AN EMPIRICAL ANALYSIS OF THE USE OF DERIVATIVES BY BANKS IN BRAZIL, CHILE, AND MEXICO

Andres Rivas[1]*
Texas A&M International University, USA.

Felice Policastro[2]
Gardner-Webb University, USA.

Teofilo Ozuna[3]
The University of Texas-Pan American, USA.

ABSTRACT

The purpose of this study is to investigate the financial characteristics that might influence the use of derivatives by banks in Latin America. We find that in Latin America banks using derivatives, compared to nonuser banks, are associated with riskier capital structures. Additionally, we find that on-balance sheet activities such as liquidity is not a substitute for derivatives and that derivatives are not being used to coordinate interest-rate risk and credit risk management strategies. These results identifying a derivative user bank as a weak capitalized bank, which does not seek to hedge unwanted risk, argue the need for any additional restrictions on derivatives activities. Latin American policy makers need to address the possible speculative behavior of banks in Latin America, otherwise they risk having an unstable and detrimental banking system.

Keywords*:* Derivatives, Banking, Risk Management, Latin America

JEL classification*:* G21, G28, G32

---

[1] Division of Banking and Finance Studies, A.R. Sanchez School of Business Administration, Texas A&M International University, Laredo, Texas 78041.
[*] Please address all correspondence to Dr. Andrés Rivas, Division of International Banking and Finance Studies. A.R. Sanchez School of Business Administration, Texas A&M International University, Laredo, Texas 78041. E-mail: arivas@tamiu.edu, Tel: (956)326-2484.
[2] Godbold School of Business, Gardner-Webb University, 100 E. Main Street, PO Box 7208 Boiling Springs, NC 28017. E-mail: fpolicastro@gardner-webb.edu , Tel: (704)406-3997.
[3] Department of Economics and Finance, College of Business Administration
The University of Texas-Pan American, 1201 West University Drive, Edinburg, TX 78541-2999

I. INTRODUCTION

During the 1990s, Brazil, Chile, and Mexico (three of the most important economies of Latin America) deregulated their banking industry, removed capital-flow controls, and promoted development of their stock market. These policies led to substantial increases in capital-flows and foreign banks to these countries and this in turn led to greater capital market volatility and more intense banking competition within these countries. Under this more open and competitive environment, banks in Brazil, Chile, and Mexico faced greater risks and uncertainties and as a result undertook riskier projects and loans (Fischer et al, 1997). Consequently, to manage their risks banks in Brazil, Chile and Mexico implemented various risk management strategies and engaged in the use of financial derivatives (see Table 1).

Table 1

Gross Market Values of Over the Counter Equity-Linked Derivatives by Instrument, Counterparty and Market Risk Factor at End-June 2008 (In Millions of US Dollars)

Category	Total	US	Japanese	European[2]	Latin American	Other Asian	Other
Forwards and Swaps	48,930	18,394	3,159	23,059	1,041	376	2,900
With Reporting Dealers	7,703	1,458	474	5,225	7	199	341
With Other Financial Institutions	25,871	7,791	1,520	13,669	784	76	2,034
With Non-Financial Customers	15,354	9,147	1,165	4,166	251	101	526
Options Sold	114,765	23,505	4,133	82,061	451	1,054	3,561
With Reporting Dealers	56,791	8,197	2,505	44,768	10	407	905
With Other Financial Institutions	36,374	5,085	1,111	28,097	181	74	1,825
With Non-Financial Customers	21,600	10,223	518	9,196	260	573	830
Options Bought	92,474	22,489	3,437	62,534	454	449	3,111
With Reporting Dealers	49,168	8,178	2,540	37,735	7	171	539
With Other Financial Institutions	25,438	3,255	728	19,472	181	60	1,744
With Non-Financial Customers	17,868	11,056	170	5,327	268	217	829
Total Options	150,448	37,797	5,065	99,827	895	1,096	5,767
Total Contracts	199,377	56,193	8,225	122,885	1,936	1,472	8,666

Note. Excluding countries in eastern Europe. [2] While data on "total options" are shown on a net basis, separate data on "options sold" and "options bought" are recorded on a gross basis, i.e. not adjusted for inter-dealer double-counting. From BIS reports. Reprinted with permission.

