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Privatization, competition, and supercompetition in the Mexican commercial banking system ☆

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Abstract

Much literature before and after the privatization of Mexico's commercial banking system in 1991–1992 argued that the system was collusive and noncompetitive and would likely continue to be for years. Banks would collude to underloan so that – at least in comparison with what would happen in a competitive system – they could overcharge. Because a parallel literature on lending after bank privatization suggests that the problem is often not too little, but too much, we resolved to test for competitive behavior in the Mexican banking system. Using an empirical approach developed by Shaffer (Econom. Lett. 29 (1989) 321, J. Money Credit Bank. 25 (1993) 49, Federal Reserve Bank of Philadelphia, Working paper no. 93-28R), we find a structural break in the middle of the privatization period that signals the start of an episode of what Shaffer calls "supercompetitive" behavior. In such a supercompetition, banks run at levels of output where marginal cost exceeds marginal revenue. This behavior is consistent with a struggle in which banks take losses now because they think the market share they get in the bargain offers a positive present value of expected future return. The behavior can also be consistent with just the sort of banking crises that ensued in Mexico.

JEL classification: G21; D4; L11; F34

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> Mr. Pereguna...suggests that after privatisation in 1991–92 most banks abandoned common sense in a race to sign up customers and expand their credit base.
>
> Financial Times, London Edition. 15 October, 1996

1. Introduction

A major theme in the literature of privatization is that the benefits are much abridged if a government monopoly is simply replaced by a private sector monopoly or oligopoly (Hanson, 1994). Variations on this theme surfaced in many discussions of Mexico's bank privatization of 1991–1992, in which controlling interests in Mexico's 18 government-owned commercial banks were sold to financial groups—chiefly organizations that already dominated the nation's securities industry. [1]

A near-universal concern was that years might pass between when Mexico's banking system was privatized and when its performance might approach most standards of competitiveness. Although Mansell Carstens (1993) argued that privatization would raise some measures of efficiency, she also suggested that spreads between banks' cost of funds and interest rates on loans could remain high for years—in part because the high degree of oligopoly power in the provision of bank services would likely continue. [2] Bazdresch and Elizondo (1993) developed similar themes and—consistent with other authors—viewed Mexico's high interest rate margins as indicative of anti-competitive market power.

An important reason for many observers' pessimism about competition in Mexican banking was the market's heavy concentration. Gavito et al. (1992) developed the anti-competitive implications of concentration in the Mexican commercial banking system while Gavito and Trigueros (1993) argued that "some additional measures would be useful to induce greater competition" in it.

Market indicators suggested that, in fact, the new banks' purchasers themselves expected not to face very intense competition. Gruben et al. (1994) suggested that the high price-to-book ratios paid for the banks signaled that the new

[1] Mexico's commercial banks had been nationalized in 1982 under the presidential administration of Jose Lopez Portillo. Under the administration of Miguel de la Madrid Hurtado (1982–1988), so-called nonbank functions of the bank were allowed to be performed by private sector institutions. The 1991–1992 privatizations of the Carlos Salinas de Gortari administration (1988–1994) were part of a series of radical reforms in the financial services industry that actually began in 1987 during the de la Madrid Hurtado administration (1982–1988).

[2] At the time of the nationalization of the Mexican commercial banking system in 1982, there had been 60 Mexican banks, of which 58 were nationalized. In order to capture perceived economies of scale, Mexico reorganized the commercial banking industry—merging the 58 commercial state-owned banks into just 18. Although the industry had been consolidating prior to 1982 in any case, these new mergers represented a significant increase in industry concentration. Indeed, at the time of privatization, the three largest banks accounted for nearly three-fifths of total assets in the commercial banking system, while the three largest US banking organizations at that time held about one-seventh of US commercial bank assets.

owners expected the banking system's industrial organization to remain relatively uncompetitive. Lopez de Silanes and Zamarripa (1995) measured the excess of expected returns over competitive returns and found them positive and significant. The North American Free Trade Agreement might ultimately allow greater competitive pressures in Mexico. So might the decrease in restrictions on starting new banks (Gavito and Trigueros, 1993). All of this, however, would take time and maybe much time. Even though privatization was expected to bring increases in lending and in the capture of financial assets by the banking system, analysts also anticipated that Mexican banks would still behave collusively for years—underloaning, at least compared with a competitive regime, so that they could overcharge.

But even as this industrial organization of privatization literature depicted a collusive system following financial liberalization and privatization in Mexico, a parallel literature on the general trajectory of reactions to financial liberalization in developing countries suggested a different pattern of possible outcomes. In that paradigm the problem is not inadequate expansion of credit, but too much too fast. The excessiveness becomes recognizable ex post in a wave of loan defaults and a banking crisis.

Consistent with this narrative, a common trajectory following financial liberalization and the appearance of new or newly privatized banks (Gorton, 1992) includes rapid increases in bank assets—which would typically include loans. Similarly, de Juan (1995) notes that on a bank-by-bank level, when new owners take control of a bank, they typically increase lending relative to the value of equity capital or the deposit base. Whether or not these liberalizations and related rapid loan expansions are followed by large increases in loan defaults—as they typically are in Gorton (1992), de Juan (1995), Kaminsky and Reinhart (1996), and McKinnon and Pill (1996)—a common adjunct to financial liberalization is often markedly increased competition in the banking system (International Monetary Fund, 1993).

Under this paradigm of financial liberalization, large spreads between cost of funds and interest rates on loans are not prima facie evidence of an uncompetitive financial system. Instead, after a repressed financial system is liberalized, the banks are unable to supply intermediation services efficiently because they lack expertise, qualified human resources, and adequate technology. The result is high intermediation costs that are in turn covered by a large spread between cost of funds and interest rates charged (de la Cuadra and Valdés, 1992). [3] Banks' portfolios become riskier because banks cannot evaluate the riskiness of loans and higher real interest rates under the

[3] Among the reasons de la Cuadra and Valdés (1992) offered for increasing spreads is that—when liberalization frees up funds for intermediation and when borrowers who were credit rationed under the old financially repressive regulations now queue up for loans—the increase in loan riskiness outstrips the increase in loan volume. This change must be factored into the spread. Mansell Carstens (1993) notes that in the Mexican case the increased risk was manifested in relative asset shifts toward consumer credit—the demand for which had long been pent up. It should be noted that between December 1991 and December 1993 alone, gross past due loans in Mexican commercial banks more than tripled, rising from 10,250.36 to 32,681.60 million. During the same period, the indice de morosidad (gross past due loans as a percentage of total loans) increased from 4.13 to 7.26.

new regime. Lenders lack past distributions on which to base their assessments. [4] For example, when Mexico began to remove government controls on loan allocation in 1988, only 25% of credit extended by Mexican banks was "unrestricted". The rest was "restricted"—allocated as credits to the federal government, or as other obligatory credits or distributions. By 1990, the year before the privatizations began, 70% of bank credit was unrestricted and by 1991, 100% was.

