WHEN DOES FINANCIAL LIBERALIZATION MAKE BANKS RISKY?
AN EMPIRICAL EXAMINATION OF ARGENTINA, CANADA AND MEXICO

by

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Abstract

In the literature on systemic banking crises, two common themes are: (1) lack of market discipline encourages risky lending and (2) financial liberalization or privatization lead to risky lending. However, there is evidence to suggest that neither financial liberalization nor weak market discipline always precedes risky lending. We test for depositor discipline and, separately for post-liberalization or post-privatization risky lending in Argentina, Canada, and Mexico. In the countries without market discipline, lending risk increases significantly in the wake of liberalization. Where depositors discipline banks, banks neither behave riskily nor does their risk increase in the wake of privatization.

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Acknowledgement

The authors thank Pierre-Richard Agénor, Jeffery Gunther, Ricardo Hausmann, George Kaufman, Kenneth Robinson, Eric Rosengren, Maria Soledad Martinez, Sherill Shaffer, John Welch, and the participants at sessions of the 1999 Federal Reserve Bank of Dallas and World Bank conference on bank privatization, of the 1999 American Economics Association meetings, of the 1998 Jornadas of the Central Bank of Uruguay, and of the 1998 meetings of the Network of Central Bank Researchers of the Americas. The opinions expressed in this paper do not reflect the opinions of the Federal Reserve Bank of Dallas or of the Federal Reserve System.

In the literature on systemic banking crises (*viz*. Calomiris, 1990: de la Cuadra and Valdés, 1992; Kaminksy and Reinhart, 1996; McKinnon and Pill, 1996), two of the most common themes are: (1) Lack of market (depositor) discipline on the banking system - which is typically blamed on government guarantees including deposit insurance - encourages risky lending that ultimately disrupts the financial system. (2) Financial liberalization or privatization often results in regulatory breakdowns and market share struggles that lead to risky lending that ultimately disrupts the financial system.

Nevertheless, while risky lending and financial disruptions occur from time to time in many countries, these events are neither continuous nor eternal components of most countries' financial landscapes. Blowups happen, but most of the time most bankers go about their business uneventfully. Similarly, not every financial liberalization in every country precedes a bubble and then a bust. Sometimes a regulatory transition is just a regulatory transition.

In sum, on the one hand there do seem to be connections of market indiscipline and of financial liberalization to what McKinnon and Pill (1996) call "overborrowing" or what - as bank regulators - we view as risky overlending. On the other hand, the sporadic appearances of these connections ought to suggest that they are conditional on something else.

This paper relies on what could be called circumstantial econometrics to suggest one type of conditionality. The econometrics are circumstantial in the sense that - with a sample of only three countries - we cannot unequivocally prove the conditionality we postulate. Nevertheless, in our model, risky bank behavior turns out to materialize just where and when we would expect it if it were indeed persistently conditional on the absence of market discipline.

We model market discipline during crisis periods in the Argentine, Canadian, and Mexican banking systems by relating depositor responses at such times to bank asset quality,

capitalization and to other factors reflecting asset and liability characteristics. The degree of banking market discipline turns out to vary greatly among these three countries.

Having identified the degree of market discipline on banks in each country, we test for the proclivity of banks to take on risk in the wake of liberalization or privatization. We use empirical models of market contestability that can determine if and when financial institutions operate at output levels where marginal cost exceeds marginal revenue before or after regulatory or ownership regime changes. Running where marginal cost exceeds marginal revenue is a statistical result consistent with a struggle for market share. Indeed, we claim that banks run in this way when some present value calculation motivates them to countenance taking short-term losses in expectation of longer-term gains.

Our results suggest a negative and direct connection between the degree of depositor-imposed discipline on a nation's banks and their predisposition towards risky lending in the wake of liberalizations or privatization.

Market Discipline: The Role of Depositors

Although government guarantees are commonly blamed for breakdowns (or the simple absence) of discipline upon bankers by depositors, the use of direct measures of government guarantees to identify such breakdowns is difficult. The reason is, depositors may perceive implicit government guarantees even when explicit guarantees do not exist.

