frontier. The construction of this frontier consists of "enveloping" the set of points which represent the banks' cost (profits) combinations by means of a convex frontier that reproduces the best practices of the banking industry. For this purpose, linear programming tools are used. The most widely used approach is Data Envelopment Analysis (DEA).

In this study we opt for the stochastic frontier parametric approach proposed by Aigner *et al.* (1977) and Meeusen and van den Broeck (1977). As well as capturing the influence of random disturbances, an additional advantage is that, as demonstrated by Bauer *et al.* (1998), it meets a greater number of consistency conditions[7].

The stochastic cost frontier is defined as follows:

$$C_i = C(Y_i, w_i, u_i, v_i) \tag{7}$$

or in logarithmic terms, and assuming that the efficiency and random error terms are multiplicatively separable from the remaining arguments of the cost function,

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[7]Although the main advantage of using the distribution free approach (DFA) to the measurement of efficiency is that it does not need to impose distributional assumptions for the inefficiency term, one drawback of the approach is that it assumes that inefficiency is constant over time. In addition, it is necessary to have a reasonable number of observations for each year. Unfortunately, as table 1 shows, there are few observations/banks in the sample used. It is important to take into account that, according to the DFA, the frontier function has to be estimated separately for each year. With few observations/banks and many parameters to estimate (in the functional form used in this paper –Fourier Flexible functional form- with 2 outputs, 2 input prices and a trend dummy, there are 39 parameters to be estimated after imposing the symmetric and grade one homogeneity restrictions), the frontier function can not be estimated for each year.

$$\ln C_i = f(Y_i, w_i) + \ln u_i + \ln v_i \qquad (8)$$

where C is the cost of bank i, Y_i is the vector of production, w_i is a vector of input prices, v is the white noise component and is assumed to be distributed as a two-sided normal, $v \sim i.i.d.\ N\left(0, \sigma_{\mathrm{v}}^2\right)$; and u is the cost inefficiency and is assumed to be distributed, as usual, as a half-normal, $u \sim N\left(0, \sigma_{\mathrm{u}}^2\right)$.

Cost efficiency *(E^c)* is defined as the ratio between the minimum cost of the bank that stands at the frontier and the observed cost of bank *i*.

$$E^C{}_i = \frac{C_{\min}}{C_i} = \frac{\exp\left(f\left(Y_i, w_i\right)\right)\exp(\ln v_i)}{\exp\left(f\left(Y_i, w_i\right)\right)\exp(\ln u_i)\exp(\ln v_i)\big)} = \exp\left(-\ln u_i\right) \qquad (9)$$

As u is non-negative, the value of cost inefficiency is bounded between 0 and 1, where 1 represents the optimum efficiency level. The estimated X-efficiency is a measure relative to the bank with best practice in the sample.

Profit efficiency is a broader concept than cost efficiency since it takes into account the effects of choosing the vector of production on both costs and revenues. Two profit functions can be distinguished, depending on whether or not market power is considered: the standard profit function and the alternative profit function (see Berger and Mester, 1997). Given that the aim of our paper is to analyze the market power of the Mexican banking sector, we estimate the alternative profit efficiency[8].

The alternative profit function (in logarithmic terms) can be expressed as:

$$\ln(\pi_i + \theta) = f(Y_i, w_i) + \ln v_i - \ln u_i \qquad (10)$$

where θ is a constant added to the profits (π) of each bank in order to attain positive values, enabling them to be treated logarithmically[9]. Profit efficiency is defined as the ratio between the actual profit of a bank and the maximum level that could be achieved by the most efficient bank:

[8] Alternative profit efficiency is closer to reality whenever the assumption of perfect competition in pricing is questionable.
[9] To avoid negative values, we transform the profit variable by adding to all individuals a constant equal to the maximum loss experienced by any bank in the sample plus one.

$$E^{\pi}{}_i = \frac{\pi}{\pi^{\max}{}_i} = \frac{\exp\left(\pi\left(Y_i, w_i\right)\right)\exp(\ln v_i)\exp(-\ln u_i) - \theta}{\exp\left(\pi\left(Y_i, w_i\right)\right)\exp(\ln v_i) - \theta} \qquad (11)$$

Note that the expression of the alternative profit function is equivalent to that of the cost function only if costs are replaced by profits as the dependent variable.

Following Jondrow *et al.* (1982), the specific inefficiency term for each bank *u* can be estimated as the conditional expectation of the inefficiency term, given the composite error term. The conditional expectation for the case of half-normal distribution is:

$$E\left(u_i \middle| \varepsilon_i\right) = \frac{\sigma\lambda}{1+\lambda^2}\left[\frac{\phi\left(\varepsilon_i \lambda / \sigma\right)}{\Phi\left(-\varepsilon_i \lambda / \sigma\right)} - \frac{\varepsilon_i \lambda}{\sigma}\right] \qquad (12)$$

where $\sigma^2 = \sigma_u^2 + \sigma_v^2$ is the total variance; $\lambda = \sigma_u / \sigma_v$; $\phi(\cdot)$ is the density of the standard normal distribution and $\Phi(\cdot)$ is the cumulative density function.

Following Berger and Hannan (1998), and Maudos and Fernández de Guevara (2007), the estimated cost function excludes financial costs and the price of deposits because these variables may directly reflect the effect of market power on setting deposit interest rates. It must be kept in mind that one of the aims of this study is to analyze the quiet life hypothesis (relationship between market power and cost efficiency), therefore the cost function and efficiencies estimated only include operating costs. Specifically, the cost (and profit) function estimated adopts the Fourier Flexible functional form, which can potentially approximate any function well over the entire range of data[10]:

[10] As Mitchell and Onvural (1996) show, an additional advantage of the Fourier Flexible form is its capacity to reveal bias resulting from use of the Translog form, since the Translog is nested within the Fourier Flexible as a special case. In addition, several studies (*e.g.* McAllister and McManus, 1993; Wheelock and Wilson, 2001) show that the Translog does not fit well when banks are of widely varying sizes.

$$\ln C_{it} = \sum \gamma_h \ln w_{hit} + \gamma_L \ln L_{it} + \gamma_D \ln D_{it} + \frac{1}{2}\sum\sum \gamma_{hm} \ln w_{hit} \ln w_{mit} + \gamma_{LD} \ln L_{it} \ln D_{it}$$
$$+\frac{1}{2}\gamma_{LL}(\ln L_{it})^2 + \frac{1}{2}\gamma_{DD}(\ln D_{it})^2 + \sum \gamma_{hL} \ln w_{hit} \ln L_{it} + \sum \gamma_{hD} \ln w_{hit} \ln D_{it}$$
$$+\mu_1 Trend + \frac{1}{2}\mu_2 Trend^2 + \mu_L Trend \ln L_{it} + \mu_D Trend \ln D_{it} + \sum \mu_h Trend \ln w_{hit} + \quad (13)$$
$$\sum\left[\phi_n \cos(x_n) + \omega_n \sin(x_n)\right] + \sum\sum\left[\phi_{nq} \cos(x_n + x_q) + \omega_{nq} \sin(x_n + x_q)\right]$$
$$+\sum\left[\phi_{nnn} \cos(x_n + x_n + x_n) + \omega_{nnn} \sin(x_n + x_n + x_n)\right] + \ln u_{it} + \ln v_{it}$$

where *C* are the operating costs, *w* the prices of the two inputs (labor and capital), *L* the loans and *D* the deposits, and *T* is a trend that captures the effect of technical progress. x_n are adjusted values of the natural log of outputs and input prices so that they span the interval [0.1*2π,0.9*2π]. The restrictions of symmetry and grade one homogeneity in input prices are imposed in the estimation. Once the cost function is estimated, we calculate the marginal operating costs necessary to estimate the Lerner index in loans and deposits.

