Is the market concentration and interest-rates relationship in the Mexican commercial banking industry a sign of efficiency?

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■ **Abstract:** This paper investigates the functional relationship between concentration and interest-rates in the Mexican commercial banking industry. A fundamental contribution of this essay is the use of parametric, nonparametric, and semiparametric procedures to determine the functional form of the concentration and interest-rate relationship. Regularities across products are checked. The semiparametric estimation dominates the other methods. The resulting functional form seems to support the prediction of the structure-conduct-performance paradigm of a positive concentration-price relationship.

■ **Resumen:** En este trabajo se investiga la relación funcional entre la concentración y las tasas de interés en la industria bancaria comercial mexicana. Una contribución fundamental de este artículo es el uso de procedimientos paramétricos, no-paramétricos y semiparamétricos, a fin de determinar la forma funcional de la relación de la concentración y las tasas de interés. Se han corroborado las regularidades entre productos. La estimación semiparamétrica domina a los otros métodos. La forma funcional resultante parece sustentar la predicción del paradigma en la estructura, conducta y desempeño de una relación positiva de concentración de precio.

■ **Key Words:** Market Concentration, Interest-Rate, Semiparametric Estimation, Structure-Conduct-Performance Paradigm, Efficient-Structure Paradigm.

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■ **JEL:** C14, G21, L10.

■ *Introduction*

An important debate between the traditional SCP (structure-conduct-performance) paradigm [Hannan (1991a)] and the ES (efficient-structure) paradigm [Demsetz (1973)] has arisen over the underlying causes of the relationship between concentration and profits in banking. The traditional SCP paradigm takes concentration as exogenous and maintains that high concentration allows for noncompetitive behavior that results in less favorable prices to consumers and higher profits to firms. The ES paradigm, however, takes firm-specific efficiencies as exogenous and maintains that these efficiencies result in both more concentrated markets and higher profits. This paradigm predicts that prices will be more favorable to consumers in concentrated markets because of the greater efficiencies exhibited in such markets.

An important question is at stake in the debate between the traditional SCP paradigm and the ES paradigm. On the one hand, the SCP paradigm suggests that antitrust or regulatory actions should be productive or beneficial. On the other hand, the ES paradigm suggests that such actions are likely to be counterproductive because these actions would eliminate the efficiency already present in the market. This paper focuses on whether semiparametric functional form improves the functional form of model specification in order to test the aforementioned conjectures.

As a consequence of problems of interpretation associated with studies that seek to identify the relationship between market concentration and firm profits, a growing body of literature has focused on the relationship between market concentration and observed prices. Weiss (1989) has summarized the general findings and significance of these studies up to the late 1980s. This paper can be viewed as another price[2]-concentration study, but applied specifically to the Mexican commercial banking industry.[3] To determine robustness with respect to

[2] In the case of the banking industry, the price is the interest-rate paid or received by the banking firms, depending on whether one deals with a deposit or a loan.

[3] The relationship between market structure and performance has been extensively studied for the U.S. banking. For instance, Gilbert (1984) provides a survey of empirical studies in the U.S. banking industry. Other studies about the commercial banking in the U.S. are Hannan (1991) and Shaffer (1989). Analysis of Market conduct and structure in other countries are presented by Matute and Vives (1994), Molyneux *et al.*, (1994), Lloyd-Williams and Molyneux (1994), Shaffer

methodology, parametric, nonparametric and semiparametric procedures are employed.

This paper departs from much of the previous cross-sectional literature because, in addition to testing hypothesis about the impact of market concentration on interest-rates, we estimate the functional form of the concentration-interest rates relationship. In other words, this paper does not attempt only to estimate or to test hypotheses about structural parameters. The aim of this paper is to shed some additional light on the functional relationship between market concentration and price, instead of determining simply if the null hypothesis of no relationship can be rejected in favor of a positive relationship as supported by the SCP conjecture.[4] Such a concentration-to-interest-rates relationship analysis may be important to bank merger policy considerations, because mergers intended to achieve market power gains and those intended to achieve efficiency gains may have different social implications.

The approach of this paper is motivated by the following practical questions encountered in applied industrial organization and in antitrust policy, namely: (1) what is the most appropriate measure of market concentration?; (2) at what point in the relationship between market-concentration and observed-interest-rates do increases in market concentration begin to influence banking interest-rates and whether increases in concentration fail to result in increased interest-rates at a given point?; (3) is the relationship between concentration and interest-rates continuous over a range or does it have kinks?, in other words, is there a threshold level of concentration above which interest-rates are uniformly high and below which they are uniformly low?; and most importantly, (4) is there any indication of a functional relationship between interest-rate and concentration that exhibits similarities and across products?

(1995), and Molyneux *et al.*, (1996). Specifically, Molyneux et al. (1996) present an empirical asssessment of competitiveness in the Japanese banking market. Moreover, Molyneux et al. (1994) show that banks in Germany, UK, France and Spain earned revenues as if under conditions of monopolistic competition. In contrast, research work investigating this relationship for Mexican banking has been scant.

4 Numerous studies find a positive statistical relationship between market concentration and measures of firm or industry profitability. Among these studies, Berger and Hannan (1989), and Lloyd-Williams and Molyneux (1994) support the SCP paradigm. Rhoades (1981) investigates the shape of the relationship between market concentration and bank performance measures using profit rates and prices constructed from bank income and call reports.

Two different types of commercial loans and two different types of deposit accounts were chosen for this study in order to check for regularities across products in the relationship between concentration and interest-rate in the Mexican commercial banking industry. [5]

From the parametric analysis, with the exception of unsecured variable-rate loans, loan-rate concentration relationships have in common a relatively sharp rise in rates starting at Herfindahl index values greater than 1667 and continuing to the highest observed values of the index.[6] The start of the rise in the concentration interest rate relationship occurs, if anything, at higher values of concentration. Observed functional relationships for the two deposit accounts examined are less stable across products. In the case of rates offered for money deposit accounts most of the decline in deposit rates accompanying an increase in the Herfindahl index occurs before the index reaches 1667, while immediate withdrawal deposit account rates during the same period continue their decline over much higher levels of concentration.[7]

In terms of the different concentration measures employed, the one-firm concentration ratio results in the highest adjusted R-squared in the parametric regression. However, the Herfindahl index ranks more consistently among the measures producing the highest R-squared over the many cross-sections examined. No strong evidence in favor of a concentration-interest-rate relationship that is positive in one range of the concentration measure and negative in another is found. Rather this relationship seems to support the SCP paradigm.

For any given product examined, results concerning the functional form appear to be robust for the parametric and semiparametric methods. With a few exceptions, both parametric and nonparametric methods appear to produce the same general outlines of the price-concentration relationship, but in terms of the Mean Square Error of fit, the semiparametric estimation definitely dominates the other procedures.

The remainder of this paper is organized as follows. Section 2 specifies the model used. Section 3 describes the data and sources, as well as the approach of the analysis. Section 4 presents the empirical

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5 Data from three different time periods characterized by relative interest rate stability were collected to check regularities over time.

6 Merger guidelines in the U.S. case are primarily concerned with mergers only after the Herfindahl index reaches values greater than 1500.

7 The cross sections of April-May 1998 and January-February 2000 generally indicate a much weaker relationship between measures of concentration and deposit rates. These relationships appear to show some variation over time.

findings about the market concentration and commercial loan rates relationship, as well as the market concentration and deposit rates relationship. Section 5 concludes this essay with a summary of the underlying findings.

■ *Model Specification*

Following Weiss (1974) and Smirlock (1985), the traditional SCP paradigm and the ES paradigm can be tested by estimating the reduced-form interest rate equations in the form:

$$r_{ijt}^{k} = a + b'x_{ijt}^{k} + \delta MS_{jt}^{k} + \gamma C_{jt}^{k} + v_{ijt}^{k} \quad (1)$$

where r_{ijt}^{k} represents the interest rate paid (or received) at time t on product k by bank i located in market j. x_{ijt}^{k} denotes a vector of control variables that may differ across banks, markets, products or time periods. These control variables account for firm-specific and market-specific characteristics. They include factors exogenous to the bank that may affect prices through market conditions or costs considerations.[8] C_{jt}^{k} denotes a measure of concentration in local market j for product k at time t. MS_{jt}^{k} is a measure of market share in local market j for product k at time t. Coefficients are represented by a, the vector b', δ and γ, while v_{ijt}^{k} denotes the error term.