In the literature on moral hazard and depositor discipline, bankers are typically imagined to know beforehand how much depositors will (or will not) discipline them - punishing (or not punishing) the bankers with bank runs in retaliation for poor performance. Bankers' perceptions of the punishments they will receive for a bad outcome of risky lending is accordingly supposed to affect how riskily bankers will lend. If bankers do not expect any or much punishment, the

good outcomes that can occur from risky lending will motivate them to lend more riskily, even though they know bad outcomes are possible. It follows that if lenders perceive that depositors believe implicit guarantees exist, lenders will lend more riskily in anticipation that depositors will not punish them for it, even in the absence of explicit guarantees.[1]

To test for depositor-imposed market discipline on banks in Argentina, Canada and Mexico, we apply an empirical model of depositor growth for each country during a period of financial stress.[2] The examination corrects for the effect of other links between deposit flows and asset quality. Consistent with a narrative in which depositors may or may not flee banks whose assets have begun to sour, this model uses bank-by-bank data to examine bank-by-bank characteristics that might aggravate or temper depositor reactions. These include a capitalization ratio to capture a bank's capital adequacy, a bank's share of total assets to account for too-big-to-fail perceptions, and a measure of liability composition.[3] However, very detailed analyses using numerous financial measures are not practical because of limitations on the number of financial institutions. Adequate data were available for only sixteen Mexican banks. In the case of Canada, a full set of data (particularly past-due loan data) was available for only the six largest banks (although it should be noted that they account for 90 percent of total Canadian bank assets).

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[1]Gilbert's (1990) review of the literature suggests that it generally finds discipline where guarantees do not exist and does not find it where guarantees exist. The literature since Gilbert seems to derive similar results (See Park and Peristiani, 1998).

[2]We focus on periods of natural financial stress because we think such periods are when depositors are most likely to consider whether they ought to leave their present banks for safer financial institutions or mattresses.

[3]Rojas-Suarez and Weisbrod (1996) argue that suitable measures of capital may be unavailable for Latin American banks. Based on the rates offered on deposits, they conclude that bank liability holders in both Argentina and Mexico were able to identify risky banks, however.

An examination of the results (Table I) linking deposit growth rates and bank characteristics in Argentina, Canada, and Mexico offers large differences across countries. Depositors exerted significant discipline on Argentine banks but not on Canadian or Mexican banks. In all models, the dependent variable (DEPGRP) is the percentage change in inflation-adjusted deposits.

Recall that the examination period chosen for each country is one of financial stress. For Argentina and Mexico, the examination is performed for the *Tequila Effect* period of December 1994-June 1995. For Canada the percentage change is year-over-year for 1984, 1985 and 1986, so as to capture the stresses leading to the first Canadian bank closures (in 1985 and 1986) in more than six decades. PDL/TA is past-due loans as a percentage of total assets, included to measure the quality of the asset portfolio. EQ/TA is equity capital as a percentage of total assets, which is included to measure the ability to maintain solvency in case of financial losses. $Ln(TA_i/TA)$ is the logarithm of the quotient of total assets for a given bank divided by the sum of all bank assets, so as to account for too-big-to-fail perceptions. DEP/L is deposits as a percentage of total liabilities, which we include to control for the potential influence of liability composition on depositor behavior.

In the cases of Mexico and Canada, none of the explanatory variables is individually significant at the 10 percent level. They are also not jointly significant at the .10 level although, with an F-value level of significance of .2027, Canada's joint significance level is closer to an acceptable level than Mexico's .4751. In contrast, the model's explanatory power for Argentina is highly statistically significant at the .0001 level.