These depictions of post liberalization/privatization banking markets are consistent with a more general theoretical literature on strategic interaction among firms in growing markets where investment and growth of the firm are constrained by physical factors (which could include qualified personnel) or financial factors. In this literature, firms make pre-emptive investments as part of a struggle for market share (Spence, 1979).

These same depictions of post liberalization/privatization banking markets are also consistent with studies of consumer behavior in which, for example, a credit card holder typically develops a long-standing affinity for the first credit card he or she receives (Wall Street Journal, 1996). That is, banks fighting for market share may be willing to engage in riskier strategies in newly opened markets (as, in a de facto sense, consumer credit turned out to be in Mexico in the early 1990s) than they might in a more mature market for the simple reason that the long-term stream of rewards might be correspondingly greater to survivors who practiced pre-emptive behavior.

Moreover, while concerns were raised about concentration in Mexico's privatized banking system, concentration by itself does not imply uncompetitive behavior. Although five banks accounted for 87% of all Canadian bank assets in the early to mid-1980s—a measure of concentration similar to that of the Mexican banking system—Shaffer's (1993) results from econometric tests of market contestability for 1969–89 "are generally consistent with perfect competition, and strongly reject the hypothesis of joint monopoly" and Nathan and Neave (1989) derived similar results for Canada using another measuring technique for 1982–84.

Nevertheless, concentration has been shown able to attenuate competition in banking markets under conditions that are common in the western hemisphere. In a study of concentration and competitive behavior in regional US banking markets, Clark and Speaker (1992) found that the relation between concentration and measures of noncompetitive behavior was positive and significant under regimes of high entry restrictiveness. [5]

[4] It should be noted that while bank privatization was an important financial market reform, it was by no means the only one. Beginning in November 1988 and largely finishing in 1990, Mexico removed controls on interest rates on bank liabilities and assets, eliminated sector-by-sector quotas and all other obligatory or targeted lending, and phased out reserve requirements and liquidity coefficients. Moreover, as Mansell Carstens (1995) notes, in 1988 20% of Mexican government financing came from the banking system but by 1993 all such financing occurred in the money market.

[5] As Berger and Humphrey (1992) point out, the extensive literature that related concentration to profitability and, by abstraction, to the higher prices that market power permitted some banks to charge has been econometrically called into question. Indeed, as the authors discuss, various works suggest that efficiency dominates concentration in explaining profit. While Clark and Speaker (1992) do not adjust for efficiency, they do find that the connection between concentration and profit is conditioned on barriers to entry.

Indeed, the percentage increase in the ratio of past-due loans to total loans between the end of 1991 and the beginning of 1992 was actually smaller than this increase between the end of 1989 and the beginning of 1990 or between the end of 1990 and the beginning of 1991 (source: Comisión Nacional Bancaria). Cost would likely not be affected by an increasing past-due loan ratio during the period under consideration here. Deposit rates were falling throughout this period. Interest rates on 90–175 day deposits, for example, fell from 31.18% in May 1990 to 12.81% in May 1992 (source: Banco de México).

In this context it is interesting to note the trajectory of Mexico's Herfindahl index (Fig. 1) over the period of our study. Consistent with a market share struggle in which the smaller banks take share away from the larger, the Herfindahl index falls from 1600 in 1991, during the privatization, to 1200 in 1993, a year after the privatization is completed. [6] Similarly, note in Fig. 2 what could be construed by some as the competitive implications of the Mexican banking system's falling spreads between loan and deposit rates from the 1990, the year prior to the beginning of the privatizations, through 1993, a year after the final privatization. [7] Conversely, as can be seen in Fig. 3, this same spread increases in the United States as a result of the deposit rate declining more rapidly than the loan rate.

Although research on bank liberalizations or privatizations are not uncommon, it is somewhat more difficult to find econometric characterizations and hypothesis tests about them. In an effort to offer a past distribution—and so to facilitate assessments of future bank privatization outcomes—we use Bresnahan's approach (Bresnahan, 1982) as developed for banking by Shaffer (1993) to identify the strategies that banks in Mexico typically followed in the wake of privatization. Some possible alternatives—although they are mutually exclusive at any point in time—include the following. (1) Banks acted as price takers—behaving as if their demand functions and marginal revenue functions were identical and producing to a point where marginal cost equaled marginal revenue. The results would have included loan levels and interest rates consistent with perfect competition. (2) Banks recognized a distinction between demand and marginal revenue functions, colluded, produced at levels where marginal cost equaled marginal revenue, and so (compared to the perfectly

[6] Note that this Herfindahl index applies to the entire nation, while typically Herfindahl indices are calculated in the United States for individual counties or even in some cases on the basis of aggregations of census tracts, so it is difficult to make clear comparisons. However, from a US regulatory standpoint a Herfindahl index between 2000 and 1000 would be considered as moderately concentrated even though a 33% drop from 1600 down to 1200 as noted above is clearly a significant decline.

[7] Even in the context of industrial countries there is considerable controversy over what interest rate spreads signify about a banking system—whether a lower spread means greater efficiency, greater competitiveness, or a combination of the two. However, it is important here to note a distinction sometimes made (see, for example Rojas-Suarez and Brock, 1998) between what the literature sees as the implications of small (or large) spreads in industrial countries in comparison with their implications for developing countries. That is, while falling spreads may reflect increasing competition and bank health, in newly liberalized developing countries they may reflect the increases in nonperforming loans that are consistent with increasingly risky lending. Rojas-Suarez and Brock (1998) offer evidence to suggest that the falling spreads occur under such conditions because individual banks raise their deposit rates to attract depositors who otherwise might not deposit in bad banks, even if the banks are protected by open-ended deposit insurance schemes.

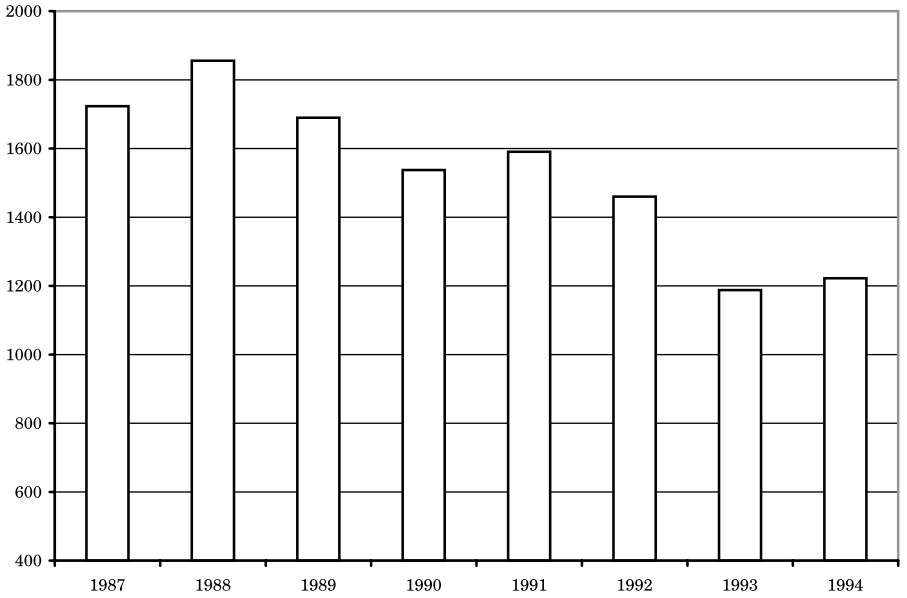

Fig. 1. Herfindahl index for Mexican Banks.