In vector notation, model (1) could be reduced to:

$$r = X\beta + \gamma c + v, \quad (2)$$

8 Research in the mainstream of industrial organization has tested the relationship between price (an index of performance) and concentration (an index of structure) including the following variables: an index of concentration or market share, financial variables and ratios, and macroeconomic variables, among others. Included financial variables and ratios are: total assets of the bank, savings, loans, the growth rate of deposits in the bank's market, total interest revenue, unit of capital, unit price of funds, number of branches of the bank, loans-to-deposits ratio, loans-to-assets ratio, capital-to-assets ratio, interbank-deposits-to-total-deposits, and the ratio commercial-and-industrial-loans to total-loans. Macroeconomic variables are local per capita income and local bank wage rate. Usually, dummy variables are location and ownership, [See Berger and Hannan (1989), Lloyd-Williams and Molyneux (1994), Molyneux et al. (1996), and Molyneux et al. (1994)].

where X includes a vector of ones, the control variables, and the measure of market share. *a, b*, and δ are now included in the vector β. c is the measure of concentration. v is the residuals vector.

The SCP paradigm maintains that market concentration results in prices less favorable to consumers. When the prices employed are interest-rates on loans, this paradigm implies a positive interest-rate-concentration relationship, or $\gamma>0$. Conversely, when the prices employed here are interest-rates on deposits, the SCP paradigm implies a negative interest-rate-concentration relationship, or $\gamma<0$.

The ES paradigm implies that loan interest rates will be more favorable to consumers in concentrated markets because of the greater efficiencies exhibited in such markets. Thus, this suggests a non-positive interest-rate-concentration relationship, or $\gamma\leq0$. Conversely, the ES paradigm implies that if banks in concentrated markets are more efficient in collecting deposit funds and transforming them into profitable investments, the marginal dollar of deposits should have more value to them. Thus, these banks should offer higher interest rates to depositors, implying a non-negative interest-rate-concentration relationship, or $\gamma\geq0$.

The Approach and Issues of Analysis

We employ interest-rates either charged or paid by banks to examine the relationship between concentration and interest-rates as they apply to two different types of commercial loans and two different types of bank deposits. Assuming that the market competition of these products is local in Mexico, the availability of information on the interest-rates associated with these products provides an opportunity to estimate numerous cross-sectional concentration-and-interest-rate relationships as they apply to the Mexican banking industry.[9]

In order to avoid distortions in equilibrium concentration-and-interest-rate relationships resulting from such differential interest-rate responses, only periods of relative interest-rate stability are examined. Evidence from both within and outside the banking industry suggests that firms in more concentrated markets may adjust prices more slowly in response to exogenous shocks. The early half of 1999 represents by

9 This assumption is not as strong as it may appear. When looking for a loan, people frequently go to local bank branches. Likewise, a similar argument applies to deposits. Additionally, for the U.S. case Berger and Hannan (1989) provide substantial evidence suggesting that competition of these products is at a local basis.

far the longest period of the data available; during this period interest rates remain relatively unchanged.[10]

Data will be restricted to banks operating in Mexican metropolitan areas because municipalities are less reliable for defining rural markets and because of possible complications introduced by urban and rural differences. As in all relevant banking studies, measures of market concentrations are constructed from information about the deposit shares of all banks operating in a defined market.[11]

Several approaches are employed in examining the functional relationship between interest-rate and concentration (for each of the four banking products). The first approach is a straightforward linear regression analysis that examines the performance of various proposed measures of market concentration, controlling for other measurable determinants of interest-rate. A second approach is a parametric approach that examines the impact of the $(x+1)^{th}$ largest market share with x-firm concentration ratio included in the regression. A third parametric approach examines the relationship between interest-rate and concentration by employing a series of dummy variables, each variable indicating a range of concentration defined on the basis of a given concentration measure.[12]

The last approach involves nonparametric procedures. Additionally, a semiparametric estimation of each relationship [Pagan and Ullah (1999)] is proposed because when used individually, both parametric

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[10] The relationship between interest-rate and concentration as they apply to each of these products is estimated at three different points in time: March to June 1998, March to September 1999, and January to March 2000. These periods were chosen because they represent periods of relative interest-rate stability in Mexico. Thus, of the three periods, July 1999 is chosen because it is the greatest interest rate stability period during 1998-2000. The other two periods represent much shorter intervals during which interest rates did not change as much. Information for those periods (1998 and 2000) can be requested from the author. The implied functional form for the market concentration and interest-rate relationship is similar over these periods and, therefore, they are not discussed in detail.

[11] This is necessary given the fact that only deposits (and not, for example, loans) are available on a branch-by-branch basis. Only banks with a majority of their deposits in one market are included in the analysis in order to ensure a close correspondence between market concentration and observed interest-rates.

[12] The interval dummies are determined using the optimal bandwith from the nonparametric analysis.

and nonparametric procedures have certain drawbacks. To explain these drawbacks let the regression model (2) be

$$r = X\beta + m(c) + v, \tag{3}$$

where $m(c)$ is γc only if the model is linear (parametric).

The pure nonparametric estimation transforms model (3) in:

$$r = m(c) + v, \tag{4}$$

where $v = X\beta + v$. In the relationship $r = m(c) + v$, where m is a function of unknown form, $m(c)$ is the conditional expectation of r.[13] If $m(c) = f(\psi, c) = \psi c$ from almost all c, and some ψ, then we say that the parametric regression model given by $r = m(c) + v$ is correct. It is well known that one can construct a consistent estimate of ψ, say $\hat{\psi}$, and hence a consistent estimate of $m(c)$ given by $\hat{m}_p(c) = f(\hat{\psi}, c) = \hat{\psi} c$. Provided that the parametric regression model is incorrect, $f(\hat{\psi}, c)$ may not be a consistent estimate of $m(c)$.

Parametric estimates have a major drawback. Regardless of the data, a parametric estimate cannot approximate the regression function better than the best function that has the assumed parametric structure. For instance, a linear regression estimate will produce a large error for every sample size if the true underlying regression function is not linear and cannot be well approximated by linear functions. Nevertheless, one can still consistently estimate the unknown regression function $m(c)$ by various nonparametric estimation techniques [See Hardle (1990) and Pagan and Ullah (1999) for details]. In this paper, the kernel estimator is considered because it is easy to implement and its asymptotic properties are now well established:

$$\hat{m}_{np}(c) = \sum rK\left(\left\lfloor c_i - c \right\rfloor / h\right) / \sum K\left(\left\lfloor c_i - c \right\rfloor / h\right), \tag{5}$$

where the summation runs over all observations, $K(.)$ is the kernel, h is the bandwidth.[14] This could be calculated for several values of c, producing an empirical representation of the unknown functional form m. This formula can be exploited to produce an estimate of the

13 $m(c)$ can be calculated as $E(r \mid c) = \int r f(r \mid c) dr$.

14 Performing the calculation of $E(r \mid c) = \int r f(r \mid c) dr$, using for $f(r|c)$ the estimate of it that results from the ratio of the joint density to the marginal density, after some algebra, the estimated $m(c)$is as given in (5).

conditional mean of any function of c, simply by replacing c_i by the relevant function of c.

In practice, the choice of functional form for the kernel is not important (so our choice of the normal distribution is uncontroversial), but the choice of variance for the kernel is very important. This suggests that an appropriate kernel could be of the form $N(0, h^2)$, where the standard deviation h is chosen with care. A small value of h means that the kernel puts non-negligible weight on observations very close to c_0; thus, the choice of h is analogous to the choice of interval width. Because the magnitude of h determines which observations are considered, h is called the bandwidth. The logic of all this suggests that h should decrease as the sample size increases, and in fact it can be shown that the optimal value of h is proportional to the fifth root of the sample size [Wand and Jones (1995)]. A further problem is that a value of h that is suitable for estimation of the main body of the density of c may not be large enough for estimation of the tails of that distribution (because there are fewer observations in the tails), suggesting that some method of allowing h to vary might be appropriate. Doing so creates variable-bandwidth estimators.[15] There is some agreement in the semiparametric literature that cross-validation is helpful in selecting the bandwidth parameter.[16] For our specific case, the kernel estimator becomes.

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[15] If h is chosen to be too small, too few observations will have non-negligible weight and the resulting density estimate will appear rough (or undersmooth-this is why h is called the smoothing parameter). If it is chosen too large, too many observations will have a non-negligible weight, oversmoothing the density. This introduces extra bias into the estimation procedure, because observations not extremely close to the c value for which the density is being calculated do not belong to it. Thus, there is a trade-off between variance and bias. A high value of h reduces the variance of the density estimate (because it causes more observations to be used) but introduces more bias.