Despite our concerns about implicit guarantees, the degree of depositor discipline among the three countries turns out to be inversely related to the maximum level of deposits that are

TABLE I
Deposit Growth and Asset Quality
In Three Western Hemisphere Nations

	Argentina	Canada	Mexico
Constant	-67.546**	-30.600	-54.999*
	(-2.17)	(-0.24)	(-1.82)
PDL_i/TA_i	-1.052***	-0.060	0.473
	(-3.43)	(-0.01)	(0.12)
EQ_i/TA_i	0.821*	-6.366	-0.888
	(1.90)	(-1.65)	(-0.25)
$Ln(TA_i/TA)$	2.978	-9.389	-8.376
	(0.63)	(-1.33)	(-1.27)
DEP_i/L_I	1.075***	0.504	0.386
	(4.20)	(0.38)	(0.66)
R^2	0.770	0.348	0.255
Prob(F-Stat)	0.0001	0.2027	0.4751
# of Observations	20	18	16

Note: the dependent variable is the percentage change in the inflation-adjusted deposit growth rate of bank i. PDL_i/TA_i is bank i's past-due loan as a percentage of total assets. EQ_i/TA_i is bank i's equity capital as a percentage of total assets. $Ln(TA_i/TA)$ is the log of bank i's total assets over the sum of total assets of the banks examined. DEP_i/L_I is bank i's deposit as a percentage of total liability. *t*-statistics in parentheses, based on approximate standard errors (***: significant at 0.01 level, **: significant at 0.05 level, *: significant at 0.1 level)

explicitly insured in each country. While Mexico's deposit insurance was virtually open-ended, that of Canada was limited to $60,000 (Canadian dollars), while Argentina's maximum was $10,000 or $20,000 (U.S.) depending on type of deposit.[4] Accordingly, in our model, a bank's asset quality least explains its deposit growth in Mexico (the country with the most explicit guarantees) and most fully explains deposit growth in Argentina (the country with the lowest level of explicit guarantees). Indeed, for Mexico the effect of asset quality weakness (PDL/TA, past-due loans divided by total assets) on deposit growth takes on a perversely positive value, although the t-value of 0.12 (.904 level of significance) is far from significant. Canada's PDL/TA coefficient is also insignificant, but the negative sign is as expected. In contrast to Mexico or Canada, the relation between asset quality weakness and deposit growth in Argentina is not only negative but significant. That is, when asset quality weakens, depositors withdraw their funds.

Results for Argentina differ noticeably from those of Mexico and Canada not only because of the model's joint significance and because of the significance of the past due loans as a share of total assets variable (PDL/TA), but also because of the significance and signs of the equity and deposit-share-of-liabilities variables. If depositors are very sensitive to a bank's capitalization, and if they are more likely to remove their funds from a poorly capitalized bank than from a well-capitalized institution, the coefficient on EQ/TA (equity as a percentage of total assets) ought to be positive and significant. For Mexico and Canada, the coefficient was negative

[4]Fernandez and Schumacher (1998) note that, because the deposit insurance program was not fully funded, the de facto level of deposit insurance was in fact far lower than the $10,000 and $20,000 maxima. They also note that, by tying the size of monetary base to the size of foreign reserves, Argentina's Convertibility Law severely restricts the government's ability to finance assistance programs through money creation. See Caprio et al. (1996) for more extensive discussion of the constraints a currency board - as Argentina has - imposes on the lender-of-last resort function.

and insignificant. For Argentina, the coefficient was positive and significant at the .08 level. In sum, for Argentina but not for Canada and Mexico, the results support the view that depositors discriminated based on the financial condition of banks.[5] That is, during stress periods, depositors disciplined Argentine banks but did not significantly (if at all) discipline Canadian banks and did not discipline Mexican banks at all according to the present criterion.[6]

Financial Liberalization, Market Share Struggles, and Risky Behavior

Having established that banks receive more market discipline in some countries than others, we now test for conditions under which banks lend more riskily in countries with less discipline than in countries with more discipline. Recall that, in testing for market discipline, we chose periods when each country's banking system was under stress.

But in testing for risky behavior, we chose periods when there is reason to suspect that each country's banks might be particularly subject to temptations to take risks. Since the periods we chose immediately followed either a financial liberalization or privatization, it is useful to clarify why we think such temptations occurred then.