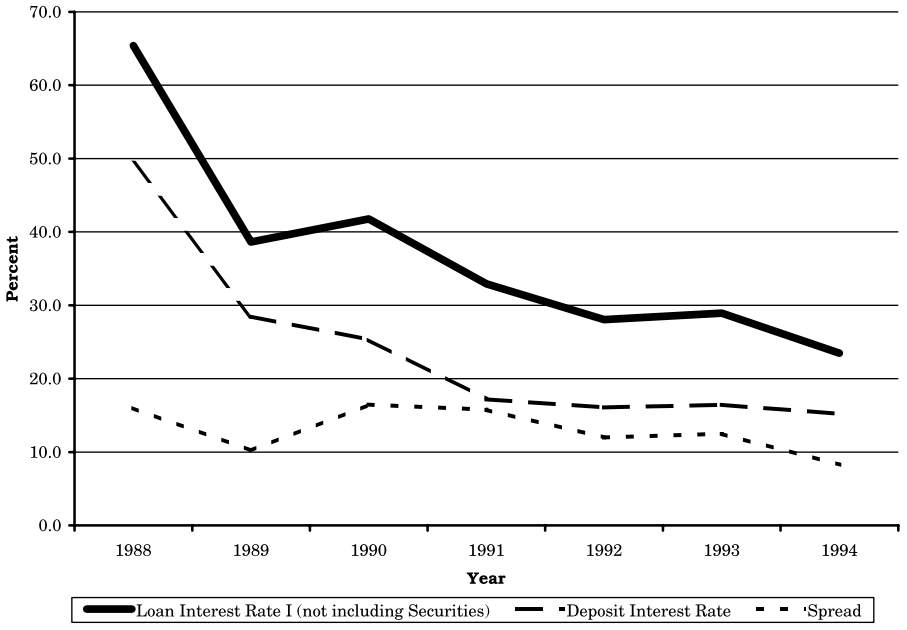

Fig. 2. Mexico loan-deposit interest rate spread.

competitive outcome) effectively underloaned in order to overcharge. (3) As in case (1), banks behaved as if the marginal revenue function and the demand function

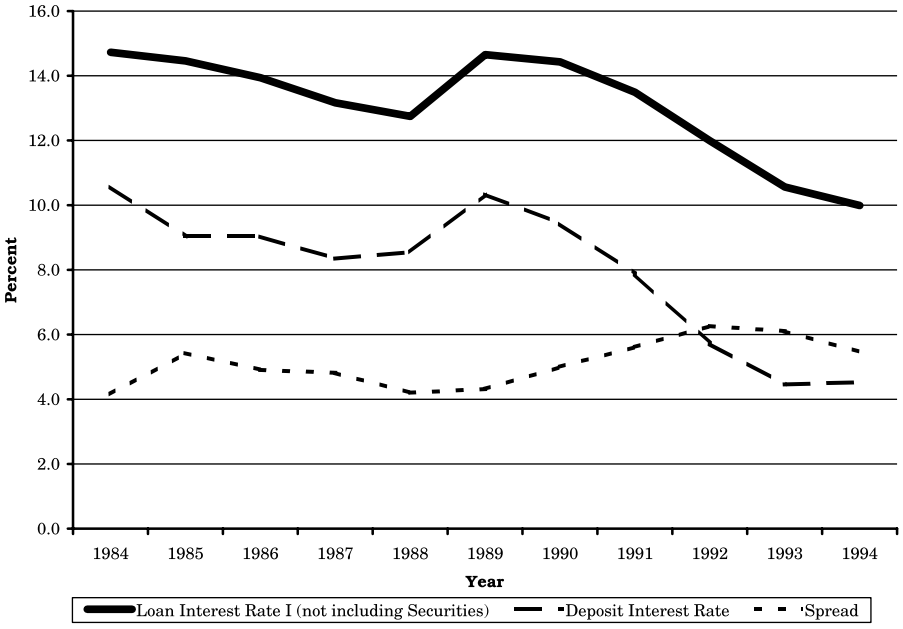

Fig. 3. Loan-deposit interest rate spread: US thrifts.

were identical. Differing from case (1), banks produced at output levels beyond where marginal cost equals marginal revenue (or price)—moving to a point where marginal cost exceeded marginal revenue—and creating what Shaffer (1993) refers to as a "supercompetitive market."

Our results for 1987 (when Mexico sold to the private sector a total of 34% of the ownership in the publicly-owned commercial banks) through 1991 (when Mexico began to sell controlling interest in each commercial bank to the private sector) are consistent with case (1) above, the more or less competitive case. That is, the mean bank treated the marginal revenue and demand functions as the same and produced where marginal cost equaled marginal revenue. [8] Starting in 1992, however,

[8] An attractive feature of 1987 as a starting point for the data is that it offers fewer opportunities for expense preference behavior to affect our results than earlier commencement points would have. The expense preference hypothesis describes an operational environment where managerial preferences for large staffs, leisure, political accommodation or plush offices motivate deviations from cost-minimizing behavior. Expense preference behavior represents the diversion of monopoly profits to cover inflated marginal costs, closing the gap between price and marginal cost and masking monopoly or other noncompetitive behavior.

The virtually complete government ownership (complete except for two commercial banks) that characterized the Mexican commercial banking system for the five years following the 1982 bank nationalization seems to have offered opportunities for expense preference behavior. Indeed, when the Mexican government in 1987 sold to the private sector 34% of its ownership in the commercial banking system, and subsequently liberalized bank regulations associated with interest rates and credit allocation, measures of bank efficiency and profitability rose rapidly—simultaneously suggesting expense preference behavior before these events and much reduced expense preference behavior thereafter.

when Mexico completed the sale of controlling interest in each commercial bank to the private sector, the supercompetitive case (case (3) above) held.

The case (3) bank strategy is consistent with efforts to derive the long-term benefits of an early lead in market share (Shaffer, 1994) for those who can survive the obvious short-run inefficiencies. Although it is either tenuous or impossible to draw any conclusions from just two examples, it is interesting to note that Shaffer (1993) identifies a systemic shift to case (3) behavior in Canada immediately following liberalization there in the early 1980s just as we do for Mexico after liberalization and privatization there. More to the point, such findings raise supervisory and regulatory questions that can only be answered with many more models of financial liberalizations and privatizations than two. When human capital constraints are binding, as Lopez de Silanes and Zamarripa (1995) argue was true in the Mexican case, a loan expansion strategy to a point where marginal cost exceeds marginal revenue might also be consistent with increases in past due loan ratios like those that occurred in Mexico well before the peso crash of 1994.