[16] Further literature about Cross-validation can be found in Hardle (1990), Gyorfi et al. (2002), and Simonoff (1996). The Cross-validation selection of h is

$$H_n = \arg\min_{h \in \Phi_n} \left\{ \frac{1}{n} \sum \left(m_h(c) - r \right)^2 \right\},$$

where Φ_n is the set of possible bandwidths. Define the cross-validation estimate by $m_n^{(H)}(c)$. In other words, the selection of the bandwidth using cross-validation consists of setting some data aside before estimation; if the average square error of these data begins to rise, the bandwidth has become too small.

$$\hat{m}_{np}^{(H)}(c) = \sum rK\left(\lfloor c_i - c \rfloor / h_i\right) / \sum K\left(\lfloor c_i - c \rfloor / h_i\right), \tag{6}$$

where the summation runs over all observations, $K(.)$ is the kernel, h_i is the resulting individual bandwidth from the cross-validation method. From (4), it is clear that a nonparametric approach does not allow for extensive statistical control of other potential determinants of interest-rates because of the paucity of observations, particularly in the case of bank deposit rates.

The semiparametric approach uses model (3), such that it is expressed in the following way:

$$r = X\beta + u, \tag{7}$$

where $u = m(c) + v$. Semiparametric estimation proceeds by first fitting r and X of this last model (3) by OLS. The residuals that result are

$$\hat{\vartheta} = \hat{u} = r - X\hat{\beta}^{OLS}.$$

$m(c)$ is obtained by fitting $\vartheta = r - x\hat{\beta}^{OLS}$ nonparametrically with c.

$$\vartheta = m(c) + v. \tag{8}$$

In this case, $m(c)$ is the conditional expectation of ϑ where m is a function of unknown form. If $m(c) = g(\gamma,c) = \gamma c$ from almost all c, and some γ, we say that the parametric regression model given by $\vartheta = m(c) + v$ is correct. Again, one can construct a consistent estimate of γ, say $\hat{\gamma}$, and hence a consistent estimate of $m(c)$ given by $\hat{m}_p(c) = g(\hat{\gamma},c) = \hat{\gamma}c$. In general, if the parametric regression model is incorrect, the $g(\hat{\gamma},c)$ may not be a consistent estimate of $m(c)$. However, one can still consistently estimate the unknown regression function $m(c)$ by nonparametric estimation techniques. The kernel estimator is again considered:

$$\hat{m}_{sp}^{(H)}(c) = \frac{\sum \hat{\vartheta} K\left(\lfloor c_i - c \rfloor / h_i\right)}{\sum K\left(\lfloor c_i - c \rfloor / h_i\right)}, \tag{9}$$

where the summation runs over all observations, $K(.)$ is the kernel, h_i is the resulting individual bandwidth from the cross-validation method. Suppose the econometrician has some knowledge of the parametric form of $m(c)$ but there are regions in the data that do not conform to this specified parametric form. In this case, even though the parametric model is misspecified only over portions of the data, the parametric inferences may be misleading. In particular, the parametric fit will be poor (biased) but it will be smooth (low variance). On the other hand, the nonparametric techniques which totally depend on the data and have *no a priori* specified functional form may trace the irregular pattern in the data well (less bias) but may be more variable (high variance). Thus, the problem is when the functional form of $m(c)$ is not known, a parametric model may not adequately describe the data where it deviates from the specified form, whereas a nonparametric analysis would ignore the important *a priori* information about the underlying model. A solution is to use a combination of parametric and nonparametric regressions, which can improve upon the drawbacks of each when used individually. The following combination of parametric and nonparametric fits, $\hat{m}_{sp}^{(opt)}(c)$, is proposed:[17]

$$\hat{m}_{sp}^{(opt)}(c) = g(\hat{\gamma},c)+\hat{\theta}\hat{\mu}(c), \tag{10}$$

where $\hat{\mu}(c) = \hat{m}_{sp}^{(H)}(c) - g(\hat{\gamma},c)$. $\hat{m}_{sp}^{(H)}(c)$ is determined by (9), and $g(\hat{\gamma}, c)$ is the parametric part of the combined estimation. In this case, one adds the nonparametric fit with a weight $\hat{\theta}$ to the parametric start $g(\hat{\gamma}, c)$. This combined procedure maintains the smooth fit of parametric regression while adequately tracing the data by the nonparametric component [Ullah and Mundra (2002)]. The combined estimator $\hat{m}_{sp}^{(opt)}(c)$ also adapts to the data (or the parametric model) automatically through $\hat{\theta}$ in the sense that if the parametric model accurately describes the data, then $\hat{\theta}$ converges to zero, hence $\hat{m}_{sp}^{(opt)}(c)$ puts all the weight on the parametric estimate asymptotically; if the parametric model is incorrect, then $\hat{\theta}$ converges to one and $\hat{m}_{sp}^{(opt)}(c)$ assigns all weights on the kernel estimate asymptotically.

The focus of this paper is to determine whether a semiparametric functional form improves the functional form of model specification in testing the SCP and ES paradigm conjectures, rather than substantiating the predictions of these paradigms or testing their validity. By doing so,

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[17] The idea of combining the regression estimators stems from the work of Olkin and Spiegelman (1987), who studied combined parametric and nonparametric density estimators. Following their work, Ullah and Vinod (1993), Burman and Chaudhri (1994), and Fan and Ullah (1999) proposed combining parametric and nonparametric kernel estimator additively, and Glad (1998) multiplicatively. The proposed estimators here are more general, and intuitively more appealing, and their Mean Square Error (MSE) performances are better than those of Glad (1998), Fan and Ullah (1999), and Burman and Chaudhri (1994). They were used by Ullah and Mundra (2002).

both the bias and the variance [or the mean squared error (MSE) of the fit] of each procedure are controlled.

■ *Data Description and Sources*

The data includes all Mexican banks that were in business from 1998 to 2000. Data on individual banks is gathered from the quarterly report of the Mexican *Comisión Nacional Bancaria y de Valores* (CNBV), Banking and Securities-Exchange National Commission, during this period.

The data on loan rates employed in the study are obtained from Boletín Estadístico de Banca Múltiple, published by CNBV, which provides extensive information on the characteristics of individual loans made by Mexican commercial banks. During the months of March, June, September, and December of each year, this bulletin provides information concerning the loans that were originated during a period that ranges from one to five days, depending on the size of the bank. In addition, information on loan rates and method of calculation, data on maturity, loan size, commitment status, collateralization, and other characteristics of each loan are available from the same bulletin.

Data concerning money deposit accounts and immediate withdrawal deposit accounts are also obtained from the CNBV. It consists of a random sample of all the banks representing all categories of commercial banks, bank size, and geographic regions of Mexico. 78 metropolitan areas are included in the analysis. The unit of observation in this case is the bank rather than the loan or individual deposits.

The choice of an appropriate measure of banking market concentration is difficult because the theory provides little guidance as to which measure is better suitable when the type of noncompetitive behavior is unknown. To determine whether the results are sensitive to the choice of concentration measure, I employ the following measures: the Herfindahl index, and the one- to five-firm concentration ratio. In order to examine the impact of the $(x+1)^{th}$ largest market share with x-firm concentration ratio included in the regression, I use the second to fifth ranked firm's market share (See Table 1).

A variable indicating the bank's total assets (bank size) is included as a control in parametric estimations in order to account for numerous possible differences, including cost differences that may vary with bank size. Variables specific to the local markets in which banks operate are included. Population is included to control for possible differences in the size of the metropolitan areas (large and small urban areas). This variable is relevant because small urban areas have fewer banks relative to large urban areas. Earnings are included to account for exogenously determined

Table 1
Variable definitions, Sample Means, and sample Standard Deviations for the Mexican Banks in the period 1998-2000

Symbol		*Definition*	*Mean*	*Stand. Dev.*
Control variables				
ASSETS	≡	Bank's total assets (bank size)*	129,374,340	26,332,150
WAGE	≡	Hourly earnings of nonsupervisory manufacturing employees in the market.* Maturity (days).	$29.70	3.90
MATUR	≡	Loan size*.	62	29
LOAN_S	≡	Population (inhabitants).	11,285.00	6,695.86
POP	≡	Failure Rate: Number of annual failures per	115,827	56,348
FAIL_R	≡	10,000 business in the state in which each bank is located.	4.8	3.6
COMT	≡	(Commitment status) Dummy variable		
D_NOTE	≡	indicating if the loan involved is made under a loan commitment. (Demand Note) Dummy variable indicating that the loan in question entails no maturity.		