Large changes in legal regimes for banks can signify changed opportunities to develop various categories of markets. The liberalization or privatization of a banking sector is typically followed by a large increase in liabilities - as banks are permitted to take on liabilities at the rate the market will bear instead of at what the government permits - and by rapid increases in bank

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[5] Note that the too-big-to-fail variable, the logarithm of the ratio of a banks assets to all sample banks' assets ($Ln(TA_i/TA)$), was not significant for any of the three countries. We used this ratio of assets in order to address the Canadian data problem, in which we had to use three years' data in order to have enough degrees of freedom to run the model. We were concerned that if we had simply used assets instead of a ratio, year-over-year growth in assets might distort our results. We also ran the models using simple logarithms of bank-by-bank assets instead of ratios. Neither the signs nor the significance of the coefficients changed as a result.

[6] It may be said, however, that poorly performing Mexican banks were disciplined by having to pay higher interbank rates on the Mexican interbank market.

assets (Gorton, 1992). In a narrative that resonates particularly with privatization episodes de Juan (1995) notes that on a bank-by-bank level, when new owners take control of a bank, they commonly increase lending relative to the value of equity capital or the deposit base. Whether or not 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 (1994) - a common adjunct to financial liberalization is markedly increased competition in the banking system (IMF,1993).

As liabilities expand and banks seek to match them with new assets, not only the quantity but the *quality* of assets changes - and in more than one sense of the term. First, more assets sometimes means much more of certain types of assets. Mexico's newly privatized banks focused on consumer markets far more than when those same banks had been publicly owned.

But asset quality also often changes in the sense of the other meaning of the term *quality*. Under this same paradigm of financial liberalization, after a repressed financial system is liberalized, banks cannot supply intermediation services efficiently because they lack expertise and adequate technology (Kaufman, 1998). Banks' portfolios become riskier because banks cannot evaluate the riskiness of loans and higher real interest rates under the new regime. Lenders lack past distributions on which to base their assessments.

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). This struggle for market share in a suddenly new market environment may be seen as key to the onset of the high-risk bank behavior

on which much of the current literature on financial and exchange rate crises is based.

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 (for example, consumer credit markets 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.

At some point, or perhaps at several, since the beginning of the 1980s Argentina, Canada, and Mexico have all undergone significant changes in the role of government in banking. In probing for shifts in risky behavior in the banking system of each country, we focus on one such major regime shift for each country.

As of 1991 publicly-owned banks controlled 61 percent of all bank assets in Argentina. Beginning in 1991, at the same time as the initiation of Argentina's Convertibility Plan and of related financial liberalizations, Argentina initiated efforts to privatize its extensive government-owned provincial banking system.[7]

Nevertheless, by the onset of the Tequila crisis at the end of 1994, only three banks were actually privatized and only one more was effectively privatized in January 1995. However, from December 1995 through the first quarter of 1997 an additional eleven institutions were privatized so that by the latter date less than one-third of all bank assets were in publicly-owned banks. We model the period 1991.IV-1997.I to assess onsets of what may be construed as risky bank behavior. The discussion below focuses on efforts to find a structural break at 1995.IV, the

[7]For a thorough and incisive analysis of the Argentine privatization process see Abad, Burdisso, D'Amato and Molinari (1997).

onset of the massive privatization effort.

Canada's regime shift commenced with the 1980 Bank Act. The Act permitted a large increase in the number of banks and allowed nonbank financial institutions to clear checks - a practice previously prohibited. The Act was the beginning of a trajectory of financial liberalization in the 1980s that relaxed restrictions on commercial and consumer lending, allowed federally chartered financial institutions and foreign investors to own 100% of securities dealers, and more generally permitted fuller bank competition with nonbanks and vice versa.[8]

In contrast, Mexico's banking system was characterized by financial repression until the late 1980s. The government had nationalized the banking system in 1982 and restricted interest rates on deposits and loans. The government forced the banks to lend to it, crowding out extensions of credit to the private sector.