In the case of the profit function, the variable to be explained is the operating profit (net income minus provisions). Because the alternative profit function does not contain output prices, we do not restrict profits to degree one price homogeneity (see DeYoung and Hasan, 1998; and Maudos *et al.*, 2002).

4. Results

4.1 Sample and variables

The sample used is formed by an unbalanced panel of data from 267 annual observations corresponding to 43 commercial banks for the period between 1993 and 2005, representing an average 92% of the total assets of the Mexican commercial banking system during the period of study[11]. The data is obtained from the Statistical Bulletin of the Multiple Banking system of the National Banking and Securities Commission (known by its Spanish acronym CNBV) and from the Basic Banking Information System of the Bank of Mexico.

[11] Observations 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. With these restrictions, the number of observations varies from a minimum of 13 in 1993 to a maximum of 29 in 1996 (see table 1).

The distribution of banks in Mexico during the sample period reflects that the banking system is dominated by a few very large banks. For example, as table 1 shows, the market share of the three (five) largest banks is always above 51% (64%). In the last year analyzed (2005), market concentration (measured by CR5) reaches a maximum of 81%[12].

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 data availability oblige us to work with average interest rates instead of marginal rates.

The variables used in the estimation of the Lerner index and the loss of social welfare are as follows (see the descriptive statistics in table 1):

a) Price of labor (w_1), obtained as the ratio of personnel expenditure to the number of workers.
b) Price of lendable funds (w_2), proxied as the ratio of financial costs to deposits.
c) Interest rate on loans (r_L), calculated as the ratio of financial revenues to the value of loans.
d) Interest rate on deposits (r_D), calculated as the ratio of financial costs to the volume of deposits. Note that by construction r_D is equal to the price of lendable funds w_2.
e) Money market interest rate (r), calculated as the annual average of the inter-bank interest rate (TIIE) at 28 days.
f) The volumes of loans and deposits are obtained from the CNBV and exclude inter-bank credits and deposits as this is frequently supposed to be a perfectly competitive market.

4.2 Market power and welfare loss

Figure 2 shows the evolution of the Lerner index. As can be observed, while market power increased in deposits, it decreased in the loans market. In the sub-period 1993-97, the evolution of Lerner indices in the loans and deposits markets is similar, rising from1993 to 1995 and falling until 1997. From that year onwards, the evolution is different for the two markets: in deposits (loans), market power increases (decreases)

[12] McAllister and McManus (1993) argue that the Translog functional form does not fit well when banks are of widely varying sizes. As this is the case in the Mexican banking system, we estimate a Fourier Flexible function form.

until 1999 (2003) and then decreases until 2003. Finally, in both banking markets the Lerner index again rises again from 2003 to 2005[13].

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.

[Insert fig. 2]

Once the Lerner indices have been estimated, we calculate the loss of social welfare (as a percentage of GDP) associated with market power on the basis of equation (6). As figure 3 shows, the welfare loss/GDP ratio rises in the sub-period between privatization and the crisis (1993-95). For this sub-period, the loss in welfare represents on average 0.60% of GDP. There follows a sub-period of restructuring and consolidation of the Mexican banking system as a consequence of the opening-up to foreign investment (1996-99), with a social loss of 0.55% of GDP. During these years, a downward evolution is observed until 1997, and subsequently a recovery as a consequence of the upturn in interest rates. Finally, once the restrictions on foreign investment were totally removed and the most important banks were acquired by foreign groups (2000-05), the loss of social welfare decreases, reaching an average value of 0.07% of GDP. For the whole of the period analyzed, the loss in social welfare represents on average 0.34% of GDP, reaching its maximum value with the crisis in 1995.

[Insert fig. 3]

Since the magnitude of social welfare loss depends not only on the evolution of the relative weight of financial income and costs in GDP but also on the evolution of market power in loans and deposits, table 2 decomposes the social welfare loss in each market (loans and deposits) into these two components. In the period 1993-95 we observe an increase in the weight of financial income (costs) from 2.27% (2.57%) to 9.73% (6.37%) of GDP. This trend is a consequence both of the increase in loan (deposit) interest rates – which due to the crisis rose from 17.73% (16.69%) to 59.43% (39.82%), and the increased weight of loans (deposits) in GDP, from 25.59% (30.75%) to 32.75% (31.99%). In addition to this, the increase of the Lerner index in the period 1993-1995 also helps to explain the increased social welfare loss.

[13] The factors explaining the evolution of the Lerner index in the Mexican banking sector can be consulted in Maudos and Solís (2007).

In the sub-period of restructuring and consolidation of the Mexican banking system (1996-99), the results show a fall in financial income (costs) from 5.03% (4.14%) to 2.30% (1.22%) of GDP. This downward trend is due both to the fall in the interest rates on loans and deposits, and the decrease in the weight of loans and deposits in GDP (from 27.63/31.35% to 19.3/21.0%). The Lerner index for loans (deposits) falls (rises) from 0.02 (0.19) to -0.14 (0.83), and the strategy of cross-subsidy can already be observed in this sub-period.

From 2000 to 2005, the ratio of social welfare loss to GDP decreases as a consequence of the fall in the weight of financial income and costs in GDP (from 1.43%/0.74% to 0.72%/0.35%). The Lerner index for loans (deposits) falls (rises) from -0.18 (0.71) to -0.29 (1.02), continuing with the strategy of cross-subsidy.

[Insert table 2]

The results indicate that once the banks had been sold to the private sector, the intensity of competition increased. Subsequently, the exchange rate crisis had an adverse effect on inflation and interest rates, inducing an increase in market power in loans and deposits, which led to an increased loss of social welfare (Harberger's triangle). 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. In this last period, we observe a downward evolution of social welfare loss.

4.3 Market power and efficiency

Columns 2 and 3 of table 3 report the weighted average efficiency scores. The average cost efficiency is 91%, meaning that the Mexican banking system is 9% inefficient in costs. In the case of profit efficiency, the weighted average for the whole period 1993-2005 (68%) is lower than the cost efficiency, a result similar to those obtained in these studies (Berger and Mester, 1997; Rogers, 1998; Maudos *et al.*, 2002, among others)[14].