Concentration Variables**,***			*L1*	*L2*	*D1*	*D2*
H	≡	Herfindahl index.	1568	1648	1426	1870
CR_1F	≡	One-firm concentration ratio.	2691	2863	2346	2818
CR_2F	≡	Two-firm concentration ratio.	4946	5078	4365	5283
CR_3F	≡	Three-firm concentration ratio.	5973	6084	5766	6941
CR_4F	≡	Four-firm concentration ratio.	6618	6985	6576	7855
CR_5F		Five-firm concentration ratio.	7192	7547	7152	8446
Market Share Variables**, ***						
MS_2R	≡	Second ranked firm's market share.	2256	2215	2019	2465
MS_3R	≡	Third ranked firm's market share.	1026	1006	1402	1658
MS_4R	≡	Fourth ranked firm's market share.	645	901	810	914
MS_5R	≡	Fifth ranked firm's market share.	574	563	576	591

* Monetary quantities are in Mexican pesos, base year 2000.

** Concentration and market shares variables have been standardized to values between 0 and 10,000.

** Means by products: L1. Unsecured, variable-rate commercial loans.
L2. Secured, variable-rate commercial loans.
D1. Money deposit accounts.
D2. Immediate withdrawal deposit accounts.

differences in labor costs across areas. An additional variable, failure rate, is defined as the number of annual failures per 10,000 businesses in the state in which each bank presumably does most of its lending. This variable accounts for the possible influence of differences (in riskiness) in the business environment in which banks are located. Table 1 presents variable definitions. It also provides descriptive statistics for the period 1998-2000 (the sample mean and the sample standard deviation).

Untabulated results for this period 1998-2000 show that each banking office has a potential customer base of 15,000 people. There are on average 25 checking, savings or other type of accounts for every 100 persons. There is a high concentration of banking activity in Mexico City: almost 60% of total deposits (58.56%) and total loans (58.91%) are on this market. For the rest of the country there is only one banking office for every 1,000 squared kilometers, providing service to 21,500 people per bank. The efficiency measure for those provincial offices is 15 accounts for every 100 people. The Mexican banking is now integrated mainly by 25 banks (10 Mexican and 15 foreign subsidiaries). 10 banks have nationwide operations while the rest have regional operations. Of the six largest banks, four are controlled by foreign banks.

■ *Empirical Results*

In this section we consider the relationship between price and concentration as it applies to two different types of commercial loans and two different types of deposits. When choosing the loans to be examined, two important characteristics of loans are considered. The first involves the distinction between secured and unsecured loans and the second concerns the difference between loans with fixed (for the length of the loan) rates or variable rates. Since the vast majority of bank loans issued in 1998, 1999, and 2000 involved variable rates, we examine loans of each category of secured variable-rate loans and unsecured variable-rate loans.

As for the different types of deposits, money deposit accounts and immediate withdrawal deposit accounts are used. Money deposit accounts typically impose minimum balance requirements, limiting the account holder to a specified number of check transactions per month, and these typically vary more substantially across banks in terms of fees and other characteristics.[18]

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[18] Because deposit rates, unlike loan rates, are paid by the bank, rather than to the bank, the relationship between concentration and interest-rate is predicted to be negative rather than positive in the case of deposit rates.

Market concentration and commercial loan rates

The relationship between concentration and interest-rate is examined as it applies to unsecured, variable-rate loans during the three periods mentioned previously. Table 2 reports parametric estimations that look at the relationship in July 1999 in three ways. Panel A reports six OLS regressions that control for the same potential determinant of loan rates but that differ in terms of the measure of concentration employed (the Herfindahl index and the one- through five-firm concentration ratios). Panel B focuses on the additional impact of the $(x+1)^{th}$ largest firm's market share after accounting for the x-firm concentration ratio. Finally, Panel C reports OLS regressions using dummy variables to indicate small ranges of concentration that are defined on the basis of the concentration measure producing the highest adjusted R-squared in panel A and, because of its role in industrial organization theory, the Herfindahl index is also included.

Results from panel A show that all estimations yield concentration coefficients that are positive and have high t-statistics. The regression employing the one-firm concentration ratio (CR_1F) yields the highest adjusted R-squared (0.2082). It is followed by the regression using five-firm concentration ratio (CR_5F) and the one using the Herfindahl index (H).[19]

In terms of the other explanatory variables, maturity (MATUR) has the expected negative coefficient, suggesting lower rates for longer maturity loans. The negative coefficients of LOAN_S, defined as the log of the size of the loan, appear to be quite significant and indicate that larger loans, *ceteris paribus*, entail lower rates. COMT is a dummy variable taking the value of one if the loan in question is made under a loan commitment. The significant negative coefficient on COMT reflects the fact that commitments are typically offered to less risky customers. D_NOTE is a dummy variable indicating that the loan in question entails no maturity (often referred to as a "demand note"). Such loans typically entail a lower rate. The positive coefficients of FAIL_R (failure rates per 10,000 businesses in the local state) are consistent with the hypothesis that loan rates are higher in areas with high business failure rates, but they are generally not significant. The coefficients of bank size (ASSETS), market wage (WAGE), and market population (POP) are not statistically significant.

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[19] Other studies present R-squared approximately in the range 0.01 to 0.80. For instance, the R-squared was from 0.27 to 0.58 for Lloyd-Williams and Molyneux (1994), 0.01 to 0.68 for Molyneux et al. (1996), and 0.33 to 0.80 for Berger and Hannan (1989)], although, in average the R-squared is below 0.30.

Table 2
The relationship between the Rate Charged for Unsecured, Variable-Rate Commercial Loans and various measures of Market Concentration (July 1999)

A. Concentration measures

Explanatory Variables	*Concentration measures*					
	H	*CR_1F*	*CR_2F*	*CR_3F*	*CR_4F*	*CR_5F*
Constant	22.87	22.78	22.83	22.74	22.67	22.58
	(39.12)	(38.94)	(38.98)	(38.56)	(38.25)	(37.87)
Concentration	1.50 E-4	1.25 E-4	0.74 E-4	0.70 E-4	0.75 E-4	0.94 E-4
	(5.07)	(5.46)	(4.77)	(4.65)	(4.94)	(5.87)
MATUR	-0.09	-0.09	-0.09	-0.09	-0.08	-0.08
	(-2.66)	(-2.74)	(-2.70)	(-2.67)	(-2.50)	(-2.50)
LOAN_S	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27
	(-17.05)	(-17.13)	(-17.00)	(-17.01)	(-16.84)	(-16.82)
ASSETS	0.015	0.013	0.012	0.012	0.50 E-2	0.50 E-2
	(0.75)	(0.67)	(0.60)	(0.61)	(0.24)	(0.25)
WAGE	0.92 E-2	0.013	0.96 E-2	0.96 E-2	0.54 E-2	0.54 E-2
	(0.55)	(0.77)	(0.57)	(0.56)	(0.33)	(0.33)
POP	0.48 E-5	0.57 E-5	0.39 E-5	0.56 E-5	0.61 E-5	0.88 E-5
	(0.92)	(1.08)	(0.71)	(1.02)	(1.12)	(1.59)
COMT	-0.46	-0.46	-0.45	-0.45	-0.45	-0.45
	(-11.98)	(-11.98)	(-11.56)	(-11.58)	(-11.62)	(-11.63)
D_NOTE	-0.21	-0.22	-0.21	-0.21	-0.20	-0.20
	(-4.70)	(-4.95)	(-4.58)	(-4.59)	(-4.50)	(-4.51)
FAIL_R	0.80 E-3	0.67 E-3	0.63 E-3	0.63 E-3	0.59 E-3	0.59 E-3
	(2.15)	(1.81)	(1.65)	(1.66)	(1.57)	(1.57)
No. of loans	2620	2620	2620	2620	2620	2620
Adj-R^2	0.2060	0.2082	0.2051	0.2047	0.2056	0.2076