The late 1980s saw profoundly market-oriented changes. In 1987, the government of Mexico sold to the private sector a total of 34 percent of the ownership in the publicly-owned commercial banks. In 1989, Mexico introduced reforms to eliminate controls on interest rates and on the term structure of traditional types of bank deposits, eliminated forced loans to the public sector at below-market interest rates, and eliminated governmental edicts on the industry-by-industry allocation of funds.

These liberalizations notwithstanding, the most profound regime change since the 1982 bank nationalization was the June 1991-July 1992 privatization, when Mexico auctioned off majority ownership in all eighteen-government owned commercial banks. We present a model of Mexico's banking system performance during the period 1987-1993, with particular attention to

[8]Amoaku-Adu and Smith (1995) note that, within a year after the passage of Bill C-56, the six largest banks in Canada had acquired control of most of the nation's large investment dealers.

a structural break at the beginning of 1992, in the middle of the privatization process.

The Model

Although the purpose of the model, as we apply and interpret it, is to identify moves toward high-risk behavior in a banking system, the model was originally designed to assess the degree of banking system competitiveness. When the model is able to identify breaks at which the typical bank commences the high-risk tactic of producing where marginal cost exceeds marginal revenue, this identification is an adjunct to the original purpose for which the model was designed. We measure the degree of competition because one state of competition - the state that Shaffer (1993) has defined as *supercompetition* - is mathematically identical to the high-risk tactic of producing where marginal cost exceeds marginal revenue.

It is important to reiterate why we emphasize breaks in bank behavior. Our efforts are intended as examinations of an aspect of the current literature (Kaminsky and Reinhart, 1996, for example) in which a trajectory beginning with financial liberalization, leading through subsequent risky bank behavior, and continuing with an onset of serious financial stress in a country can conclude with a financial and exchange rate crisis. We here focus on the portion of the trajectory that joins the financial liberalization to the risky bank behavior.

However, when seeking the bases for high-risk bank behavior, there is a second and equally important reason to focus on structural breaks. The paradigm we have presented so far involves banks' struggles for market share when liberalization and privatization have suddenly made new market opportunities possible. A market share struggle occurs when the present value of expected future return to the struggle looks consistent with the short-term stresses involved in a cost/revenue relation that cannot long be sustained, i.e marginal cost exceeds marginal

revenue.[9] We focus on breaks because high-risk bank behavior as we characterize it must be a temporary phenomenon. Because the type of high-risk behavior we attempt to characterize occurs as a struggle among banks for market share, it takes place across much or all of the banking system.

In order to characterize breaks into high-risk bank behavior, we present a simultaneous equation model that Shaffer (1993) introduced to the banking literature. This approach permits testing of the competitiveness of a commercial banking system through estimation of 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 would set marginal cost equal to what the literature calls 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 a 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

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[9]The discussion above of consumer behavior with respect to credit cards offers a case in point. If credit cards have been little used in a country until a certain moment and if the first bank that presents a consumer with a credit card is likely to win the consumer for life, then some banks entering the suddenly new credit card market may be motivated to distribute credit cards as rapidly as possible and with less thought than otherwise to borrower creditworthiness.

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, ϵ is a random error term. Actual (as distinguished from perceived) marginal revenue is:

$$\begin{aligned} MR &= P + h(Q, Y, \alpha), \\ &= P + Q/(\partial Q/\partial P) \end{aligned} \tag{2}$$

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

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

where λ is a new parameter to be estimated, $0 \leq \lambda \leq 1$. 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, where η is a random error term,

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

Price taking firms perceive no difference between their marginal revenue functions and demand function. For them, $\lambda = 0$. Firms acting as joint monopolies clearly perceive 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. A Cournot equilibrium is suggested when $\lambda = 1/n$.

An instructive detail of this estimating 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.

Of greatest importance for the purposes of this paper, if $-\lambda>0$, then actual output seems to exceed the competitive equilibrium output level, even though static allocative efficiency requires the marginal cost pricing outcome of $\lambda = 0$. This bank behavior outcome is referred to as *supercompetition*. It signifies that the typical bank in the market is operating at an output level where marginal cost exceeds marginal revenue.