[Insert table 3]

[14] The cost efficiency level is higher than that obtained for the period 1997-2004 by Guerrero and Negrín (2005) who found a value for cost inefficiency of 19% using the distribution free approach estimating a Translog cost function. However, contrary to the general evidence obtained in several papers, these authors find a lower value for profit inefficiency (15%) compared to cost inefficiency (19%).

As can be observed in figure 4, the cost efficiency of the Mexican banking system remains stable over the period analyzed. In the case of profit efficiency, the magnitude decreases from 1993 to 1997. It then increases until 1999 and remains quiet stable over the period 2000-05, with an average value of around 68%. However, as the last rows of table 2 show, the changes in cost and profit efficiencies among subperiods are not statistically significant.

[Insert fig. 4]

Since inefficiency in the management of banks represents a cost to society because it translates into higher intermediation margins, it is of interest to quantify its magnitude in relation to GDP. As shown in table 3, the average cost inefficiency in the period analyzed is 0.020% of GDP (see column 4 of table 3). By sub-periods, from 1993 to 1995 (the years between privatization and the crisis), it was 0.023%; for the years of restructuring and start of consolidation of the Mexican banking system as a consequence of the opening-up to foreign investment (1996-99), it is 0.017%. Finally, once the restrictions on foreign investment were totally removed and the most important banks were acquired by foreign groups (2000-05), cost inefficiency decreased slightly to 0.019% of GDP.

Regarding the profit efficiency levels, the potential loss associated to an average inefficiency of 32.2% translates into a welfare loss equivalent to 0.068% of GDP, a value which is higher than the one corresponding to cost inefficiency (0.020%). By subperiods, the higher welfare loss takes places in the subperiod 1993-95 (0.141%).

If we compare the loss in welfare related to setting prices above marginal cost with that caused by inefficiency in banking management, we observe that the former is greater than the latter. For example, in 2005, the social inefficiency of market power represents 0.15% of GDP compared to 0.021% in the case of cost-inefficiency, and 0.075% in the case of profit-inefficiency. The cost-inefficiency result is compatible with that obtained by Maudos and Fernández de Guevara (2007) for the European banking system but differs from the results of Berger and Hannan (1998) for the U.S. banking system.

4.4 Quiet life hypothesis

The objective of this section is to test the quiet life hypothesis. For this purpose we estimate a regression model where the dependent variable is cost efficiency, and the independent variables are market power and other explanatory variables that may affect the efficiency of the Mexican banking system. Specifically, as in Maudos and Fernández de Guevara (2007), four control variables are used: total assets *(A)* to capture the influence of size; the ratios of loans to total assets *(E^1)* and of deposits to total assets *(E^2)* as proxies for banking specialization; and the equity / total assets ratio *(E^3)* which captures the influence of the structure of capital on X-cost efficiency.

The model to be estimated is as follows:

$$E^c{}_{it} = f\left(Market\ power_{it}, A_{it}, E^1_{it}, E^2_{it}, E^3_{it}\right) \qquad (14)$$

where market power is proxied by the Lerner index for loans and deposits for bank *i* in year *t*[15].

Given that the estimated values of cost efficiency are between zero and one, we use the logistical functional form in equation (14):

$$\text{logistic}\left(E^c{}_{it}\right) = \frac{e^{\alpha + \beta_1 Market\ power_{it} + \gamma \ln A_{it} + \sum_{k=1}^{3} \delta_k E^k_{it}}}{1 + e^{\alpha + \beta_1 Market\ power_{it} + \gamma \ln A_{it} + \sum_{k=1}^{3} \delta_k E^k_{it}}} \qquad (15)$$

which can be linearized as:

$$\ln\left(\frac{\text{logistic}\left(E^c{}_{it}\right)}{1 - \text{logistic}\left(E^c{}_{it}\right)}\right) = \alpha + \beta_1 Market\ power_{it} + \gamma \ln A_{it} + \sum_{k=1}^{3} \delta_k E^k_{it} \qquad (16)$$

Equation (16) is estimated with fixed effects in order to capture the influence of each bank's specific variables, and with time effects which capture the influence of factors common to all the banks and specific to the different years of the period analyzed. The results are presented in column 2 of table 4.

The sign of the coefficient of the Lerner index for deposits is positive and significant at 5%, the quiet life hypothesis thus being rejected for this market. On the other hand, the sign of the Lerner index for loans is negative but not significant.

[15] Other studies use market concentration as a proxy for market power. However, the sensitivity of the results cannot be analyzed using market structure indicators since only national indicators are available which have a common value for all the banks of the sample.

The coefficient of the ratio of loans to total assets is positive and significant, reflecting the greater efficiency of the banks most specialized in lending activities. The ratios of deposits to total assets and equity to total assets are not significant.

Finally, the coefficient of total assets is positive and significant. It is important to highlight that the impact of the size of banks is determined both by the coefficient that accompanies the variable A_{it} (total assets) and the coefficients of the specialization variables (E^1, E^2, E^3)[16], because the latter are scaled as a proportion of total assets. The total effect of size on efficiency is subsequently quantified.

To determine the economic impact of the explanatory variables on efficiency their elasticities are calculated (see bottom of table 4). The effect of the Lerner index on deposits is small: when market power in deposits increases 10%, *ceteris paribus*, efficiency increases by 0.29%. On the other hand, the impact of bank size is bigger: if the bank increases its size by 10%, its efficiency will increase by 1.0%, *i.e.* the bigger the bank, the easier it is to manage it efficiently.

The specialization in lending activities (Loan/TA) has a greater economic impact in relation to the variables described above: with an increase of 10% in loans as a proportion of total assets, cost efficiency increases by 1.9%.

[Insert table 4]

Given that the marginal cost used in calculating the Lerner indices and cost efficiency are obtained through the same cost function (equation 13), there may be a problem of endogeneity when estimating equation (16). To correct the problem, the model is estimated with instrumental variables with fixed and time effects. The results using the two stage least squares (2SLS) are reported in column 3 of table 4.

Before analyzing the results of the estimation it is important to analyze the instruments. A valid instrument is one that is not correlated with the error term and is partly correlated with the endogenous regressors. The instruments of the Lerner indices we use are $(r_L - r)/r_L$, $(r - r_D)/r_D$ and ROA.

The next step is to determine the validity and relevance of the instruments. Using the Sargan over-identifying test, the null hypothesis that the instruments are not correlated with the residuals is not rejected. Furthermore, the Anderson canonical

[16] The capital structure and deposit/TA coefficients are not considered because they are not significant.

correlation, and the Cragg and Donald tests reject the null hypothesis of under-identification. Another test used was the Cragg–Donald F statistic, which rejects the null hypothesis that the equation is weakly identified. To determine the relevance of the instruments, we use Shea's "partial R-squared" and the F-test of the excluded instruments. Both present evidence of a high correlation between the instruments and the endogenous regressors (Lerner index for loans and for deposits).