2. The model

Perhaps because of the intense regulation to which the banking industry is subject, measuring the degree of competition in banking markets has long been the subject of study. In early work (see Gilbert's (1984) survey), a positive link between concentrations and returns was imagined to be prima facie evidence that competition had been abridged. This approach actually did not offer a clear statistical delineation of what competitive returns were, however, and offered other statistical problems that are well-documented in the literature.

To avoid these difficulties, we apply a simultaneous equation model that Shaffer (1989, 1993, 1995) introduced to the banking literature and that has been applied to additional areas and countries by Shaffer and DiSalvo (1994), Shaffer (1994) and Molyneux et al. (1994, 1996). This approach allows us to test the competitiveness of the Mexican commercial banking system by estimating an index of market power (λ) and then identifying breaks in competitiveness by applying a dummy variable. The test revolves around the idea that profit-maximizing firms set marginal cost equal to what the literature refers to as their *perceived marginal revenue*. If the firm's perceived marginal revenue schedule and the firm's demand schedule are identical, then setting marginal cost equal to perceived marginal revenue is the same as setting marginal cost equal to demand price, yielding the classical conditions for a competitive equilibrium. Here, of course, firms behave simply as price takers. In the collusive extreme, in which firms act as a joint monopoly, the firm sets marginal cost equal to a perceived marginal revenue that corresponds to the industry's marginal revenue curve (Bresnahan, 1982). Because the firm only perceives the marginal revenue schedule and the demand schedule as identical under competitive equilibrium, the index we use to gauge the competitiveness of the Mexican commercial banking system simply expresses the deviation of the average bank's perceived marginal revenue

curve from the industry demand schedule. If there is no deviation, we have pure competition.

Following Bresnahan (1982) we write a demand function for commercial bank services:

$$Q = D(P, Y, \alpha) + \epsilon, \tag{1}$$

where Q is quantity, P is price, Y is a vector of exogenous variables, α is a vector of demand equation parameters to be estimated, and ϵ is a random error term. Actual (as distinguished from perceived) marginal revenue is

$$\mathrm{MR} = P + h(Q, Y, \alpha) = P + Q/(\partial Q/\partial P). \tag{2}$$

The function $h(Q, Y, \alpha)$ is the semi-elasticity of demand, and $h(\cdot) \leqslant 0$. Firms' *perceived* marginal revenue is

$$\mathrm{MR}^{\mathrm{p}} = P + \lambda h(Q, Y, \alpha), \tag{2'}$$

where λ is a new parameter to be estimated, $0 \leqslant \lambda \leqslant 1$. Here, λ measures the degree to which firms recognize the distinction between demand and marginal revenue functions. Let $c(Q, W, \beta)$ be the average firm's marginal cost function, where W is a vector of exogenous supply side variables and β is a vector of supply side parameters to be estimated. Maximizing firms will set perceived marginal revenue equal to marginal cost, or

$$P = c(Q, W, \beta) - \lambda h(Q, Y, \alpha) + \eta, \tag{3}$$

where η is a random error term. If firms act as price takers, so that they do not perceive a difference between their marginal revenue functions and demand function, then $\lambda = 0$. If firms act as a joint monopoly, clearly perceiving a difference between their demand and marginal revenue functions, they set output where marginal cost equals marginal revenue such that $\lambda = 1$. Intermediate values of λ correspond to other oligopoly solution concepts. Of particular interest, $\lambda = 1/n$ suggests a Cournot equilibrium.

From the point of view of our analysis, an important detail of this procedure is that (Shaffer, 1993) $-\lambda$ is also a local estimate of the percentage deviation of aggregate output from the competitive equilibrium level of output. Since actual price deviates from the competitive price by $-\lambda Q/(\partial Q/\partial P)$, and actual quantity deviates from the competitive quantity by $\partial Q/\partial P$ times the deviation in price, actual quantity will deviate from the competitive quantity by $-\lambda Q$. Thus, the percentage deviation in quantity is $-\lambda Q/Q = -\lambda$. If $-\lambda < 0$ then output is less than what would occur in competitive equilibrium, meaning that firms are behaving as if they perceived that they had market power. Even more interestingly if $-\lambda > 0$, then actual output seems to exceed the competitive equilibrium level of output, although static allocative efficiency requires the marginal cost pricing outcome of $\lambda = 0$.

To estimate λ, it is necessary to estimate simultaneously specifications of both Eqs. (1) and (3), treating P and Q as endogenous variables. The demand function is specified as

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \alpha_3 PZ + \alpha_4 Z + \alpha_5 PY + \alpha_6 YZ + \epsilon, \tag{2''}$$

where Q is output quantity, P is output price, Y is a measure of macroeconomic activity, assumed to be an exogenous variable, and Z is the price of a substitute for bank output, also assumed to be exogenous. The interaction terms, the products PZ, PY and YZ, are necessary to permit rotation of the demand curve as required to identify λ.

Following Shaffer (1993), we utilize the translog cost function to estimate the average commercial bank's cost function, as follows:

$$\ln C = \gamma_0 + \gamma_1 \ln Q + \gamma_2 (\ln Q)^2 + \gamma_3 \ln W_1 + \gamma_4 \ln W_2 + \gamma_5 (\ln W_1)^2 + \gamma_6 (\ln W_2)^2 + \gamma_7 \ln W_1 \ln W_2 + \gamma_8 \ln Q \ln W_1 + \gamma_9 \ln Q \ln W_2, \tag{4}$$

where C is total cost and W_1 and W_2 are exogenous input prices, as explained below. [9] Eq. (4) gives rise to following marginal cost function, $c(Q, W, \beta)$:

$$\mathrm{MC} = (C/Q)(\beta_1 + \beta_2 \ln Q + \beta_3 \ln W_1 + \beta_4 \ln W_2) + \eta. \tag{5}$$

Therefore, Eq. (3) is specified as follows:

$$P = -\lambda Q/(\alpha_1 + \alpha_3 Z + \alpha_5 Y) + (C/Q)(\beta_1 + \beta_2 \ln Q + \beta_3 \ln W_1 + \beta_4 \ln W_2) + \xi. \tag{3'}$$

For our purpose of analyzing the effect of privatization of the commercial banking sector in Mexico, we estimated, rather than Eq. (3′), the following specification of Eq. (3):

$$P = -\lambda Q/(\alpha_1 + \alpha_3 Z + \alpha_5 Y) + (C/Q)(\beta_1 + \beta_2 \ln Q + \beta_3 \ln W_1 + \beta_4 \ln W_2) - \beta_5 DQ/(\alpha_1 + \alpha_3 Z + \alpha_5 Y) + \xi, \tag{3''}$$

where D is a privatization dummy variable to be explained below and ξ is a random error term. We then estimate simultaneously the system of equations represented by Eqs. (2″) and (3″).