B. The effect of adding the Next Highest Market Share to the Concentration Rate (All Control Variables included)

CR_1F	1.85 E-4	CR_2F	0.74 E-4	CR_3F	0.75 E-4	CR_4F	1.12 E-4
	(5.13)		(4.78)		(4.86)		(6.75)
MS_2R	-1.37 E-4	MS_3R	0.17 E-4	MS_4R	1.66 E-4	MS_5R	5.21 E-4
	(-2.16)		(0.34)		(2.01)		(5.69)
Adj-R^2	0.2083	Adj-R^2	0.2048	Adj-R^2	0.2057	Adj-R^2	0.2152

C. Investigating functional form with Dummy Variables indicating Range of Concentration (All Control Variables included)

H:	500<H≤1000	1000<H≤1200	1200<H≤1667	1667<H≤2200	2200<H≤2667	H>2667	Adj-R^2
	-0.15 E-4	0.12 E-4	-0.18 E-4	0.51 E-4	0.41 E-4	0.25 E-4	0.2258
	(-2.67)	(1.88)	(-2.24)	(6.61)	(0.68)	(3.13)	
No. of Banks	4	2	2	4	3	4	
(14 with H≤500)							
CR_1F:	1800<C≤2000	2000<C≤2300	2300<C≤2600	2600<C≤3000	3000<C≤3600	C>3600	Adj-R^2
	-0.16 E-4	-0.07 E-4	-0.02 E-4	0.36 E-4	0.23 E-4	0.31 E-4	0.2361
	(-1.63)	(-1.12)	(-0.13)	(4.34)	(-3.68)	(4.39)	
No. of Banks	3	3	4	3	2	3	
(15 with C≤1800)							

Numbers in parenthesis are t-statistics.

Panel B presents the results of adding the next highest ranked bank in calculating the numerator of the concentration ratio. Results are generally consistent with panel A of the table. The significant negative coefficient of the second ranked firm's market share, MS_2R, in panel B, for instance is consistent with the smaller coefficient of CR_2F than CR_1F in panel A, and the significant positive coefficient of the fifth ranked firm's market share, MS_5R, in panel B is consistent with larger coefficients of CR_5F than CR_4F in panel A.

Panel C divides the range of concentration values observed in the data into seven segments to investigate the difference across groups controlling for all other explanatory variables (coefficients and t-statistics for the controls are not reported). In addition to reporting regression coefficients and t-statistics, the number of banks falling within each category is also indicated. These should not be confused with the much larger number of loans, which serve as the unit of observation in all regressions.

We compare the results obtained employing the Herfindahl index with purely nonparametric results, mainly using the Kernel method presented in Figure 1.1 [Wand and Jones (1995)].[20] Because the data set from this CNBV bulletin contains many observations of loans for each bank, this relationship may be examined for various specified loan characteristics. Estimations reported in Figures 1.1, 1.2, 2.1, and 2.2 are for loans that

[20] In this specific case, this procedure calculates a weighted average of observed loan rates falling within a specified band associated with each of numerous specified concentration levels, with the weights declining the more distant (in terms of concentration) the observed observation from the specified concentration ratio.

Figure 1.1
Unsecured, variable-rate commercial loans (July 1999).
Nonparametric Curve Fitting

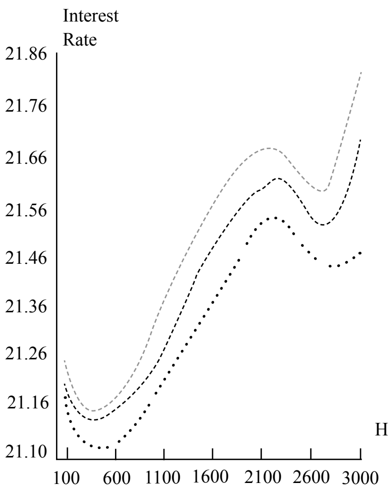
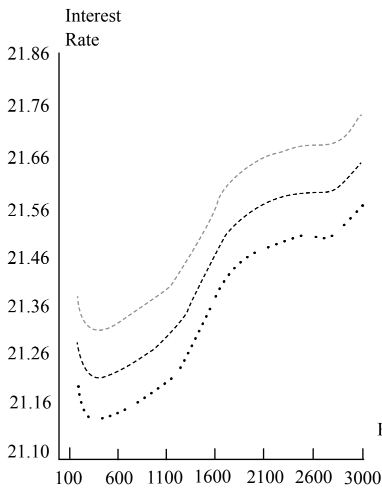


Figure 1.2
Unsecured, variable-rate commercial loans (July 1999).
Semiparametric Curve Fitting



are between 10,000 and 50,000 Mexican pesos, base year 2000 (which includes the median size) and that have maturities less than 90 days. Consistent with Figure 1.1, rates applying to Herfindahl index values between 500 and 1000 are somewhat lower than those implied by values less than 500 (the omitted dummy variable). Rates then rise to a peak associated with the range between 1667 and 2200, thereafter falling off at higher levels of concentration. One difference between Figure 1.1 and these results is that, instead of a steady rise in rates beginning at a Herfindahl index of 500, the dummy-variable approach suggest a sharper climb starting at a Herfindahl index level higher than 1667. As indicated on the bottom of table 2.1, a similar analysis based on the one-firm concentration ratio (CR_1F) yields equivalent results in terms of the general shape of the relationship.

Strictly speaking, parametric and nonparametric methods are not comparable. The nonparametric procedures employed do not control for the effect of other explanatory variables, whereas the parametric procedures presumably do. Then, it is more appropriate to compare Table 2 and Figure 1.2. Figure 1.2 presents a graphical representation of this relationship obtained from the semiparametric regression estimation.

Figire 2.1
Secured, variable-rate
commercial loans (July 1999).
Nonparametric Curve Fitting

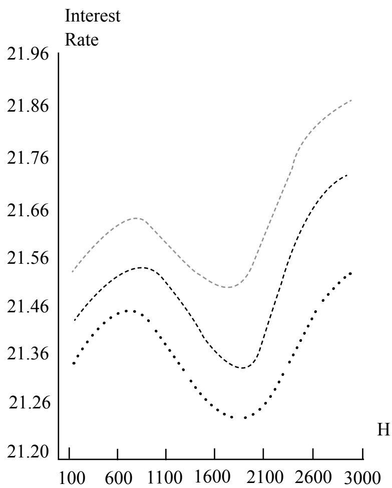
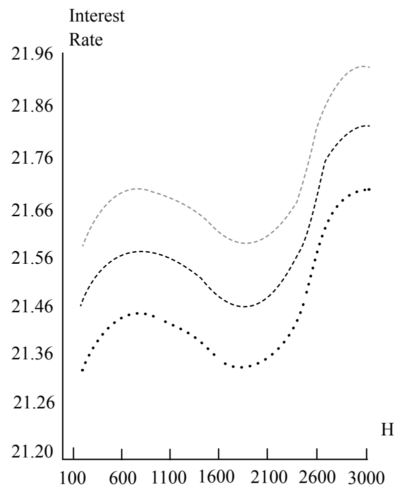


Figure 2.2
Secured, variable-rate
commercial loans (July 1999).
Semiparametric Curve Fitting



The result is a continuous line which depicts the relationship between loan rates and concentration over the observable range of concentration. Figure 1.2 depicts the relationships between the Herfindahl index (on the x-axis) and the commercial rate loan (on the y-axis) resulting from this procedure. The middle line indicates the estimated mean loan rate applying to each concentration level, while the top and the bottom lines indicate loan rates that are one standard deviation above and below the mean. The Herfindahl index is chosen for initial examination because of its central role in the Industrial Organization literature. If enough variables are available, however, various slices of the relationship may be examined by restricting the sample to specified values of other explanatory variables.

The relationship between market concentration and the rate charged for unsecured, variable loans depicted in Figure 1.2, is generally positive, rising sharply from a Herfindahl index value of 200 to a high at a value of 2200, thereafter stable between values 2500 to 2600. That is due to the paucity of observations at high levels of concentration which is wider. These results suggest that concentration can increase the interest rate charged for unsecured variable-rate commercial loans by approximately

0.60 percent. It also suggests that concentration becomes more relevant for a Herfindahl index of about 500, and continues to result in higher interest-rates well past the level of 1667.

Table 3 and Figure 2.1 investigate the interest-rate-and-concentration relationship as it applies to secured variable-rate loans. Table 3 shows that the use of CR_1F registers the highest adjusted R-squared, followed closely by the Herfindahl index. Consistent with Figure 2.1, part C of Table 3 provides some evidence of a substantial rise in loan rates starting at some value of the Herfindahl index higher than 1667. Dummy variable coefficients also provide some indication of the bulge before 1667. Dummy variables for an alternative measure of concentration, CR_1F, suggest a similar functional form.