Once the validity and relevance of the instruments has been demonstrated, the results show that the signs (and statistical significance) of the Lerner indices are maintained. In addition, there exists a positive relation between cost efficiency and the specializations variables. Again, the equity to total assets quotient is not statistically significant. Finally, the coefficient of total assets is positive and statistically significant[17].

One limitation presented by the analysis carried out so far is that it does not take into account the possible existence of inertia in the behavior of efficiency, since the current values of efficiency may be determined by its previous values. For this reason, instead of the static specification used up to now, we estimate the following dynamic model:

$$\ln\left(\frac{\text{logistic}\left(E^{c}{}_{it}\right)}{1-\text{logistic}\left(E^{c}{}_{it}\right)}\right)=\alpha+\xi\ln\left(\frac{\text{logistic}\left(E^{c}{}_{it-1}\right)}{1-\text{logistic}\left(E^{c}{}_{it-1}\right)}\right)+\beta_1 Market\ power_{it}+\gamma\ln A_{it}+\sum_{k=1}^{3}\delta_k E_{it}^{k}+\mu_t+\eta_i+\upsilon_{it} \quad (17)$$

where μ_t is a year-specific intercept (time effects), η_i is an unobserved time-invariant bank-specific effect and υ_{it} is a disturbance term. Given that the explanatory variables and the dependent variable are correlated with η_i, a transformation such as first-differencing is required to eliminate the individual effects.

For this purpose we use the methodology proposed by Arellano and Bover (1995), and Blundell and Bond (1998). The basic idea is to estimate a system of equations in both first-differences and levels (the "system" GMM estimator). The system GMM estimator thus combines the standard set of equations in first-differences with suitably lagged levels as instruments, with an additional set of equations in levels

[17] In a similar way to the "within" model, the lower part of table 4 reports the elasticities of cost efficiency to the explanatory variables.

with suitably lagged first-differences as instruments. The Lerner indices are considered as variables that are not strictly exogenous.

Although precision is gained by considering additional moment restrictions, it is not desirable to have "too many instruments" because this can cause problems (see Roodman, 2006). For this reason, not all the instruments available were included in the regressions since the size of the sample is relatively small, and a large number of instruments may result in a small sample bias. Specifically, up to 9 lags are considered[18].

Column 4 of table 4 shows the empirical results using one-step GMM estimators[19] with asymptotic standard errors robust to heteroskedasticity. An estimator that uses lags as instruments under the assumption of white noise errors could lose its consistency if the errors are serially correlated. To determine the consistency of the estimators it is necessary to test the validity of the instruments, *i.e.* testing lack of serial correlation (Arellano and Bond, 1991). Therefore the Hansen over-identifying test is carried out, and no evidence is found to reject the null hypothesis that the model is correctly specified and the instruments are valid. Furthermore, to test the additional moment conditions used in the levels equation, the Hansen Difference statistic was employed, which accepts their validity at 1% level.

The absence of serial correlation of the errors in levels is tested using the statistic proposed by Arellano and Bond (1991). This statistic tests the absence of second-order serial correlation of the first difference residuals. The evidence shows negative first-order serial correlation in differences (by construction), but no significant second-order serial correlation.

As can be observed in table 4, the first order autoregressive component AR(1) is significant at 10% and presents a high value (0.42), reflecting strong inertia. This indicates that a proper specification of cost efficiency must include a dynamic term. The inclusion of this variable causes the coefficients of the Lerner indices to be statistically significant. The empirical evidence under this specification rejects the quiet life hypothesis for the deposits market. This positive relationship between cost efficiency and market power in deposits may be due to the fact that, as indicated by Maudos and Fernández de Guevara (2005 and 2007), the banks that enjoy greatest market power

[18] The coefficients estimated do not change much if all possible instruments are permitted. However, the Sargan/Hansen test is weakened to the point where it generates implausibly good *p* values of 1.00.
[19] In finite samples, the asymptotic standard errors associated with the two-step GMM estimators can be seriously biased downward, and thus form an unreliable guide for inference (see Blundell and Bond, 1998). For this reason, the one-step GMM is preferred.

offer lower quality in services associated with deposits, so their operating costs are reduced and their efficiency increases. On the other hand, the evidence maintains the quiet life hypothesis in the loan market, and means that bank managers have fewer incentives to reduce their costs as their market power increases.

The economic impact of the Lerner indices on cost efficiency is greater when we consider that the current values of efficiency are determined by its previous values (see table 4). When the market power in deposits increases by 10%, *ceteris paribus*, efficiency increases by 0.47%. However, the impact of market power in loans is less. If banks increase the Lerner index for loans by 10%, their efficiency will decrease by 0.13%.

The results obtained indicate that the measures of economic policy aimed at increasing competitive rivalry in the Mexican banking system have different effects. On the one hand, social welfare increases due to the reduction of market power. On the other hand, since the elasticity associated with the Lerner index for deposits is greater than that for loans, the social welfare associated with cost inefficiency decreases. For this reason, it is necessary to quantify the net effect of the implementation of such economic policy actions.

With this aim, and by way of illustration, we analyze the possible consequences of a simultaneous reduction of 10% of market power in loans and deposits. The results indicate that it would lead to a decrease in cost efficiency of 0.34%, which for the year 2005 represents 0.0001% of GDP (column 3 of table 5). This same reduction of 10% of market power in loans and deposits would cause social welfare to increase by 0.09% (column 2 of table 5)[20]. Consequently, the net effect of the reduction of market power is a gain in social welfare, so economic policy should be oriented towards increasing banking competition.

[Insert table 5]

The results obtained for the Mexican banking system, though consistent with those obtained by Maudos and Fernández de Guevara (2005 and 2007) for the Spanish banking system and that of the European Union, respectively, are contrary to those obtained by Berger and Hannan (1998) for the U.S. The latter discrepancy may be due to the assumptions made by these authors to estimate the loss of social welfare (the Harberger's triangle). For this reason, we also estimate the loss of welfare using the

[20] Where the welfare gain is negative, this indicates a reduction of the gain, since there is no loss during these years.

same methodology as Berger and Hannan (1998), with the aim of testing the sensitivity of the results. Specifically, Berger and Hannan approximate the value of the welfare triangle loss by means of the following expression:

$$\textit{Welfare triangle loss} = (1/2)\cdot PQ\cdot\varepsilon\cdot\tau^2 \quad (17)$$

where P and Q represent respectively the price and the quantity of financial services where market power is exercised; ε is the absolute value of the elasticity of demand (or supply in the case of deposits); and τ is the proportional change in the price of exercising market power $\Delta P/P$. The value of PQ is proxied by banking revenues. In respect of the values of ε and τ, the results of the loss of social welfare were simulated giving values 1, 2 and 3 in the first case and 0.01, 0.05, 0.1 and 0.15 in the second.