Many articles on the Mexican banking system disaggregate the system according to market scope including large national, small national, multiregional and regional. Out of appreciation for this bank-by-bank heterogeneity of market scope, it should be noted that the technique offered here does not rely on any particular definition of bank markets. As long as the data sample spans at least one complete market, then estimates of λ are unbiased. In cases where the industry comprises multiple markets, λ signifies the average degree of market power over the separate markets. Note here

[9] In displaying Eq. (4) we have followed the form and style used by Intriligator (1978, pp. 280–295). However, the same mathematical characterization as presented in Eq. (4) may also be presented as follows: $\ln C = \delta_0 + \delta_1 \ln Q + \delta_2 (\ln Q)^2/2 + \delta_3 \ln W_1 + \delta_4 \ln W_2 + \delta_5 (\ln W_1)^2/2 + \delta_6 (\ln W_2)^2/2 + \delta_7 (\ln W_1 \ln W_2) + \delta_8 \ln Q \ln W_1 + \delta_9 \ln Q \ln W_2$. It may be seen that the two equations are the same with the exception of variables preceded by coefficients (in the equation in this footnote) δ_2, δ_5, and δ_6. Note that each of these three variables is divided by two in this equation form, meaning in effect that $\gamma_2 = 1/2\ \delta_2$, $\gamma_5 = 1/2\ \delta_5$, and $\gamma_6 = 1/2\ \delta_6$. While this form of presentation is equally correct and is favored by Greene (1993, p. 209, 505), we prefer the Intriligator approach because of its greater parsimony.

that λ reflects the behavior of the average firm in the sample. As Shaffer (1993) notes, a dominant firm or cartel plus a competitive fringe would generate estimates of λ that are a weighted average of the competitive and collusive values—therefore exceeding the competitive value.

Another detail that could be particularly important in the Mexican context is that although this model assumes banks are input price takers, violations of the assumption do not damage the results in a way that would bother most modelers. If banks have market power over deposits, in violation of the assumption, it can be shown that the specification of λ overstates the overall degree of market power by misattributing any deposit power to the asset side. [10] Here, a finding of perfect competition or supercompetition would be even more striking than if the input price taking assumption were not violated.

3. Data

Monthly data on all Mexican commercial banks were made available from the Central Bank of Mexico and from Mexico's National Banking Commission for the period April, 1987 through December, 1993. These data covered all commercial banks that were owned by the state as well as the two private banks, Obrero and Citibank. Following December, 1993, data are reported only on a quarterly basis by the CNB, making subsequent observations incompatible with our monthly series. All data we use, plus their means and standard deviations, are presented in Table 1.

This period gives us roughly two years of monthly observations on the Mexican commercial banks after the largest banks—and those banks holding most of the system's assets and deposits—had been returned to private ownership. Of the total of 81 observations on the variables in the data set, there were two missing observations on total assets for the months of January and February, 1990. These observations were simply excluded from the data supplied by the CNB. Thus, these estimations were based on a sample of size 79.

As in Shaffer (1993), we utilize the intermediation model of a bank. This approach, developed by Klein (1971) and Sealey and Lindley (1977) treats a bank as a firm that uses labor to acquire deposits and, then, uses labor and deposits to generate assets. The measure of output (Q) is thus total assets measured in 1000s of new pesos. The price of output (P) is total interest income in 1000s of new pesos divided by total assets, i.e., the average rate earned on assets. It should be noted that this average rate of return will be affected not only by market lending rates but by changes in the past due loan ratio. [11] Since deposits and labor are the only production inputs, we require input prices for deposits (W_1) and labor (W_2). We

[10] For proof of this point, see Shaffer (1994, pp. 8–9).

[11] Regulatorily speaking, interest income that a past-due loan would have earned if it had not been past due would actually have been booked for one month and thereafter would have been required to be provisioned against. We are indebted to Javier Gavito of Mexico's National Banking Commission for this point.

Table 1
Mexican data

Year and month	Assets	Asset interest rate	Industrial production index	Cete rate	Deposit interest rate	Wage
8704	40528.93	0.05011	104.2	0.07741667	0.06393	0.00524
8705	43278.97	0.05126	108.6	0.07633333	0.06582	0.00548
8706	47846.44	0.04933	106.2	0.07633333	0.0645	0.00573
8707	49733.86	0.05205	105.2	0.07608333	0.06844	0.00667
8708	52465.74	0.05121	106.7	0.07525	0.06549	0.0069
8709	56444.46	0.04858	107	0.07491667	0.06252	0.00694
8710	59914	0.04953	110.3	0.075	0.06414	0.00854
8711	64809.96	0.04868	111.3	0.08658333	0.057	0.00921
8712	78503.5	0.05264	112.3	0.1015	0.07721	0.0107
8801	76192.97	0.06099	106.7	0.12841667	0.08246	0.01076
8802	80776.98	0.06281	106.6	0.12791667	0.08479	0.0112
8803	85993.51	0.06194	109.3	0.07983333	0.08572	0.01199
8804	86714.16	0.04525	107	0.05433333	0.05634	0.01233
8805	89771.39	0.03738	106.8	0.04225	0.04587	0.01243
8806	91585.15	0.03142	107.2	0.03366667	0.03734	0.01257
8807	91900.48	0.02554	102.2	0.03358333	0.03047	0.01162
8808	90740.37	0.02767	108.5	0.03441667	0.03251	0.01285
8809	92587.34	0.02631	105.5	0.03483333	0.03212	0.01262
8810	95392.73	0.02725	109.4	0.03716667	0.03721	0.01362
8811	92763.09	0.02709	114.5	0.04158333	0.03189	0.01392
8812	107258.9	0.02301	114	0.04358333	0.03547	0.01354
8901	104294.2	0.02383	112.1	0.04233333	0.04321	0.01415
8902	98694.65	0.0226	110.2	0.041	0.03809	0.01497
8903	100625.9	0.02392	111.7	0.03983333	0.03958	0.01516
8904	99271.11	0.0222	116.1	0.04175	0.03335	0.01534
8905	104294.4	0.02438	115.1	0.04316667	0.03478	0.01606
8906	115459.6	0.02423	114.6	0.04725	0.03736	0.01613
8907	114722.8	0.0275	110.9	0.03916667	0.04001	0.01689
8908	114685.9	0.02458	115.3	0.029	0.0305	0.01848
8909	123522.7	0.02036	109.9	0.02858333	0.02578	0.01704
8910	127750.1	0.02197	114.1	0.03158333	0.0279	0.01791
8911	134465.1	0.02206	118.9	0.0325	0.02536	0.01924
8912	159476.2	0.02098	113.5	0.03375	0.03047	0.0222
9003	179858	0.02178	121.4	0.03883333	0.0345	0.02115
9004	199260	0.02295	114.9	0.03716667	0.03473	0.02664
9005	203493	0.02288	120.6	0.03075	0.03344	0.02524
9006	204478	0.0202	120.1	0.027	0.02808	0.02465
9007	213559	0.01928	118.2	0.02558333	0.02781	0.02352
9008	220255	0.01826	123.3	0.02475	0.0254	0.02471
9009	228976	0.01707	118	0.02508333	0.024	0.02637
9010	239582	0.01797	126.2	0.02391667	0.0251	0.02634
9011	250028	0.01695	127.6	0.02066667	0.02137	0.02923
9012	268003	0.0169	123.2	0.02166667	0.02347	0.03337
9101	273706	0.01622	125.4	0.01966667	0.02243	0.0298
9102	288136	0.0141	119.8	0.01925	0.01915	0.02923
9103	299082	0.01419	121.7	0.01833333	0.01997	0.0354
9104	311107	0.01439	129.1	0.01758333	0.01851	0.03393
9105	332931	0.01322	127.3	0.0165	0.01859	0.0336