By 2008, the notional value of derivatives contracted by banks in Brazil, Chile, and Mexico amounted to about US$ 865,025 million (see Table 2) and

of this total Brazil held the largest notional value (US$ 829,210 million) followed by Chile (US$ 34,971 million) and Mexico (US$ 844 million). Surprisingly, not much else is known regarding the use of derivatives by banks in Brazil, Chile and Mexico nor the rest of Latin America for that matter. Given the growing importance of the use of derivatives by banks in Brazil, Chile and Mexico it would be informative to know whether banks in these countries use derivatives to hedge against detrimental movements in interest-rates; to coordinate their risk management activities; and/or as substitutes for other on-balance sheet hedging activities. As such, the purpose of this study is to empirically examine the use of derivatives by banks in Brazil, Chile and Mexico and thus provide evidence regarding how financial derivatives are employed by these banks. This evidence will offer valuable information and lessons regarding the use of derivatives to bankers, shareholders, depositors and policy makers concerned with the safe and sound operation of banks in these three countries and in other Latin American countries as well.

In the literature, a series of studies have examined the use of derivatives by banks in the United States. In general, these studies yield a number of key findings. First, banks that use derivatives experience greater growth in lending (Brewer, et al., 2000). Second, the bank's corporate-governance and ownership-structure influences the bank's use of derivatives (Whidbee & Wohar, 1999). Third, increases in the bank's uses of interest-rate derivatives correspond to greater interest-rate risk exposure (Carter & Sinkey, 1998; Gunther & Siems, 1996; Hirtle, 1997; Shanker, 1996; Sinkey & Carter, 2000).

Lastly, banks that use derivatives have riskier capital structures; larger maturity mismatches between assets and liabilities; greater loan charges-offs; and lower net income margins (Carter & Sinkey, 1998; Sinkey & Carter, 2000). Our study adds to this literature in that it is the first to examine the use of derivatives by banks in Brazil, Chile, and Mexico and to contrast the results obtain in these three developing countries with the results obtain in the U.S. In essence, we examine whether the results regarding the use of derivatives by U.S. banks transfers over to the case of banks in developing countries.

Using data regarding derivative usage and bank characteristics from 133 Brazilian banks, 27 Chilean banks and 41 Mexican banks, we obtain several important findings. We find first, that Latin American user banks, compared to nonusers, are associated with riskier capital structures and lower spread margin. Second, that on-balance sheet activity such as liquidity is not a substitute for derivatives and that derivatives are not being used to coordinate interest-rate risk and credit risk management strategies. Third, we

uncover that smaller banks benefit in the market for derivatives when they are foreign banks. These results identifying a derivative user bank as a weak capitalized bank, which does not seek to hedge unwanted risk argue the need for any additional restrictions on derivatives activities. Latin American policy makers need to address the possible speculative behavior of Latin American banks, otherwise they risk having an unstable and detrimental banking system.

The rest of this study is organized as follows. Section 2 provides a description of the Latin American banking environment. In section 3 the study's theoretical framework and econometric model specification is presented. Section 4 identifies the data and how it was obtained and modified and compares the statistical means of derivative user and nonuser banks. Section 5 presents the empirical results of the estimated model and a discussion of these results. Lastly, section 6 concludes the study and draws implications for the use of derivatives by banks in Latin America.