Table 6 reports the results obtained. The results are observed to be sensitive to the elasticity values and to the difference between the monopoly price and that of perfect competition. Consequently, it cannot be determined whether the loss of social welfare associated with market power is greater than the loss of welfare caused by cost inefficiency, as this depends on the values of ε and τ.

[Insert table 6]

5. Conclusions

The objective of this study is threefold. First, to analyze the market power of the Mexican banking system in the period 1993-2005 (a period of deregulation, liberalization and consolidation of the industry). Second, to quantify the loss of welfare associated with market power as a consequence of setting prices above marginal costs (Harberger's triangle). And third, to analyze the effect of market power on the cost efficiency of banking management, testing the so-called *quiet life* hypothesis. For this purpose, we consider the existence of endogeneity of the Lerner indices and that current efficiency values may be determined by previous values.

Compared to other studies of the Mexican banking system, this paper presents the following novelties. First, the Lerner index is used to measure the evolution of market power and is estimated separately for the loans and deposits markets. Second, we estimate the loss of welfare associated with market power as a consequence of setting prices above marginal cost, and also as a consequence of being cost and profit inefficient. The loss of welfare is measured using the methodology of Oroz and Salas

(2003), and Maudos and Fernández de Guevara (2005 and 2007). The sensitivity of the results is analyzed using the simulation of Berger and Hannan (1998). Third, the relationship between cost efficiency and market power (quiet-life hypothesis) is analyzed for the first time in the Mexican banking system, as although other papers have analyzed its efficiency, none have studied the possible effect of market power on cost efficiency in the management of banks. A further novelty of the paper is that for the first time the endogeneity of Lerner indices is considered when testing the quiet life hypothesis, as well as the possibility that current values of efficiency may be determined by its previous values.

Using the Lerner indices to quantify Harberger's triangle, the results show that the evolution of the social welfare loss deriving from banks' market power is greater than the loss derived from cost (and profit) inefficiency in banking management, as they represent 0.15% and 0.021% (0.075%) of GDP, respectively in 2005. However, the results are not conclusive if the approach of Berger and Hannan (1998) is used, as it depends on the values of the elasticity of demand and on the difference between monopoly prices and those of perfect competition. For this reason, we opt for the approach of Oroz and Salas (2003), and Maudos and Fernández de Guevara (2005 and 2007) to proxy Harberger's triangle because it is not necessary to adopt assumptions for the value of these variables.

The results indicate that once banks had been sold to the private sector, the intensity of competition increased. Subsequently, the exchange rate crisis had an adverse effect on inflation and interest rates, inducing an increase in market power in loans and deposits. This increase in market power caused a rise in the loss of social welfare, which reached its maximum value. 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. In this last period, there is a downward evolution in the loss of social welfare.

The empirical evidence for the Mexican banking system rejects the quiet life hypothesis for the deposits market. This positive relationship between cost efficiency and market power in deposits may be, as indicated by Maudos and Fernández de Guevara (2005 and 2007), because banks which enjoy greater market power offer lower quality in the services associated with deposits, so their operating costs go down and their efficiency increases. Furthermore, the evidence is favorable to this hypothesis in the loans market.

One economic policy implication deriving from the results of the study is that the Mexican financial authorities must orientate their policies towards increasing competition in the banking sector, since the gain in social welfare attributable to the reduction of market power is greater than the loss of cost efficiency.

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Table 1: Descriptive statistics

Year	Banks	Statistics	Operating costs / TA	Price of labor / TA	Price of lendable funds / TA	Interest rate on loans	Interest rate on deposits	Interbank interest rate	Loans / TA	Deposits / TA	ln(TA)	Equity / TA	CR(3)	CR(5)
1993	13	Mean	4.08	0.00	0.02	17.73	16.69	18.29	61.88	55.78	1012.06	6.30	61.13	76.74
		Standard deviation	(0.01)	(0.00)	(0.00)	(0.03)	(0.05)	(0.00)	(0.20)	(0.14)	(0.99)	(0.03)		
1994	14	Mean	3.54	0.00	0.02	19.30	15.03	17.84	62.44	50.86	1020.51	5.05	60.36	74.30
		Standard deviation	(0.01)	(0.00)	(0.00)	(0.03)	(0.04)	(0.00)	(0.19)	(0.12)	(1.18)	(0.02)		
1995	24	Mean	3.23	0.01	0.33	59.43	39.82	55.21	57.71	51.38	873.44	11.94	55.01	68.92
		Standard deviation	(0.01)	(0.00)	(0.01)	(0.11)	(0.17)	(0.00)	(0.24)	(0.15)	(1.99)	(0.09)		
1996	29	Mean	3.36	0.01	0.54	36.39	26.40	33.61	49.13	42.45	853.21	9.64	51.89	64.65
		Standard deviation	(0.01)	(0.00)	(0.02)	(0.08)	(0.05)	(0.00)	(0.23)	(0.21)	(1.86)	(0.07)		
1997	27	Mean	5.77	0.03	0.53	22.14	16.36	21.91	67.46	55.69	786.09	18.73	58.57	71.79
		Standard deviation	(0.04)	(0.00)	(0.01)	(0.06)	(0.05)	(0.00)	(0.16)	(0.20)	(2.08)	(0.15)		
1998	24	Mean	6.18	0.03	0.46	26.36	15.45	26.89	64.39	52.10	792.76	20.36	53.51	67.26
		Standard deviation	(0.05)	(0.00)	(0.01)	(0.05)	(0.04)	(0.00)	(0.22)	(0.24)	(2.08)	(0.17)		
1999	20	Mean	5.72	0.03	0.49	23.74	11.60	24.10	59.80	62.80	833.27	17.40	58.21	74.09
		Standard deviation	(0.03)	(0.00)	(0.01)	(0.05)	(0.05)	(0.00)	(0.20)	(0.21)	(1.98)	(0.16)		
2000	22	Mean	5.62	0.02	0.40	16.93	8.26	16.96	53.98	55.14	798.35	16.99	62.92	77.63
		Standard deviation	(0.04)	(0.00)	(0.01)	(0.04)	(0.03)	(0.00)	(0.24)	(0.20)	(1.93)	(0.11)		
2001	20	Mean	5.53	0.02	0.43	12.80	6.23	12.89	52.64	68.95	849.84	12.07	57.90	73.62
		Standard deviation	(0.06)	(0.00)	(0.01)	(0.03)	(0.02)	(0.00)	(0.26)	(0.16)	(1.93)	(0.09)		
2002	18	Mean	5.17	0.02	0.41	8.20	3.76	8.17	55.04	61.50	854.78	16.86	61.80	77.85
		Standard deviation	(0.03)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.23)	(0.18)	(2.04)	(0.14)		
2003	20	Mean	5.27	0.01	0.30	6.91	3.09	6.83	58.02	63.38	850.17	13.47	59.23	75.81
		Standard deviation	(0.05)	(0.00)	(0.01)	(0.02)	(0.01)	(0.00)	(0.21)	(0.20)	(1.92)	(0.09)		
2004	18	Mean	5.90	0.02	0.48	7.22	2.70	7.15	55.79	65.10	866.04	12.87	58.29	74.66
		Standard deviation	(0.06)	(0.00)	(0.01)	(0.02)	(0.01)	(0.00)	(0.18)	(0.18)	(2.00)	(0.08)		
2005	18	Mean	5.84	0.02	0.55	9.90	3.46	9.61	56.42	62.80	855.99	15.19	61.53	80.68
		Standard deviation	(0.04)	(0.00)	(0.01)	(0.04)	(0.02)	(0.00)	(0.22)	(0.18)	(2.01)	(0.10)		