Table 1 (*continued*)

Year and month	Assets	Asset interest rate	Industrial production index	Cete rate	Deposit interest rate	Wage
9106	340663	0.01272	125.2	0.01475	0.01752	0.03524
9107	348868	0.01327	123.9	0.01541667	0.01654	0.03453
9108	372062	0.01227	125.6	0.01391667	0.01741	0.03785
9109	360871	0.01314	122.6	0.01458333	0.01519	0.03844
9110	393576	0.01343	131	0.01491667	0.0156	0.03853
9111	405052	0.01326	132.6	0.01383333	0.0147	0.0399
9112	407354	0.01481	127.6	0.01383333	0.0163	0.03861
9201	410565	0.01371	127	0.01275	0.01576	0.04152
9202	401909	0.01317	125.5	0.01216667	0.0139	0.04451
9203	409795	0.01345	133.2	0.00983333	0.01366	0.04629
9204	419775	0.01279	126.3	0.01033333	0.01286	0.04833
9205	429795	0.01248	130.6	0.01133333	0.01303	0.04806
9206	414938	0.01367	130.6	0.0125	0.01373	0.04991
9207	448990	0.01367	129.8	0.0135	0.01566	0.05106
9208	438868	0.01464	127.9	0.01375	0.01581	0.0535
9209	449696	0.01519	129.6	0.01458333	0.01539	0.0523
9210	475906	0.01581	132.1	0.01616667	0.0171	0.05788
9211	470055	0.01638	132.3	0.01508333	0.01671	0.05912
9212	493626	0.01906	133.9	0.01408333	0.01822	0.05691
9301	540103	0.0162	129.5	0.01391667	0.01834	0.05786
9302	526442	0.01545	125.6	0.01478333	0.01677	0.05714
9303	543818	0.01658	137.4	0.01458333	0.01725	0.06142
9304	546648	0.01558	131.5	0.01345833	0.01638	0.06156
9305	553550	0.01585	129.7	0.01255	0.01657	0.06315
9306	565498	0.0146	130.4	0.01295	0.01568	0.06473
9307	560357	0.01494	121.8	0.01155833	0.01535	0.06624
9308	578588	0.01405	123.3	0.01139167	0.01509	0.07311
9309	530168	0.01472	125	0.011425	0.0142	0.0689
9310	632933	0.0124	127.9	0.01093333	0.01414	0.07157
9311	611690	0.01258	134.2	0.011775	0.01397	0.06727
9312	627727	0.01342	138.6	0.01015833	0.01403	0.0624
Mean	270820.324	0.02403	119.88481	0.03334789	0.03097	0.03151
Std. dev.	183455.761	0.01367	9.47801	0.02654498	0.01914	0.0199

use the average interest rate paid on deposits, i.e., total financial costs/total liabilities for W_1 and the average monthly cost of labor, i.e., total personnel expenditures/total personnel in 1000s of new pesos for W_2 in the marginal cost function. Note that we do not include inputs of physical capital as a variable in the model. [12]

[12] Data that enable us to measure physical inputs over this time frame were unavailable, but Shaffer's (1993) estimates for Canada do not show substantive differences in results between those in which physical capital was included and those in which it was not. It should be noted that, where the share of physical capital in total costs has been measured in North America, it tends to be very small—on the order of 2–6%. If this small share also characterizes Mexico, the robustness of the results in models omitting physical capital costs as compared with models that include them would be likely. As long as physical capital does not vary much from month to month the linear restriction does not seem unreasonable.

The substitute for banking services we utilize is commercial paper, although this market is thin in Mexico. To proxy the price of this paper (Z), we use the rate on 28-day peso-denominated treasury bills (Cetes). As a measure of national output, we employ the monthly index of industrial production (Y). This is the only output measure available on a monthly basis. All nominal variables were deflated using the consumer price index. The dummy variable (D) was set equal to zero for all months in the sample prior to January, 1992. It took the value of 1 for all months in the sample beginning with and following January, 1992.

4. Estimation and results

Tables 2–4 present the results of our estimates. Eq. (3″) was paired with two variants of Eq. (2″). These variants include one in which there were no a priori restrictions (Table 2) and one in which the linear restriction $b_3 + b_4 = 0$ (linear homogeneity in input prices) was included (Table 3). This restriction would be appropriate if physical capital is not an input to the banks' production. In order to allow comparison of the preceding results with a benchmark that contains neither dummy variables nor restrictions, Table 3 presents estimation results for the pairing of Eq. (3′) with the unrestricted version of Eq. (2″).

Our a priori expectations on the parameter estimates (a_i for α_i, b_i for β_i) were generally confirmed by the results, with the exception of a_4. Since the demand curve is assumed to be downward sloping, the estimate of $\partial Q/\partial P = a_1 + a_3 Z + a_5 Y < 0$ must hold. We also expected to find $a_2 > 0$ and $a_4 > 0$. As earlier noted, either a_3 or a_5

Table 2
Results for estimation of Eq. (3″) and unrestricted equation (2″)

Equation	DF model	DF error	SSE	MSE	Root MSE	R^2	Adj. R^2
Q	4.5	74.5	3.573E11	4.7959E9	69252.1	0.7738	0.7632
P	7.5	71.5	0.000296	4.144E−6	0.00204	0.9804	0.9786
Parameter	Estimate	Approx. std. err.	Approx. t value	$P > \|t\|$			
A_0	709681.6	579066	1.23	0.2242			
A_1	−5.202E7	23922801	−2.17	0.0329			
A_2	−1907.58	4683.8	−0.41	0.6850			
A_3	1996872	402147	4.97	<0.0001			
A_4	−177722	25463.7	−6.98	<0.0001			
A_5	546742.6	221220	2.47	0.0158			
λ	0.097399	0.1130	0.86	0.3916			
B_1	0.003172	0.00135	2.35	0.0218			
B_2	−0.00017	0.000118	−1.40	0.1662			
B_3	0.000086	0.000057	1.53	0.1316			
B_4	0.000075	0.000163	0.46	0.6456			
B_5	−0.14722	0.0689	−2.14	0.0361			

Table 3
Results or estimation of Eq. (3″) and restricted equation (2″)