II. LATIN AMERICAN BANKING BACKGROUND

For years the Latin American banking market has been viewed as a single market with similar cultures and regulations, which are perceived as weaker banking environment. Yet recent studies have shown that this is not the case. Research by the Federal Reserve banks of Dallas and Atlanta and the Heritage foundation have shown that Latin American banks differ with Chile having as good as or better banking regulatory environment than the US. Brazil was found to be superior to the US in regulations capital adequacy, liquidity, and loan allowances. Even though Mexico has the poorest regulatory environment of the three Latin American countries, it has better liquidity ranking than the US (Levy & Micco, 2003). This shows that the Latin American banking environment is a diverse one and difficult to generalize since each Latin American country have distinct regulations. Additionally, Latin American banking authorities continue to sharpen their regulatory requirements and raise the region's banking rules up to international standards (Latin Finance, 2001).

Brazil

During the last years, the Central Bank of Brazil has engaged in many projects such as granting the domestic financial institutions the ability to compete internationally. Among the changes we find the Central Bank of Brazil has revised the accounting standards, implementing more accurate capital adequacy rules including country exposure and liquidity risk, and establishing more comprehensive measures of transparency and disclosure of

information. In the year 2000, the Central Bank developed a clear definition of Tier-one and Tier-two capital agreement with the Basel Committee Standards.

Another relevant change is related to the standardization of the control and supervisional procedure on ownership within the national financial system. The Central Bank of Brazil established conditions of financial institutions' ownership within the country, allowing an increase in flexibility, seeking more competent control and supervision, which will allow accomplishing the objectives of the financial system. A new recent regulation introduced a new concept known as "economic group", which requires two different types of financial statements.

Chile

During the year 2000, the Superintendence of Bank and Financial Institutions (SBFI) included the article 35II into the Chilean's general banking laws. This article was enacted with the aim to help globalize the Chilean banking system. The first refers to treatment of the mergers and acquisitions; the SBFI must authorize banks mergers, in both the partial or complete acquisition of assets and liabilities and in cases in which a single person or controlling group owns two or more banks. The SBFI requires that the acquiring institutions should have a significant market share of at least 15%. Additionally, the new regulation also increased the minimum of capital adequacy for 8% to 14%, increasing the technical reserves to 1.5 times capital and reserves from 2.5 times, or reducing inter-bank loans to 20% from 30% of bank's portfolio.

The second important regulation is the criteria for classifying financial institutions into five categories by analyzing the standards and solvency of the banks and financial institutions. This regulation aims to allow the banking system to get a greater market discipline. This classification is based on the capital adequacy established by Basel Committee. Another relevant aspect is the incorporation of essential elements in determining the risk of commercial loan, the analysis of risk exposure taken up by bank debtors, mainly in relation to a gap or mismatch between assets and liabilities in foreign currencies and operations done through derivative instruments.

Mexico

The National Commission of Banking and Security (CNBV) has introduced relevant reforms for the Mexican banking system. Article 73 of the Law of credit Institutions was modified, with the objective of providing a more sound and efficient framework in relation to credits. The CNBV has the

power to apply prompt corrective actions such as suspending the payments of dividends, canceling interest on subordinated debts among others, in order to avoid deterioration of the institution and thus reducing the possibility of a systemic risk.

The amendment of article 73 enables CNBV the power to regulate financial group. Additionally, the change try to enhance corporate governance standards in the boards of financial intermediaries and issuers, by establishing a stronger set of responsibility of their members and requiring the inclusion of independent board members.

The regulatory changes also improve the methodology for rating of commercial loans. This regulation establishes the procedures to follow by the institution taking into consideration the levels of credit risk. Additionally, the accounting criteria for banking institutions were updated so that it takes into consideration the minimum disclosure as well as the complexity of some transactions undertaken between annual reports.

A. Comparison among Brazil, Chile and Mexico Regulations

Comparing the three countries Brazil, Chile, and Mexico, we can observe that there exist some similarities and differences among them. Bellow we provide a short analysis of the three countries in the areas of competition, capital requirements, liquidity, deposit insurance and transparency.