TA: total assets

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

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Table 2: Social welfare loss (% of GDP)

Year	Welfare loss	Loan market			Deposit market		
		Total	$Lerner_L$	$(r_L * L) / 2GDP$	Total	$Lerner_D$	$(r_D * D) / 2GDP$
1993	-0.58%	-0.39%	-0.17	2.27%	-0.18%	-0.07	2.57%
1994	-0.06%	-0.13%	-0.04	3.00%	0.06%	0.02	2.52%
1995	2.44%	0.34%	0.03	9.73%	2.11%	0.33	6.37%
1996	0.88%	0.08%	0.02	5.03%	0.79%	0.19	4.14%
1997	0.02%	-0.30%	-0.12	2.57%	0.31%	0.17	1.89%
1998	0.60%	-0.39%	-0.13	2.97%	0.99%	0.56	1.77%
1999	0.69%	-0.33%	-0.14	2.30%	1.01%	0.83	1.22%
2000	0.27%	-0.26%	-0.18	1.43%	0.52%	0.71	0.74%
2001	0.17%	-0.22%	-0.23	0.99%	0.39%	0.65	0.60%
2002	-0.06%	-0.22%	-0.35	0.63%	0.16%	0.47	0.34%
2003	-0.08%	-0.20%	-0.41	0.48%	0.12%	0.41	0.28%
2004	-0.01%	-0.21%	-0.39	0.54%	0.20%	0.75	0.27%
2005	0.15%	-0.21%	-0.29	0.72%	0.36%	1.03	0.35%
1993-95	0.60%	-0.06%	-0.06	5.00%	0.66%	0.09	3.82%
1996-99	0.55%	-0.23%	-0.09	3.22%	0.78%	0.44	2.25%
2000-05	0.07%	-0.22%	-0.31	0.80%	0.29%	0.67	0.43%
1993-05	0.34%	-0.19%	-0.18	2.51%	0.53%	0.47	1.77%

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

Table 3: Mean efficiency scores and social welfare loss associated to bank's cost and profit inefficiencies [1/]

Year	Cost efficiency	Profit efficiency	Welfare loss associated to cost inefficiency (% GDP)	Welfare loss associated to profit inefficiency (% GDP)
1993	0.90	0.79	0.027%	0.050%
1994	0.92	0.65	0.022%	0.111%
1995	0.91	0.76	0.022%	0.036%
1996	0.91	0.61	0.019%	0.085%
1997	0.91	0.54	0.020%	0.090%
1998	0.90	0.61	0.021%	0.057%
1999	0.90	0.76	0.020%	0.033%
2000	0.91	0.68	0.018%	0.046%
2001	0.91	0.68	0.018%	0.070%
2002	0.90	0.67	0.019%	0.056%
2003	0.91	0.69	0.018%	0.066%
2004	0.91	0.65	0.019%	0.093%
2005	0.91	0.73	0.021%	0.075%
1993-95 (s_1)	0.91	0.74	0.023%	0.141%
1996-99 (s_2)	0.91	0.62	0.017%	0.049%
2000-05 (s_3)	0.91	0.70	0.019%	0.073%
1993-05	0.91	0.68	0.020%	0.068%
Mann - Whitney test				
p-value H_0: $s_1=s_2$	0.37	0.24		
p-value H_0: $s_1=s_3$	0.76	0.74		
p-value H_0: $s_2=s_3$	0.35	0.30		

[1/] Weighted means (weighted by total assets)

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

Table 4: Determinants of cost efficiency

Variable	Static 1/		Dynamic 2/
	Within	2SLS	SYSGMM
Dependent variable $_{(t-1)}$			0.4157 *
			(4.58)
Lerner_Loans	-0.0098	-0.0133	-0.1343 ***
	(-0.25)	(-0.35)	(-1.95)
Lerner_Deposits	0.0419 **	0.0386 ***	0.0688 **
	(2.20)	(1.92)	(2.5)
ln(Total Assets)	0.0916 ***	0.0911 **	-0.0054
	(1.97)	(2.06)	(-0.19)
E^1 (loans / total assets)	0.3050 *	0.2999 *	0.6660 **
	(2.97)	(3.08)	(2.29)
E^2 (deposits / total assets)	0.1666	0.1735 *	0.0328
	(1.38)	(1.50)	(0.16)
E^3 (equity / total assets)	-0.1037	-0.0982	-0.1723
	(-0.40)	(-0.40)	(-0.47)
constant			0.8988 ***
			(1.86)
N. obs.	267	262	212
R^2	0.5290	0.6171	
Sargan / Hansen J Statistic over-identification test [p-value]		[0.913]	[0.344]
Anderson canonical correlations		354.71	
[p-value]		[0.000]	
Cragg-Donald under-identification test		879.12	
[p-value]		[0.000]	
Cragg-Donald weak-identification test		267.85	
Stock-Yogo weak ID test critical values: 10%		13.43	
Shea's Partial R^2 (lerner_L , lerner_D)		0.8755 , 0.8099	
First stage F-statistic (lerner_L , lerner_D)		912.28, 156.86	
[p-value]		[0.00 , 0.00]	
Arellano-Bond_order 1 [p-value]			[0.000]
Arellano-Bond_order 2 [p-value]			[0.558]
Difference-in-Sargan tests [p-value]			[0.515]
Elasticities			
Lerner_Loans			-0.0130
Lerner_Deposits	0.0285	0.0262	0.0467
ln(Total Assets)	0.1011	0.1005	
E^1 (loans / total assets)	0.1949	0.1916	0.4256
E^2 (deposits / total assets)		0.1088	
E^3 (equity / total assets)			

Dependent variable: ln[logistic(E^c) / (1-logistic(E^c)]

1/ Estimations with fixed effects and time effects

2/ Estimations with 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%

The Sargan/Hansen test is a test of overidentification restrictions. Under the null hypothesis, the test statistic is distributed as a chi-squared in the number of overidentifyng restrictions, p-values are presented in square brackets

The Cragg and Donald test is a test of of underidentification restrictions. Under the null hypothesis, the statistic is distributed as chi-squared with degrees of freedom (L-K+1) where L is the number of instruments (included + excluded) and K is the number of regressors, p-values are reported in square brackets

The Cragg and Donald weak-identification statistic is used to test that the equation is only weakly identified. The critical value for a 10% is reported in square brackets (Stock and Yogo statistic)

The first stage F-statistic test the hypothesis that the coefficients on all the excluded instruments are zero in the 1st stage regression of the endogenous regressor on all instruments. p-values are reported in square brackets

Shea's Partial R^2 is a measure of instrument relevance that takes into account intercorrelations among instruments.