Equation	DF model	DF error	SSE	MSE	Adj. root MSE	R^2	Adj. R^2
Q	4.5	74.5	3.413E11	4.5813E9	67685.6	0.7839	0.7737
P	6.5	72.5	0.000281	3.877E−6	0.00197	0.9814	0.9799
Parameter	Approx. estimate	Std. err.	Approx. t value	$P > \|t\|$			
A_0	617043.8	528523	1.17	0.2468			
A_1	−4.796E7	20979541	−2.29	0.0251			
A_2	−1115.55	4234.1	−0.26	0.7929			
A_3	1940954	382863	5.07	<0.0001			
A_4	−172507	24449.5	−7.06	<0.0001			
A_5	506929.7	194653	2.60	0.0111			
λ	0.120374	0.0972	1.24	0.2196			
B_1	0.002192	0.000579	3.78	0.0003			
B_2	−0.00008	0.000048	−1.58	0.1192			
B_4	−0.00007	0.000047	−1.47	0.1471			
B_5	−0.159	0.0574	−2.77	0.0072			

must be different from zero in order to identify λ, a conclusion we can reach most easily in the case of a_3. Our estimate of the parameter vector β also met with a priori expectations, although we held no a priori expectation on b_5.

The systems of equations were estimated by the method of full information maximum likelihood using SAS. Full information maximum likelihood estimation assumes normally distributed errors. Initial parameter values for the FIML estimation were supplied by first estimating the system by nonlinear three-stage least squares. The interaction variable YZ had to be omitted in the estimation because it was nearly perfectly linearly correlated with the variable Z. This was due to the small variation in industrial production that occurred over the period of the sample. Therefore, in the reported results, there are no estimates for α_6.

Problems with multicollinearity remain in this sample. In particular, $\ln W_1$ is highly correlated with Z, causing difficulty in estimating and making inferences on the parameter vector β. [13] Nevertheless, convergence of the estimates was fairly rapid in all cases. The estimates also appear to be robust relative to initial values of the parameter estimates. Different sets of initial values chosen arbitrarily from within a fairly wide neighborhood of the FIML estimates (a range from a factor of 0.5 to 2 times the reported FIML estimates) did not yield significantly different results.

[13] While the inclusion of Z leads to econometric difficulties, rotation of the model through the use of terms that interact with Z requires its use, as clarified in the discussion of Eq. (2). As an experiment, we ran the model without the use of Z and the model did not converge.

Table 4
Results for estimation of Eq. (3′) and unrestricted equal equation

Equation	DF model	DF error	SSE	MSE	Adj. root MSE	R^2	Adj. R^2
Q	4.5	74.5	4.371E11	5.8676E9	76600.2	0.7232	0.7102
P	6.5	72.5	0.000432	5.959E−6	0.00244	0.9714	0.9692
Approx. parameter	Estimate	Approx. std. err.	Approx. t value	$P > \|t\|$			
A_0	1383911	826924	1.67	0.0984			
A_1	−8414E7	36637125	−2.30	0.0245			
A_2	−7626.84	6855.4	−1.11	0.2695			
A_3	2322876	495711	4.69	<0.0001			
A_4	−200322	32693.1	−6.13	<0.0001			
A_5	842063.8	337811	2.49	0.0149			
λ	−0.04279	0.1224	−0.35	0.7277			
B_1	0.006004	0.00164	3.66	0.0005			
B_2	−0.00043	0.000150	−2.89	0.0051			
B_3	0.000144	0.000067	2.17	0.0337			
B_4	0.000571	0.00224	2.55	0.0130			

5. Interpretation and discussion of results

The results suggest bank behavior that is consistent with competitiveness before the privatization [14] but with supercompetitiveness—in which bankers still treat the marginal revenue function and the demand function as identical but marginal cost exceeds marginal revenue—after the privatization. Recall that the value of $-\lambda$ represents a typical bank's percentage deviation of output from competitive levels. Thus, a $-\lambda < 0$ signifies output below the competitive level while $-\lambda > 0$ suggests that output for some reason exceeds the competitive level.

In point of fact, we could not reject the hypothesis that $\lambda = 0$ at a reasonable level of significance for any of the estimations. However, instead of equaling λ, the index of market power will equal $\lambda + \beta_5$ whenever the dummy variable is equal to one, as it is for 1992–1993. In both models that we test that include β_5 (Tables 2 and 3), the hypothesis that the 1992–1993 dummy variable β_5 equals zero can be rejected at the 0.05 level of significance.

The sign and value of β_5, the dummy variable coefficient, deserve attention. Note that a positive and significant coefficient would suggest that the industry is acting less competitively after the government's divestiture of the largest banks. But instead of a positive and significant coefficient, those on our dummy variables took on negative

[14] Despite our distinction between a publicly-owned and a privately-owned banking system, it is useful to recall that Mexico's commercial banks were at least partially privatized during our entire sample period. In 1987, 34% of the equity in the 18 publicly-owned banks was sold to private investors and large increases in profitability and efficiency soon followed. It was not until the privatization of 1991–1992, however, that private investors were permitted to hold the majority of the equity in each bank.

and significant values, so that $(\lambda + \beta_5) < 0$. [15] Here, the value of $-(\lambda + \beta_5)$ represents the typical bank's output's percentage deviation from competitive levels after privatization. This suggests that the supercompetitive level of output in the post-privatization market was 7–10% above what would have prevailed in a competitive market. [16]

Although our finding of supercompetitiveness for the average bank is inconsistent with a paradigm in which all banks underproduce in order to overcharge (where *overcharging* signifies prices that are higher than in a competitive outcome), the supercompetitive result is consistent with several other paradigms. Supercompetitive behavior is consistent with short-run efforts to grab market share if bankers believe they can derive long-run profits from engaging in short-run inefficiencies in the extension of credit—overproducing and undercharging. This paradigm is consistent with a model delineated by Spence (1979).

Although the market share argument as we have presented it could apply to many newly deregulated industries, the peculiarities of a deregulated banking environment with deposit insurance and lender-of-last-resort options in a McKinnon and Pill (1996) overborrowing model may aggravate the phenomenon. That is, without these governmental supports the overborrowing (or, as we have cast it, overlending) could be less profound. The reaction to liberalization might not be qualitatively different, but subsidized deposit insurance and other government programs to support banks against bad outcomes can be seen as lowering the constraints on risky bank behavior (Kareken and Wallace, 1978; Merton, 1977; Calomiris, 1990a,b; Grossman, 1992; Hooks and Robinson, 1996; and a host of others), even if bank charter or franchise value does mitigate the risk-taking incentives of deposit insurance.

This issue is compelling in a Mexican context not only because that country's deposit insurance of the period was virtually without legal limits on coverage per deposit but because of the evidence suggesting that depositors would not pull out their deposits from Mexican banks in response to worsening bank asset quality (Moore, 1997). If bankers were able to forecast this lack of discipline—which contrasts strongly with that of the other Latin American country Moore (1997) tests—it may be seen why they felt empowered to take risks.