Using the same semiparametric estimation as above, Figure 2.2 presents the relationships between the Herfindahl index and the commercial rate charged for secured loans originated during July 1999. As indicated, the relationship observed for this kind of loan is considerably different than the one presented for unsecured variable-rate loans originated in the same month. The most striking feature of the relationship is the takeoff in rates that occurs at very high levels of the Herfindahl index (about 2400).

Market concentration and deposit rates

The relationship between concentration-and-interest-rate as it applies to the rate offered for money deposit accounts during the proposed period is examined on this section. Panels A, B, and C of Table 4 present OLS estimations of the concentration-and-interest-rate relationship in July 1999. As indicated in panel A, the coefficients of all concentration measures are negative and statistically significant. In this case, the use of CR_2F registers the highest adjusted R-squared, followed in order by the Herfindahl index (H) and CR_3F. None of the coefficients of the control variables presented in panel A are statistically significant. The reason for a lack of significant relationship for this cross section and the next one is not clear. Substantial changes in regulatory requirements occurred between 1998 and 1999, the most important of which was the establishment of a minimum-balance requirement (set at $1,000 in 1999). Substantial changes in the deposit rate also occurred by 1998, resulting, among other things, in fewer usable observations. These results may also reflect, however, real differences in the market for money deposit accounts occurring between 1998 and 1999.

The use of dummy variables, reported in panel C, reveals a functional relationship between concentration and interest-rate that is more or less consistent with that found using nonparametric methods.

Table 3
The relationship between the Rate Charged for Secured, Variable-Rate Commercial Loans and various measures of Market Concentration (July 1999).

A. Concentration measures

Explanatory Variables	*Concentration measures*					
	H	*CR_1F*	*CR_2F*	*CR_3F*	*CR_4F*	*CR_5F*
Constant	21.90	21.81	21.76	21.47	21.6	21.31
	(50.37)	(50.60)	(50.29)	(49.48)	(49.08)	(48.79)
Concentration	1.76 E-4	1.54 E-4	0.93 E-4	0.76 E-4	0.72 E-4	0.72 E-4
	(10.43)	(11.43)	(10.27)	(7.97)	(7.41)	(6.91)
MATUR	-0.004	-0.34 E-2	-0.36 E-2	-0.45 E-2	-0.43 E-2	-0.47 E-2
	(-0.29)	(-0.23)	(-0.24)	(-0.29)	(-0.29)	(-0.31)
LOAN_S	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17
	(-15.02)	(-15.18)	(-15.16)	(-15.03)	(-15.05)	(-15.04)
ASSETS	-0.31 E-2	-0.70 E-2	-0.31 E-2	0.014	-0.019	0.021
	(-0.22)	(-0.49)	(-0.23)	(0.98)	(1.35)	(1.48)
WAGE	-0.71 E-2	0.032	0.029	0.031	0.030	0.031
	(-0.25)	(2.86)	(2.59)	(2.72)	(2.66)	(2.63)
POP	0.77 E-5	0.75 E-5	0.61 E-5	0.30 E-5	0.15 E-5	0.12 E-5
	(1.58)	(1.57)	(1.27)	(0.62)	(0.32)	(0.25)
COMT	-0.71 E-2	-0.65 E-2	0.35 E-2	-0.11	-0.65 E-2	0.23 E-2
	(-0.25)	(-0.23)	(0.13)	(0.38)	(0.23)	(0.09)
D_NOTE	-0.39	-0.43	-.036	-0.034	-0.035	-0.037
	(-1.40)	(-1.54)	(-1.29)	(-1.23)	(-1.31)	(-1.33)
FAIL_R	0.14 E-3	0.13 E-2	0.14 E-2	0.15 E-2	0.15 E-2	0.16 E-2
	(6.20)	(5.73)	(5.89)	(6.27)	(6.64)	(6.80)
No. of loans	8837	8837	8837	8837	8837	8837
Adj-R^2	0.0898	0.0934	0.0892	0.0821	0.0806	0.0794

B. The effect of adding the Next Highest Market Share to the Concentration Rate (All Control Variables included)

CR_1F	2.15 E-4	CR_2F	0.79 E-4	CR_3F	0.71 E-4	CR_4F	0.66 E-4
	(9.80)		(8.37)		(7.23)		(6.01)
MS_2R	-1.43 E-4	MS_3R	-1.57 E-4	MS_4R	-1.29 E-4	MS_5R	-1.07 E-4
	(-3.62)		(-5.38)		(-2.39)		(-1.94)
Adj-R^2	0.0954	Adj-R^2	0.0939	Adj-R^2	0.0831	Adj-R^2	0.0813

C. Investigating functional form with Dummy Variables indicating Range of Concentration (All Control Variables included)

H:	500<H≤1000	1000<H≤1200	1200<H≤1667	1667<H≤2200	2200<H≤2667	H>2667	Adj-R^2
	0.15 E-4	0.15 E-4	-0.10 E-4	0.12 E-4	0.25 E-4	0.43 E-4	0.0939
	(3.11)	(3.18)	(-2.02)	(2.64)	(4.61)	(8.35)	
No. of Banks	4	2	2	4	3	4	
(14 with H≤500)							

CR_1F:	1800<C≤2000	2000<C≤2300	2300<C≤2600	2600<C≤3000	3000<C≤3600	C>3600	Adj-R^2
	0.19 E-4	0.31 E-4	-0.61 E-7	0.26 E-4	0.39 E-4	0.56 E-4	0.1056
	(4.06)	(5.92)	(0.01)	(4.56)	(6.60)	(10.63)	
No. of Banks	3	3	4	3	2	3	
(15 with C≤1800)							

Numbers in parenthesis are t-statistics.

Table 4
The relationship between the Rate Paid for Money Deposit Accounts and various measures of Market Concentration (July 1999).

A. Concentration measures

Explanatory Variables	*Concentration measures*					
	H	*CR_1F*	*CR_2F*	*CR_3F*	*CR_4F*	*CR_5F*
Constant	21.05	21.10	21.21	21.29	21.35	21.43
	(96.06)	(85.11)	(82.17)	(71.44)	(64.41)	(57.18)
Concentration	-2.32 E-4	-1.61 E-4	-1.16 E-4	-1.03 E-4	-1.11 E-4	-1.11 E-4
	(-6.80)	(-6.27)	(-7.16)	(-6.68)	(-6.52)	(-6.17)
ASSETS	5.16 E-9	3.72 E-9	5.09 E-9	5.88 E-9	6.03 E-9	5.86 E-9
	(0.89)	(0.65)	(0.89)	(1.05)	(1.02)	(1.03)
POP	-1.16 E-6	-3.41 E-7	-1.17 E-6	-1.41 E-5	-1.52 E-6	-1.71 E-6
	(-1.24)	(-0.36)	(-0.87)	(-1.09)	(-1.15)	(-1.27)
FAIL_R	0.19 E-3	0.36 E-3	0.35 E-3	0.37 E-3	0.33 E-3	0.30 E-3
	(1.30)	(0.91)	(0.93)	(0.93)	(0.81)	(0.73)
N	1330	1330	1330	1330	1330	1330
Adj-R^2	0.1242	0.1076	0.1361	0.1205	0.1154	0.1047

B. The effect of adding the Next Highest Market Share to the Concentration Rate (All Control Variables included)

CR_1F	-0.95 E-4	CR_2F	-1.17 E-4	CR_3F	-1.03 E-4	CR_4F	-0.93 E-4
	(-2.97)		(-7.16)		(-6.60)		(-5.55)
MS_2R	-1.48 E-4	MS_3R	0.17 E-4	MS_4R	0.03 E-4	MS_5R	1.22 E-4
	(-3.38)		(0.36		(0.03		(1.27)
Adj-R^2	0.1352	Adj-R^2	0.1339	Adj-R^2	0.1177	Adj-R^2	0.1171

C. Investigating functional form with Dummy Variables indicating Range of Concentration (All Control Variables included)

H:	500<H≤1000	1000<H≤1200	1200<H≤1667	1667<H≤2200	2200<H≤2667	H>2667	Adj-R^2
	-0.11 E-4	-0.11 E-4	-0.35 E-4	-0.08 E-4	0.28 E-4	-0.38 E-4	0.1563
	(-1.93)	(1.68)	(-4.68)	(5.93)	(3.24)	(-3.48)	
No. of Banks	4	2	2	4	3	4	
(14 with H≤500)							
CR_2F:	3600<C≤4000	4000<C≤4600	4600<C≤5300	5300<C≤6000	6000<C≤6500	C>6500	Adj-R^2
	-0.09 E-4	-0.07 E-4	-0.26 E-4	-0.36 E-4	-0.39 E-4	-0.38 E-4	0.1118
	(-1.60)	(-1.11)	(-3.83)	(-4.03)	(-1.60)	(-1.11)	
No. of Banks	3	3	4	3	2	3	
(15 with C≤5400)							

Numbers in parenthesis are t-statistics.