Arellano-Bond_order 1 (2) are tests for first (second)-order serial correlation, asymptotically N(0,1). These test the first-differenced residuals in the system GMM estimators

System GMM results are one-step estimates

Difference-in-Sargan tests the additional instruments used by the System GMM estimator. Under the null hypothesis, valid specification, p-values are reported in square brackets.

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

Table 5: Social welfare gains and cost efficiency losses associated to a reduction in market power

(% of GDP)

Year	Social welfare gains	Cost efficiency lost
	-10% LernerL and -10% LernerD	-10% LernerL and -10% LernerD
1993	-0.6325%	0.00009%
1994	-0.0835%	0.00007%
1995	2.1995%	0.00007%
1996	0.7892%	0.00006%
1997	-0.0449%	0.00007%
1998	0.4662%	0.00007%
1999	0.5540%	0.00007%
2000	0.1888%	0.00006%
2001	0.1099%	0.00006%
2002	-0.0992%	0.00007%
2003	-0.1101%	0.00006%
2004	-0.0467%	0.00006%
2005	0.0891%	0.00007%

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

Table 6: Social welfare loss: Berger and Hannan' methodology (1998)

(% of GDP)

Year	τ=0.01			τ=0.05			τ=0.10			τ=0.15		
	ε=1	ε=2	ε=3	ε=1	ε=2	ε=3	ε=1	ε=2	ε=3	ε=1	ε=2	ε=3
1993	0.0004%	0.0007%	0.0011%	0.0093%	0.0185%	0.0278%	0.0370%	0.0740%	0.1110%	0.0833%	0.1666%	0.2498%
1994	0.0004%	0.0007%	0.0011%	0.0091%	0.0183%	0.0274%	0.0366%	0.0731%	0.1097%	0.0823%	0.1645%	0.2468%
1995	0.0008%	0.0017%	0.0025%	0.0210%	0.0420%	0.0631%	0.0841%	0.1682%	0.2523%	0.1892%	0.3784%	0.5676%
1996	0.0005%	0.0010%	0.0015%	0.0121%	0.0242%	0.0363%	0.0484%	0.0968%	0.1452%	0.1089%	0.2178%	0.3267%
1997	0.0003%	0.0006%	0.0009%	0.0076%	0.0152%	0.0229%	0.0305%	0.0610%	0.0915%	0.0686%	0.1372%	0.2058%
1998	0.0004%	0.0007%	0.0011%	0.0093%	0.0185%	0.0278%	0.0370%	0.0740%	0.1111%	0.0833%	0.1666%	0.2499%
1999	0.0004%	0.0007%	0.0011%	0.0088%	0.0175%	0.0263%	0.0351%	0.0702%	0.1053%	0.0790%	0.1579%	0.2369%
2000	0.0003%	0.0005%	0.0008%	0.0067%	0.0135%	0.0202%	0.0269%	0.0539%	0.0808%	0.0606%	0.1212%	0.1819%
2001	0.0002%	0.0004%	0.0006%	0.0053%	0.0105%	0.0158%	0.0211%	0.0421%	0.0632%	0.0474%	0.0948%	0.1421%
2002	0.0002%	0.0003%	0.0005%	0.0040%	0.0081%	0.0121%	0.0162%	0.0324%	0.0486%	0.0364%	0.0728%	0.1093%
2003	0.0001%	0.0003%	0.0004%	0.0034%	0.0069%	0.0103%	0.0137%	0.0274%	0.0412%	0.0309%	0.0617%	0.0926%
2004	0.0002%	0.0003%	0.0005%	0.0039%	0.0079%	0.0118%	0.0157%	0.0314%	0.0471%	0.0353%	0.0707%	0.1060%
2005	0.0002%	0.0004%	0.0006%	0.0051%	0.0103%	0.0154%	0.0205%	0.0410%	0.0615%	0.0461%	0.0923%	0.1384%

Notes: ε: elasticity of demand (or supply in the case of deposits)

τ: the proportional change in price from the exercise of market power ΔP/P

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

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Figure 1: Harberger's triangle

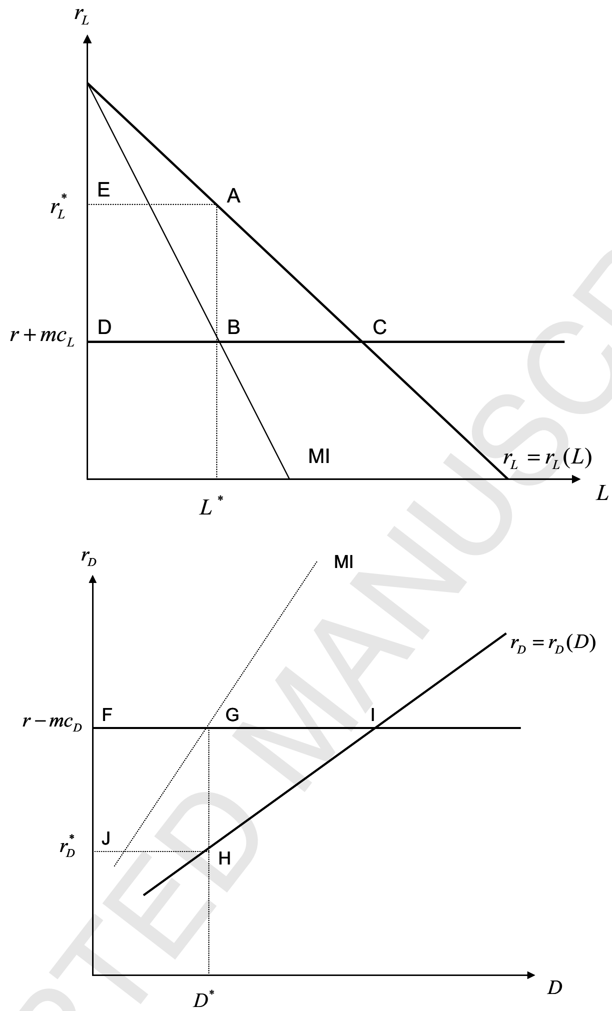
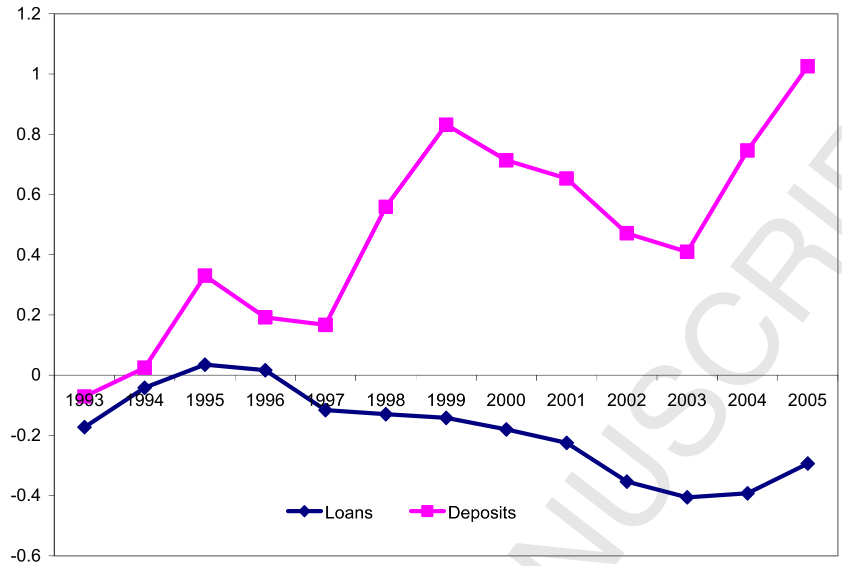