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

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \alpha_3 PZ + \alpha_4 Z + \alpha_5 PY + \alpha_6 YZ + \epsilon \qquad (2'')$$

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.[10]

Following Shaffer (1993), a translog cost function is used to estimate the average

[10] As Shaffer (1993) explains, a necessary and sufficient condition to identify λ is that the demand equation not be separable in at least one exogenous variable that is included in the demand function, but excluded from the marginal cost function. This condition is satisfied if α_3 and α_5 do not both equal zero. This specification of the demand function, apart from the interaction terms, represents a first-order (linearized) approximation of the true demand function (Shaffer 1993). Our results lead to the conclusion that α_3 and α_5 are not zero. Therefore λ is identified.

commercial bank's cost function as follows:

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

where C is total cost, W_1 and W_2 are exogenous input prices, as explained below. Equation (4) gives rise to following marginal cost function, c(Q, W, β),

$$MC = (C/Q)(\beta_1 + \beta_2 \ln Q + \beta_3 \ln W_1 + \beta_4 \ln W_2) + \eta \quad (5)$$

Therefore, equation (3) is specified as follows:

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

However, equation (3') is not configured to facilitate analysis of breaks in bank behavior. To allow for breaks, we rely on the following specification of (3):

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

where D is a dummy variable to be more fully explained below and ξ is a random error term. The system of equations represented by (2'') and (3'') is then estimated simultaneously.

It is not unusual in articles on the banking systems of any of the three countries we consider to disaggregate a banking system according to market scope. Banks are sometimes characterized as large national, small national, multiregional or 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. Where the industry comprises multiple markets, λ signifies the average degree of market power over the separate markets.

Note that λ reflects the behavior of the average firm in the sample.

Another important detail 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.[11] Here a finding of perfect competition or supercompetition would be even more striking than if the input price-taking assumption were not violated.

Data

So as to maximize degrees of freedom, we used the most often-reported data available for the applicable period for each country. This decision means that the number of observations per year is different in each of the three country models. For Mexico, the data were monthly and the period was April 1987 through December 1993. For Argentina, the data were quarterly and the period was 1991.I through 1997.I. For Canada, we ran a model using data presented in Shaffer (1993), which are annual and run from 1965 through 1989.[12]

It is important to reiterate that the latter portions of these time series capture events following major liberalizations and privatizations. These periods give us roughly two years (1992-93) of monthly observations on the Mexican commercial banks during and after which the

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[11]For a proof, see Shaffer (1994), 8-9.

[12]In the case of Mexico, we stopped the model at 1993 because thereafter data reporting began to take place on a quarterly rather than monthly basis. We started with 1987 for Mexico and 1991 for Argentina because those were the earliest years for which data were available from each country's central bank. Recall that 1987 was an important year in the history of modern Mexican financial liberalization. In that year, the government sold off 34 percent of ownership in Mexico's publicly-owned banks. Thereafter, in the years prior to the 1991-92 privatizations of the majority of bank ownership, substantial liberalizations included removal of controls on deposit and loan rates and considerable other changes. In Argentina, 1991 marked the inception of the Convertibility Plan and attendant financial liberalizations .

largest banks were privatized, six quarterly observations (1995.IV-1997.I) for Argentina during which most privatized banks there went through their privatizations, and a nine-year Canadian period (1981-89) following Canada's Bank Act of 1980.[13]

The model applied here uses the intermediation model of a bank. This approach, developed by Klein (1971) and Sealey and Lindley (1977) and applied in Shaffer (1993) treats the 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. The price of output (P) is total interest income divided by total assets, i.e. 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. Since deposits and labor are the only production inputs, input prices for deposits (W_1) and labor (W_2) are required. In the marginal cost function, for W_1 the average interest rate paid on deposits (i.e. total financial costs/total liabilities) is used. For W_2 total personnel expenditures/total personnel is applied.