Competition

The competitive situation within Brazil, Chile, and Mexico is diverse. Brazil has the greatest number of banks totaling 203 banks, followed by Mexico with 40 banks, and Chile with 25 banks. Over the last few years, these Latin American countries have been subject to substantially increased concentration yet according to recent research this has not affected competition (Barth et al, 2003). The concentration is further evidenced by the 5-bank concentration ratio of 80% for Mexico and about 60% for Chile and Brazil (Levy & Micco, 2003).

Capital Requirement

Among these three countries capital requirements are relatively similar. Of the three countries Chile has the highest required minimum risk-based capital of 14%, well above the minimum BIS standards, followed by Brazil with 11%, while Mexico has the same minimum risk-based capital of BIS standards of 8%. All three countries follow the Basel guidelines. Except for the case of Mexico with bank credit risk and Chile for Market risk the capital asset requirement ratio varies (Barth et al, 2003).

Liquidity

The regulatory requirements for liquidity for these countries are rated as high as or higher than those of the US (Barth et al, 2003; and Levy & Micco, 2003).

Deposit Insurance

Although all three countries have deposit insurance scheme, each country varies in the way they are administered and funded. Like the US, Brazil's insurance is funded by the banks themselves while in Chile it is funded by the government, and in Mexico by both banks and the government. The insurance limit per account is unlimited for deposits in the case of Mexico and for the current deposits only in Chile, yet in Brazil all accounts are protected up to US$ 20,000 while time deposits in Chile are protected up to US$ 3,340. It is important to note that for Brazil and Chile the insurance is per person while in Mexico and US is per account (Barth et al, 2003).

Transparency

Traditionally large wealthy family firms or corporations have owned banks in Latin America. As the banking systems have been opened to foreign competition, which have access to funds from foreign equity markets domestic banks have been forced to also seek equity capital to compete. As a result, greater transparence is required in order to access this new equity market. Banking regulations have increased the disclosure of off-balance sheet items to the public, such as derivatives. However, none of the banks in the three countries are required to disclose risk management to public. Lastly, Chilean and Mexican regulators require credit ratings for commercial banks while Brazilian does not require it (Barth et al, 2003).

Activities

Banks in Brazil and Chile are permitted to undertake securities and insurance activities while Mexico is restricted. Additionally, Brazilian and Chilean banks are restricted to undertake real estate activities while Chilean banks are prohibited.

III. THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

In this section we present theoretical arguments regarding why banks use derivatives. We use these arguments to identify variables or proxies, which can be used to test the argument made in the literature. Lastly, we specify an econometric model that employs the identified variables and used to test the arguments made in the literature.

3.1 Derivatives usage

Following Demsets and Strahan (1997) and Sinkey and Carter (2000), we employ the total notional value of outstanding derivatives contracts (*i.e.,* the sum of the notional value of futures, forwards, swaps and options), scaled by total assets to capture the extent of derivatives activities by Latin American banks in Brazil, Chile, and Mexico. We use the total notional value since some banks only report this total while a few banks from Brazil provide a breakdown by derivative type. Nevertheless, since the focus of our study is on the characterization of the use of derivatives by Latin American banks, the notional values of outstanding derivatives contract are satisfactory measure of the extent of involvement of Latin American bank's in the derivatives market. We denote this variable DERIVATIVE.

3.2 Economies of scale and scope

Theory predicts that large well-diversified banks will be less likely to fail than small banks. Thus, larger banks are more likely to use derivatives than smaller banks (Shyu, 1999). Prior studies of bank derivative use have documented a positive and significant relationship between bank size and use of futures (Koppenhaver, 1990), swaps (Kim & Koppenhaver, 1993), and interest-rate derivatives (Carter & Sinkey, 1998; Gunther & Siems, 1995). To measure size, we use total assets (TASS) in the comparison between users and non derivatives users. However, in the regression models, we use the natural logarithm of total assets, expressed in thousands (LNTASS). If large banks have made the necessary investment in human capital and control systems as well as broaden their scope of activities necessary to engage in derivatives activities, we expect that a positive relationship exists between the use of derivatives and bank size as measured by the variable LNTASS.