Dummy variables defined on the basis of the Herfindahl index suggest a general decline in money deposit account rates as the index rises, with the lowest point reached in the range between 1666 and 2200. Rates thereafter are portrayed as bouncing around somewhat at higher levels of concentration. The dummy variable coefficients suggest an apparent plateau between the two values of 500 and 1200 that is not reflected in Figure 3.1 (which uses the nonparametric regression estimations). Dummy variables defined on the basis of CR_2F portray a similar relationship, except that interest rates do not seem to bounce around as much at higher levels of concentration.

Figure 3.2 presents a graphical representation of this relationship obtained through semiparametric estimation. Unlike the case of the loan data, the deposit data does not offer enough observations to restrict the analysis to specified values of other potential determinants of interest-rates (there are only 1330 observations). Thus, the relationship presented in Figure 3.1 may be thought of as strictly univariate for the full sample of firms in the data. The functional form depicted is one in which the money deposit account interest-rate declines sharply from the lowest levels of concentration reaching a low at a Herfindahl index of approximately 1100 and thereafter bouncing up and down somewhat. In Figure 3.2, the relationship between the Herfindahl index and the money deposit account rates, as expected, is negative. The functional form depicted is one in which the money deposit account interest-rate declines sharply from the lowest levels of concentration to a Herfindahl index of approximately 1100 and thereafter decreases slowly.

Table 5 presents equivalent regressions employing data on immediate withdrawal deposit account rates offered in July 1999. As indicated

Figure 3.1
Money deposit accounts
(July 1999). Nonparametric
Curve Fitting.

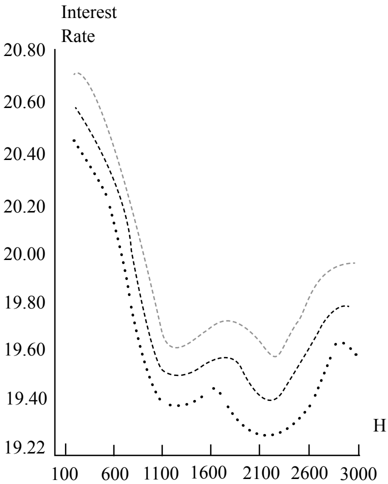
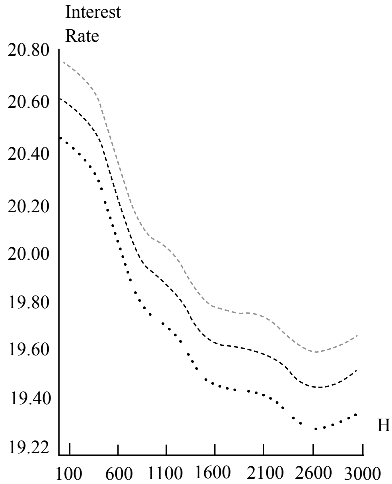


Figure 3.2
Money deposit accounts
(July 1999). Semiparametric
Curve Fitting.



in panel A of Table 5, the use of CR_2F and the Herfindahl index yield (identically) the highest adjusted R-squared, with CR_1F yielding the lowest. Consistent with Figure 4.1, dummy variables defined on the basis of the Herfindahl index suggest a decline in the rates that starts at an index value of roughly 1200 and reaches its lowest point at a value in excess of 2200. However, this decline does not appear to be as uninterrupted as that presented in Figure 4.1. The functional relationship suggested by the use of dummy variables based on CR_2F appears to be similar to that suggested by dummy variables based on the Herfindahl index.

Figure 4.2 presents results of the same semiparametric estimation procedure. The relationship between the Herfindahl index and the rates offered on immediate withdrawal deposit accounts is estimated for July 1999. As indicated, this relationship indicates a more or less continual decline in rates, starting at a Herfindahl index value of approximately 500 and ending at a value roughly 2667.[21]

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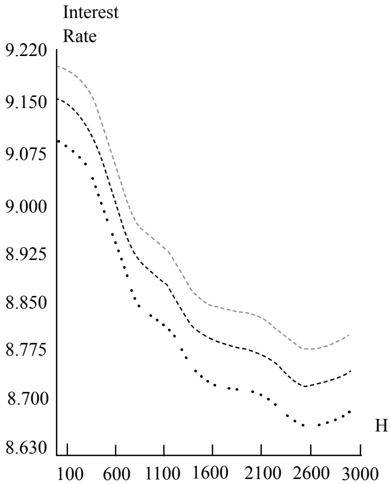
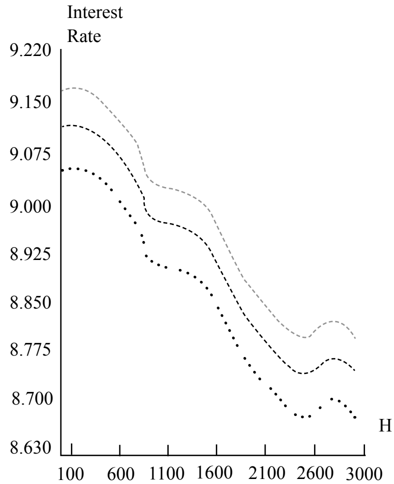
[21] Because the decline on this account continues well beyond the value of 1500, these results are more supportive of the concern expressed in the merger guidelines over mergers in more concentrated markets.

Figure 4.1
Immediate withdrawal deposit accounts (July 1999).
Nonparametric Curve Fitting.



Fgure 4.2
Immediate withdrawal deposit accounts (July 1999).
Semiparametric Curve Fitting.



Except for the case of unsecured variable-rate loans in July 1999 (depicted in Figures 1.1, 1.2 and Table 2), loan-rate relationships have in common a relatively sharp rise in rates starting at Herfindahl index values greater than 1667 and continuing to the highest observed values of the index. These relationships appear to show some variation over time, with the start of the rise occurring at higher values of concentration in the other two cross-sections. Observed functional relations for the two deposit accounts examined are less stable both over time and across products. In the case of rates offered for money deposit accounts during July 1999, most of the decline in deposit rates, accompanying an increase in the Herfindahl index, occurs before the index reaches 1667, while immediate withdrawal deposit account rates during the same period continue their decline over much higher levels of concentration. The cross sections of the other two periods generally indicate a much weaker relationship between measures of concentration and deposit rates.

Table 6 summarizes the results for the parametric, the pure nonparametric, and the optimal semiparametric estimators. The last two are evaluated at the mean Herfindahl index corresponding to July 1999 and

Table 5
The relationship between the Rate Paid for Immediate Withdrawal Deposit Accounts and various measures of Market Concentration (July 1999).