In principal, a particularly appropriate substitute for banking services would be the commercial paper rate in each country. Unfortunately, during the periods under study in each country, data on such instruments were not available. Accordingly, in the case of Mexico, the interest rate on 28-data *cetes*, or Mexican treasury bills was used. In the Canada model, rates on three-month Canadian government paper were applied. In the Argentine case, because of a lack of a series even for Argentine government paper rates for the period, three-month U.S. treasury bill rates were used because of their close correlation with LIBOR rates. Use of this series in the Argentine model provided the expected signs and hoped-for levels of significance in most cases.

[13]We also tested as Argentina's privatization period 1995.I-1997.I, so as to pick up twelve of the fifteen privatizations instead (as with 1995.IV-1997.I) of eleven. The results were not substantively different from characterizing the regime shift period as 1995.IV-1997.I.

As a measure of national output, an index of industrial production was used for Argentina and Mexico since less-than-annual observations for GDP were not always available. In the Canada model, annual GNP is used. All nominal variables were deflated using the consumer price index.

Estimation and Results

Table II presents the estimation results for the models of each of the three countries, with dummy variables for the relevant period of privatization or liberalization in each case. The results show that, after national liberalization or privatization regime changes, the average bank in the high-guarantee, low depositor-discipline nations of Canada and Mexico began to pursue statistically significantly riskier behavior than before these changes. In contrast, the average bank in the low-guarantee, high depositor-discipline nation of Argentina did not.

Indeed, our *a priori* expectations of the parameter estimates (a_i for α_i, b_i for β_i) were in general confirmed by the results, with the exception of a_2 in the cases of Argentina and Mexico. Since the demand curve is assumed to be downward sloping, the estimate of $\partial Q/\partial P = a_1 + a_3 Z < 0$

must hold, as it did in all cases. We also expected to find $a_2 > 0$ and $a_4 > 0$. As earlier noted, either a_3 or a_5 must be different from zero in order to identify λ, a condition that was always satisfied by 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. This method assumes normally distributed errors. Initial parameter values for the FIML estimation were supplied by first estimating the system by non-linear 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 for both Argentina and Mexico. 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 a_6 for those two countries although there are estimates for Canada, where GNP was used for Y.

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. 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.

For the purposes of this discussion, the most important results involve the coefficients of λ, the variable that measures level of competitiveness, and of b_5, the λ-related dummy variable coefficient for the liberalization or privatization period for each of the three countries. 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.

The null hypothesis that $\lambda = 0$ could not be rejected at a reasonable level of significance for any of the estimations. That is, the average bank in each of the three countries behaves consistently with the competitive paradigm. The inability to reject the null hypothesis means that in no case did the average bank operate for each **total** observation period where marginal cost exceeded marginal revenue.

TABLE II
Estimation of Equation (2'') and (3')

	Argentina	Canada	Mexico
α_0	750979***	-12211	425690
	(3.86)	(-0.11)	(0.74)
α_1	-23857842***	-3020770***	-38456010*
	(-4.55)	(-5.25)	(-1.89)
α_2	-7342***	0.56925	-156
	(-3.89)	(1.27)	(-0.03)
α_3	-3373371***	61863	1828469***
	(-5.33)	(0.72)	(4.19)
α_4	133609***	9874	-186328***
	(5.38)	(0.76)	(-5.36)
α_5	243664***	13.869***	460617**
	(4.73)	(4.48)	(2.37)
α_6		-0.07015	
		(-1.69)	
β_1	6.89405***	0.71310	6.71503***
	(4.16)	(0.95)	(2.91)
β_2	-0.36894***	0.01034	-0.35608**
	(-4.09)	(0.26)	(-2.63)
β_3	0.01051	-0.06658**	-0.00144
	(0.17)	(-2.54)	(-0.02)
β_4	0.39261**	-0.00272	0.37083*
	(2.23)	(-0.03)	(1.83)
β_5	0.00620	-0.03563*	-0.32464**
	(1.25)	(-1.95)	(-2.57)
λ	-0.00053	-0.00183	0.45874
	(-0.24)	(-1.08)	(1.63)
Adj R^2 (2")	0.770	0.971	0.700
Adj R^2 (3")	0.959	0.995	0.969
# of Observations	22	25	81

Note: *t*-statistics in parentheses, based on approximate standard errors (***: significant at 0.01 level, **: significant at 0.05 level, *: significant at 0.1 level).