3.3 Intermediation profitability

Carter (1996), Carter and Sinkey (1998) and Sinkey and Carter (2000) argue that banks use derivatives to lock-in the spread (*i.e.,* intermediation profitability) between interest income and interest expenses. To measure the bank's intermediation profitability before credit loses, prior studies have used the variable NIM. Gunther and Siems (2002) argue that to the extent NIM reflects franchise value, the incentive to protect rents would be expected to produce a positive relationship between NIM and hedging activities. However, to the extent that derivatives are used primarily to speculate, the protection of franchise value could entail a negative relationship between NIM and derivatives activities.

3.4 Regulatory environment

Simons (1995) argues that an important reason banks manage their risk using derivatives is because these instruments entail lower capital requirements. However, bank regulators have also expressed concern about bank's use of derivative for speculative purposes because of the potential threat that derivatives might pose to the country's financial system (Hefferman, 2001). Thus, an important issue is whether Latin American banks use derivatives for hedging purposes or for speculation. Similar to prior studies, the variable EQRATIO is used in this study to capture this regulatory environment. The proxy could have a positive or negative effect on derivative use. If banks use derivative for hedging purposes, we expect a positive relationship to exist between EQRATIO and derivative use. However, Sinkey and Carter (2000) argue that a negative relation could suggest that banks use derivatives to reduce the likelihood of default when debt levels are high (to hedge low capital adequacy) or simply to because the use of derivative is associated with a higher probability of default.

3.5 Exposure to risk

Koch and McDonald (2003) argue that unexpected changes in interest-rates affect a bank's net interest income. Sinkey and Carter (2000) state that the use of derivatives is related to a bank's exposure to interest-rate fluctuations. If banks use derivatives to hedge interest-rate changes, we expect that there exists a positive relationship to exist between GAP (a proxy for bank's exposure to interest-rate risk) and derivative use.

NETCO (Loan loses) is the variable used to measure credit risk. If a bank has more credit risk, it would have less access to additional capital and may therefore be more likely to use derivatives. Thus the coefficient NETCO is predicted to be positive. On the other hand, the use of derivatives may be perceived by regulators as risky, and banks with weak asset quality might be subject to more scrutiny or restrictions by regulators when they attempt to use derivatives, thus discouraging the use of derivatives by such banks (Simmons, 1995). This might indicate a negative sign in the coefficient. Therefore the sign on this variable is ambiguous.

3.6 Coordinated risk management

Another important consideration related to derivative usage is whether Latin American banks are practicing coordinated risk management to control interest-rate risk and credit risk. If, as argued by Schrand and Unal (1998), banks use a coordinated risk management strategy, one could expect that their use of derivatives to hedge interest-rate risk might also be related to the

credit risk they face. If banks use derivatives to hedge their credit risk, we expect a positive relationship to exist between loan losses and derivative use. In this study, we use the variable net loan charge off (NETCO) as a proxy for a bank's exposure to credit risk.

3.7 Alternatives to hedging

Rather than using off-balance sheet instruments such as derivatives to manage risk, banks could opt to use on-balance sheet alternatives instead (Nance et al., 1993). Two such alternatives are investing in safer more liquid assets and limiting the amount of dividend payouts (Sinkey & Carter, 2000). These on-balance sheet alternatives have the potential to reduce the bank's financial distress and assure creditors that sufficient funds exist to cover the bank's debt obligation (Carter & Sinkey, 1998). In this study, we employ the variable LIQUID to determine if banks are using alternatives to hedge risk. If LIQUID do indeed represent alternatives to hedging, we expect that banks will be less inclined to use derivatives as they invest in more liquid assets.