Moreover, to the extent that our findings of supercompetitive bank behavior may signify a struggle for market share in Mexico, they are consistent with assessments of bank behavior in the wake of other liberalizations—although these other assessments have rarely involved econometric testing. Drees and Pazarbaşioğlu (1995)

[15] In light of the previous discussion of expense preference behavior (footnote 8), it deserves note that where $(\lambda + \beta_5) < 0$, expense preference behavior would by definition be unsustainable. Although it is conceivable that under some circumstances a negative $(\lambda + \beta_5)$ could capture a time-consuming transition from expense preference behavior towards cost-minimizing behavior, it can be argued that the change in bank behavior after 1987 but before the privatization suggests at the very least significant reductions in such behavior well before the privatization.

[16] Because of the peculiarity of the supercompetitive outcome, we performed a Goldfeld–Quandt (1973) switching regression, following the application in Shaffer (1993) model of the Canadian banking system. The only notable regime shift (in fact, the only regime shift) took place at the 1991–1992 privatization process, as we had hypothesized.

note that, following deregulation in Finland, Norway and Sweden, banks appeared to have employed market-share strategies after deregulation. In this context, it is useful to note the similarity between certain aspects of Mexico's financial liberalization and those of the Scandinavian countries. These similarities include the relaxation of credit allocation rules and the resulting novelty to bankers of freedom to lend to whom they wished. Recall, for example, that in 1988 only 25% of credit extended by Mexican commercial banks was "unrestricted." The remaining 75% of credit extended by commercial banks was—by government rules—allocated to the government or other specified sectors. By 1990, 70% of bank credit extension was unrestricted and by 1991, 100% was. In both Mexico and Scandinavia, relaxations of credit restrictions offered to bankers lending options for which their prior experiences had ill prepared them.

Although we have argued that our post-privatization results are consistent with a temporary struggle for market share, other analytics could explain the risky behavior banks pursued in the early 1990s. Large inflows of international capital might explain the entrance of banks into riskier investments. [17] This phenomenon could explain the subsequent large increases in the ratio of past due loans to total loans, but it may be more difficult to use as an argument for why banks suddenly produced services where marginal cost exceeded marginal revenue immediately after the privatizations. [18]

Another argument that might be offered is that the deregulation of the banking system is tantamount to a reduction in the franchise value of the banking system and therefore a motivation to take larger risks. However, for the case of Mexico during our study period, Rojas-Suarez and Weisbrod (1996) offer statistical evidence and arguments that the franchise value actually increased, rather than declined.

[17] Clearly, as the newly privatized banks increased their assets, some of the liabilities they utilized to do it were foreign. Mexican commercial banks' foreign debt outstanding (measured in millions of US dollars) took on the following pattern: 1988: $8057, 1989: $8863, 1990: $13425, 1991: $18235, 1992: $18948, 1993: $23018 (source: Institute for International Finance). Net international capital inflows (again in millions of US dollars) to Mexican commercial banks took on a more jagged movement over the same period, but the slope is generally positive: 1988: $1380, 1989: $980, 1990: $4384, 1991: $5609, 1992: $916, 1993: $4673 (source: Banco de México). As percentages of total Mexican bank liabilities, these inflows took on the following configuration (source: Banco de México): 1988: 3.05%, 1989: 1.69%, 1990: 5.44%, 1991: 4.72%, 1992: 0.64%, 1993: 2.82%. Total net capital inflows to Mexico (including those to banks) are typically much larger (again in millions of US dollars): 1988: $591, 1989: $4346, 1990: $16997, 1991: $25507, 1992: $20867, 1993: $34495. Note that in 1998, total net capital inflows were larger than net inflows just to banks, signifying net outflows (or debt repayments) from other Mexican sources including the nonbank public sector and the Banco de México. Meanwhile, Mexican bank credit as a percentage of GDP grew rapidly, taking on the following pattern: 1988: 15.1%, 1989: 18.3%, 1990: 21.4%, 1991: 25.4%, 1992: 30.9%, 1993: 35.1% (sources: Comisión Nacional Bancaria and Banco de México).

[18] Recall that, as explained in footnote 11, interest income that a past-due loan would have earned if it had not been past due is booked for one month and then is provisioned against. This means that P falls as a result of increasing past due loans. Accordingly, past-due loans negatively affect the measure of marginal revenue. They would not explain the structural break our model identified between the end of 1991 and the beginning of 1992.

It is difficult to generalize from our results about what may occur as a general result of financial liberalization, but the consistency of Shaffer's (1993) findings for Canada with ours for Mexico offer grounds for concern. Both Shaffer (1993) results and ours find post-liberalization shifts in bank behavior away from an apparent matching of marginal cost to marginal revenue where banks treated the marginal revenue function and the demand function as if they were the same and toward supercompetition. Although there was no real Canadian banking crisis in the 1980s, even Canada saw a significant increase in problem banks in the years following the liberalization. [19]

That Canada did not suffer from a banking crisis demonstrates that a simple finding of the anomalous relation we identified between marginal cost and marginal revenue in Mexico is not necessarily the basis for serious subsequent banking difficulties. Moreover, whether or not supercompetitive behavior is really typical after privatizations or financial liberalization is a question that can only be answered by modeling the liberalizations of additional countries.

But if supercompetitive behavior is indeed widespread in the wake of a liberalization, the fiscal consequences for governments that bail out banks ought to raise questions about how regulators might optimally respond in the short run to a discovery that it has become typical—at least temporarily. In the context of other banking literature, our findings suggest that countries that liberalize may be particularly likely to reduce bad fiscal and payments systems outcomes from risky behavior by making sure banks and depositors understand there will be no or only limited rescue operations. That is, our results reinforce the wisdom behind highly limited "widows and orphans" deposit insurance systems.

It has long been understood that bankers do not engage in extremely risky behavior all of the time, even when deposit insurance systems are implicitly or explicitly very liberal. Our results with respect to Mexico—especially when considered in the contest of Moore's (1997) result for depositor discipline in Mexico and Shaffer's result for risk-taking in Canada—suggests a circumstance when bankers do engage in such behavior. If our results turn out to be more generally applicable to other financial systems at other times in other countries, then what we have found suggests that steps to avoid moral hazard associated with a liberalization have a bigger payoff than steps to avoid moral hazard when there is no liberalization.

[19] Canada's banking problems of the 1980s may also be linked to asset price declines in a classic terms-of-trade shock. However, Canada had no bank closures—not even during the asset price shocks of the Great Depression—between 1923 and the bank failures of 1985–1986. Shaffer (1993) result of a structural break towards supercompetition in 1980, together with Kryzanowski and Roberts (1992) notation that Canadian banks have long run relatively high leverage ratios in any case, suggests that terms-of-trade shocks were likely not the only factors involved in Canada's banking difficulties of the 1980s. Certainly the causes of Canadian banking problems of this period are complex. Adjaoud and Rahman (1996) finding that Canadian bank stock returns were inversely related to interest rates during the late 1970s and the 1980s—considering the high real interest rates of the late 1970s and early 1980s—deserve attention as does their result that systemic bank risk in Canada increased markedly between 1977 and 1986.

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