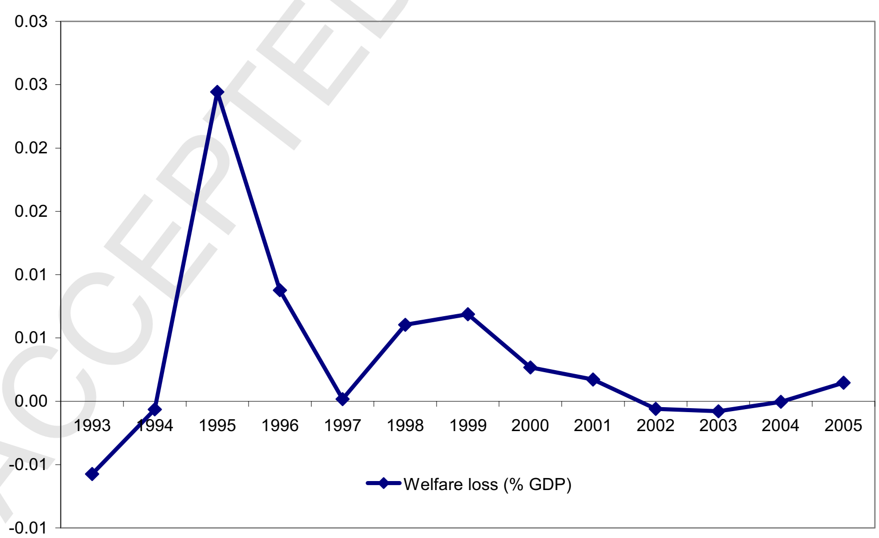
Figure 2. The evolution of the Lerner index



Note: Weighted means (weighted by total assets)

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

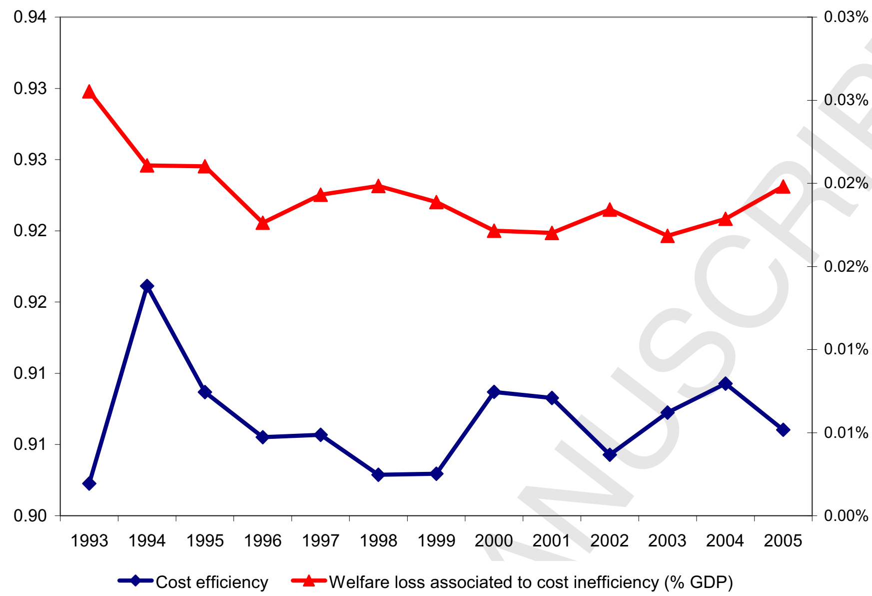
Figure 3: The evolution of the social welfare loss



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

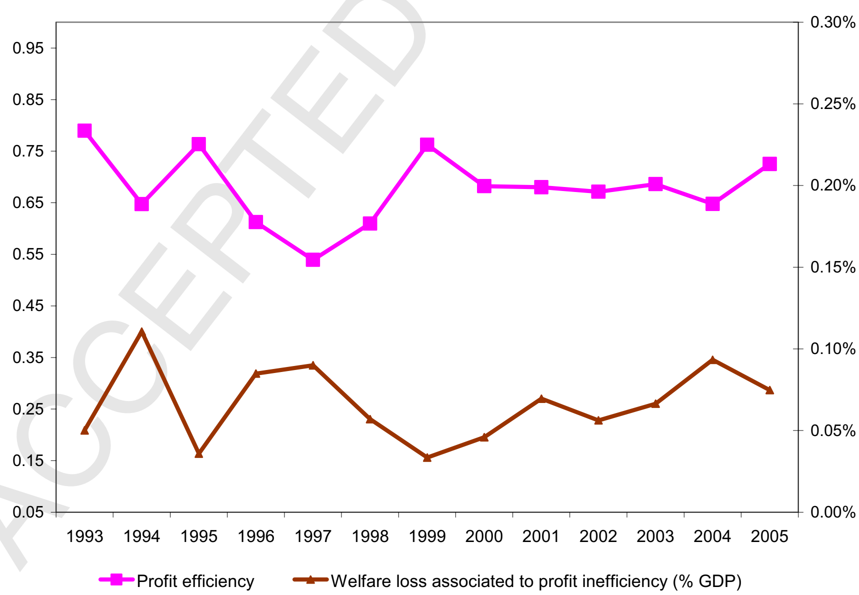
Figure 4: Efficiency scores and the evolution of the cost and profit inefficiencies

a) Cost efficiency



Note: Weighted means (weighted by total assets)
Source: Own elaboration based on data from *Comisión Nacional Bancaria y de Valores* and *Banco de México.*

b) Profit efficiency



Note: Weighted means (weighted by total assets)
Source: Own elaboration based on data from *Comisión Nacional Bancaria y de Valores* and *Banco de México.*