A. Concentration measures

Explanatory Variables	*Concentration measures* *H*	*CR_1F*	*CR_2F*	*CR_3F*	*CR_4F*	*CR_5F*
Constant	9.25	9.22	9.32	9.36	9.38	9.39
	(66.36)	(58.49)	(55.66)	(48.45)	(43.40)	(38.30)
Concentration	-1.23 E-4	-0.64 E-4	-0.59 E-4	-0.53 E-4	-0.51 E-4	-0.45 E-4
	(-2.86)	(-2.00)	(-2.86)	(-2.70)	(-2.53)	(-2.18)
ASSETS	-8.22 E-9	-9.39 E-9	-8.17 E-9	-7.84 E-9	-8.06 E-9	-8.53 E-9
	(-0.99)	(-1.14)	(-0.99)	(-0.95)	(-0.97)	(-1.02)
POP	-8.35 E-7	-7.35 E-8	-5.48 E-7	-7.10 E-7	-6.73 E-7	-5.91 E-7
	(-0.56)	(-0.03)	(-0.38)	(-0.47)	(-0.45)	(-1.36)
FAIL_R	-0.72 E-4	0.68 E-5	0.43 E-5	0.53 E-5	0.80 E-5	0.59 E-6
	(-0.17)	(0.04)	(0.01)	(0.01)	(-0.02)	(-0.36)
N	3298	3298	3298	3298	3298	3298
Adj-R^2	0.0204	0.0067	0.0204	0.0175	0.0147	0.0091

B. The effect of adding the Next Highest Market Share to the Concentration Rate (All Control Variables included)

CR_1F	0.01 E-4	CR_2F	-0.59 E-4	CR_3F	-0.51 E-4	CR_4F	-0.34 E-4
	(0.001)		(-2.84)		(-2.61)		(-1.05)
MS_2R	-1.47 E-4	MS_3R	0.04 E-4	MS_4R	0.51 E-4	MS_5R	2.22 E-4
	(-2.69)		(0.09)		(0.50)		(1.82)
Adj-R^2	0.0265	Adj-R^2	0.0163	Adj-R^2	0.0142	Adj-R^2	0.0215

C. Investigating functional form with Dummy Variables indicating Range of Concentration (All Control Variables included)

H:	500<H≤1000	1000<H≤1200	1200<H≤1667	1667<H≤2200	2200<H≤2667	H>2667	Adj-R^2
	0.07 E-4	0.02 E-4	-0.11 E-4	-0.18 E-4	-0.11 E-4	-0.27 E-4	0.0178
	(0.87)	(0.31)	(-1.18)	(-1.98)	(-0.92)	(-1.90)	
No. of Banks	4	2	2	4	3	4	
(14 with H≤500)							
CR_2F:	3600<C≤4000	4000<C≤4600	4600<C≤5300	5300<C≤6000	6000<C≤6500	C>6500	Adj-R^2
	0.08 E-4	0.11 E-4	-0.09 E-4	-0.10 E-4	-0.10 E-4	-0.25 E-4	0.0215
	(1.02)	(1.18)	(-1.06)	(-1.06)	(-1.02)	(-2.18)	
No. of Banks	3	3	4	3	2	3	
(15 with C≤5400)							

Numbers in parenthesis are t-statistics.

Table 6
The relationship between the Interest Rate (paid or received) and the Herfindahl Index for the four different products (July 1999).

A. Parametric, Pure Nonparametric, and Optimal Semiparametric Estimations.

Products	*Parametric Estimation*	*Pure Nonparametric Estimation**		*Optimal Semiparametric Estimation**	
		July 1999	*Sample 1998-2000*	*July 1999*	*Sample 1998-2000*
Unsecured, variable-rate	1.50 E-4	1.29 E-4	3.28 E-4	1.17 E-4	4.52 E-4
commercial loans.	(-5.07)	(-2.88)	(3.89)	(4.54)	(2.67)
Secured, variable-rate	1.76 E-4	0.87 E-4	-1.95 E-4	1.08 E-4	0.54 E-4
commercial loans.	(-10.43)	(-11.94)	(5.46)	(11.03)	(3.84)
Money deposit accounts.	-2.32 E-4	-3.22 E-4	1.32 E-4	-3.28 E-4	-6.85 E-4
	(-6.80)	(-4.47)	(-2.73)	(-7.36)	(-2.61)
Immediate withdrawal	-1.23	-1.27 E-4	-3.16 E-4	-1.29 E-4	-1.79 E-4
deposit accounts.	(-2.86)	(-3.80)	(-1.73)	(-9.51)	(-2.94)

*Evaluated at the mean.

t-statistics are calculated using the Newey-West corrected standard errors.

Numbers in parenthesis are t-statistics.

B. Mean of the MSE of fitted values.

Products	*Parametric Estimation*	*Pure Nonparametric Estimation*	*Optimal Semiparametric Estimation*
Unsecured, variable-rate	1.4957	10.7169	0.9198
commercial loans.	(0.5454)	(3.5116)	(0.1876)
Secured, variable-rate	9.7035	5.7583	1.2406
commercial loans.	(2.9642)	(0.4896)	(0.1154)
Money deposit accounts.	6.9401	15.7365	1.5998
	(4.8960)	(4.9657)	(0.5654)
Immediate withdrawal	0.9932	3.4783	0.9549
deposit accounts.	(0.0549)	(0.1970)	(0.0678)

Numbers in parenthesis are the standard deviation of the MSE of fitted values.

C. Optimal Semiparametric Estimation: Estimated weighting parameter, estimated bias and root mean square errors.

Products	$\hat{\theta}$	*BIAS*	*RMSE*
Unsecured, variable-rate commercial loans.	0.434	-0.122	0.9591
Secured, variable-rate commercial loans.	0.396	0.109	1.1138
Money deposit accounts.	0.765	-0.116	1.2648
Immediate withdrawal deposit accounts.	0.288	-0.128	0.9772

at the sample Herfindahl mean (1998-2000).[22] At the sample mean both the secure variable-rate commercial loans and money deposit accounts have a different sign for the coefficient of the relationship of Herfindahl and interest-rate. The optimal semiparametric estimation, however, keeps the sign of these coefficients. There is no real difference in the magnitude of the coefficients for July 1999; however, the two aforementioned banking products exhibit a significant difference when evaluated at the sample mean (see Table 6, panel A).

The proposed optimal semiparametric estimator performs better than both the parametric and nonparametric estimators given that the pure parametric model is incorrect. The net result is that the combined regression controls both the bias and the variance and hence improves the mean squared error (MSE) of fit. (See Table 6, panel B). The weighting parameter indicates that most of the combination in the optimal semiparametric estimator is from the parametric estimator; with the clear exception of the money deposit accounts (see Table 6, panel C). Thus, the combined semiparametric estimators always perform better than the kernel estimate (pure nonparametric estimation), and are more robust to model misspecification compared to the parametric estimator.

■ *Conclusions*

Using interest-rates set by banks for various bank products, this paper investigates the functional relationship between concentration and interest-rate in the Mexican commercial banking industry. Two different types of commercial loans and two different types of deposit accounts were chosen

[22] The "regression coefficient" in the context of nonparametric estimation is the partial derivative of m with respect to c. One way of estimating it is to estimate $m(c)$ for $c=c_0$ and then for $c=c_0+\varepsilon$; for $\varepsilon > 0$, the difference between these two estimated m values divided by ε, is the estimate of the regression coefficient. Unless m is linear, it will vary with c. In the analysis performed, I use the mean Herfindahl index as c_0.

for study in order to check for regularities in this relationship across products. To determine robustness with respect to methodology, parametric, nonparametric and semiparametric procedures were employed.

In terms of the different concentration measures employed, the one-firm concentration ratio sometimes results with the highest adjusted R-squared in the parametric regression. This result seems to point to the overall importance of the bank with the largest market share. However, the Herfindahl index ranks more consistently among the measures producing the highest R-squared over the many cross-sections examined. For any given product and period examined, results concerning the functional form appear to be robust with respect to the method used. With a few exceptions, both parametric and nonparametric methods (although they are not comparable)[23] appear to produce the same general outlines of the price-concentration relationship. However, in terms of the Mean Square Error of fit, we find that the semiparametric estimation definitely dominates the other procedures.

No strong evidence of a concentration-interest-rate relationship that is positive in one range of the concentration measure and negative in another is found. Rather, the results seem to support the prediction of the structure-performance paradigm of a positive relationship for concentration and interest-rate paid for loans (and a negative one for deposits).[24] On the other hand, if concentration results from the inefficiency of small firms in the market, rather than the efficiency of large firms, the ES paradigm is supported by these results. However, in the case of the Mexican banking industry, the concentration could be associated with less efficiency. Thus, we conclude that the observed interest-rates-concentration relationship contradicts the ES paradigm.

The fact that this study reports results that are consistent with the SCP paradigm does not necessarily imply that higher market concentration leads to more effective collusion among banks. Since the theoretical foundation of this study does not reflect the influence of bank regulation on the relationships to be estimated, it is not possible to determine from

[23] The nonparametric procedures used do not (for the most part) control for the effect of other explanatory variables, while the parametric procedures presumably do, while semiparametric estimation definitely control for that effect.

[24] The overall interest-rate-concentration relationship is positive when the products are loans, and is negative when the products are deposits. Since this last empirical results, pooling the cross-section data available, along the lines of the paper by Berger and Hannan (1989), may also improve the estimation efficiency and increase the number of significant parameters.

these results the influence that changes in regulations have on the SCP relationship. The focus of future research must be broadened to provide analysis that is relevant for current policy issues.

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