That is, the average bank in each country did not follow the high-risk tactic. The question remains, however, as to whether these countries operated at such levels during their post-liberalization or privatization periods.

In examining the results for the post-liberalization or privatization period, the sign and value of b_5, the dummy variable coefficient, deserve particular attention. For such periods, instead of equaling λ, the index of market power will equal $\lambda + b_5$ and b_5 is the difference of level of competitiveness between two periods. If b_5 is negative and significant, the period for which the dummy applies demonstrates a significant increase in the riskiness of bank behavior.

For both Canada and Mexico, b_5 is negative, significant, and takes on a modulus (absolute) value substantially larger than that of λ (where λ's value is insignificant in any case). The negative and significant value of b_5 suggests that the average bank in each of these two high-guarantee countries significantly increased the riskiness of its behavior after liberalization or privatization. In the Argentine model, by contrast, neither b_5 nor λ were significantly different from zero. This signifies that neither did the average Argentine bank pursue the high-risk tactic of operating where marginal cost exceeded marginal revenue for the entire measurement period nor did banks increase the riskiness of their tactics in the wake of privatization. That is, the post regime-shift operating behavior of Canadian and Mexican banks was at marked variance from Argentina's but pre-shift behavior was not.[14]

[14]We tried to test the robustness of the results for other specifications especially for log first differences. The results are qualitatively unchanged if iterations converge.

Conclusion

Although the oft-alleged relation between market discipline and risky bank tactics is clearly demonstrated in the models we present here, of equal importance in our results is that this connection is not an eternal feature of banking systems - at least not *in extremis*. While a predisposition towards high risk tactics revealed itself in the low-discipline high-guarantee countries of Canada and Mexico and not in the high-discipline low-guarantee nation of Argentina, no country's banking system always operated where marginal cost exceeded marginal revenue. Although it would be hard to imagine a scenario in which any particular bank always operated where marginal cost exceeded marginal revenue (at least in the absence of both eternal stockholder optimism and eternal managerial optimism of the most extreme nature), the endless replacement of old banks with new and optimistic institutions would be possible. Neither phenomenon materialized.

Instead, banks in low-market-discipline, high-guarantee countries followed risky tactics when there were new markets that may have seemed to warrant new market-share struggles. Otherwise, high-risk tactics did not appear to be typical. While this additional conditionality for risky behavior may not be surprising, discussions of it are less common in the literature than are simple allegations of links between guarantees or low market discipline and risky lending without detailed consideration of how or when[15]. According to our results, the risky behavior

[15]Another factor that might conceivably have influenced cross-country differences in bank risk is the strength or weakness of a country's banking supervision and regulation. Banks in a country with less prudential banking supervision and regulation might tend to behave more riskily. However, it turns out to be unlikely that banking supervision and regulation factors cause significant bias in the estimation of our model. In order to examine this problem, we need to have a single cross country index which measures a country's regulation and its ability to supervise its banks. The research to set up this cross country index is in progress (See Barth, Caprio and Levine 1998, Caprio 1998, and JP Morgan 1997) but is not yet refined enough for our purposes. An alternative method is to use proxies for banking supervision and regulation. La Porta et al (1998) report the indexes of law enforcement variables during 1980-95. Since prudential

and liberalization story is true and the risky behavior and guarantees story is true, but only when the two stories are told together.

supervision depends more on the quality of supervision than on institutional elements, indexes of rule of law and of corruption can be proxies for prudential supervision. With the best law enforcement indexed to 10, the indexes of rule of law in Canada, Argentina and Mexico are 10.00, 5.35, 5.35, respectively. The indexes of corruption in Canada, Argentina and Mexico are 10.00, 6.02, 4.77, respectively. These proxies suggest that banking supervision in Canada would not be worse than Argentina and Mexico, and the difference between Argentina and Mexico may not be significant. Our results in Table 2 do not reflect these differences in the proxies of banking supervision.

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