3.8 Foreign banks

International banks are increasingly exposed to a multitude of risks such as, interest rate risk, foreign exchange risk, credit risk, and funding risk. Shyu and Reichert (2002) argue that international banks use financial instruments, such as derivatives, to protect themselves and their customers from the above mentioned financial risks as well as a means of enhancing earnings. The rapid growth of derivative transactions highlights the rapidly changing nature and level of sophistication associated with international banking. As end users of derivatives, swaps have become an accepted hedging tool for many banks even though they can use on-balance sheet strategies to manage interest rate risk. They have also developed strategies that are designed to provide additional types of risk reduction along with enhanced earnings.

Because in the countries used in this study at least one-third of total bank assets are controlled by foreign institutions and the behavior of such banks regarding the use of derivative may be very different from domestic banks, we use a dummy variable (Foreign) to control for their actions. Foreign is coded as 1 for those foreign banks in Brazil, Chile, and Mexico and 0 otherwise. We expect a positive relationship with the dependent variable.

3.9 Model specification

In order to capture and test the various relationships discussed above, we use five regression models. Model 1 presents all the banks (Brazil, Chile, and Mexico) with a dummy variable per country with Mexico equal 1 and 0 otherwise; and Brazil equal 1 and 0 otherwise. Model 2 is a variation of Model 1 including a foreign dummy variable with a value of 1 for foreign banks and 0 otherwise. Model 3 is a nested model to test whether statistically significant differences exist between large and small banks and the dummy variable Foreign. Lastly, Model 4 and 5 uses a subset data for small and large banks and the dummy variable Foreign. The five models are specified as follows:

$$DERIVATIVE_i = \beta_0 + \beta_1 \text{LNTASS}_i + \beta_2 \text{NIM}_i + \beta_3 \text{EQRATIO}_i + \beta_4 \text{LIQUID} + \beta_5 \text{GAP}_i + \beta_6 \text{NETCO}_i + \beta_7 \text{Mexico}_i + \beta_8 \text{Brazil}_i + u_i \quad (1)$$

$$DERIVATIVE_i = \beta_0 + \beta_1 \text{LNTASS}_i + \beta_2 \text{NIM}_i + \beta_3 \text{EQRATIO}_i + \beta_4 \text{LIQUID} + \beta_5 \text{GAP}_i + \beta_6 \text{NETCO}_i + \beta_7 \text{Mexico}_i + \beta_8 \text{Brazil}_i + \beta_9 \text{Foreign}_i + u_i \quad (2)$$

$$DERIVATIVE_i = \beta_0 + \beta_1 \text{LNTASS}_i + \beta_2 \text{NIM}_i + \beta_3 \text{EQRATIO}_i + \beta_4 \text{LIQUID} + \beta_5 \text{GAP}_i + \beta_6 \text{NETCO}_i + \beta_7 \text{Mexico}_i + \beta_8 \text{Brazil}_i + \beta_9 \text{Foreign}_i + \beta_{10} \text{Small}_i + \beta_{11} \text{Small*LNTASS}_i + \beta_{12} \text{Small*GAP}_i + u_i \quad (3)$$

$$DERIVATIVE_{i(\text{Small Banks})} = \beta_0 + \beta_1 \text{LNTASS}_i + \beta_2 \text{NIM}_i + \beta_3 \text{EQRATIO}_i + \beta_4 \text{LIQUID} + \beta_5 \text{GAP}_i + \beta_6 \text{NETCO}_i + \beta_7 \text{Mexico}_i + \beta_8 \text{Brazil}_i + \beta_9 \text{Foreign}_i + u_i \quad (4)$$

$$DERIVATIVE_{i(\text{Large Banks})} = \beta_0 + \beta_1 \text{LNTASS}_i + \beta_2 \text{NIM}_i + \beta_3 \text{EQRATIO}_i + \beta_4 \text{LIQUID} + \beta_5 \text{GAP}_i + \beta_6 \text{NETCO}_i + \beta_7 \text{Mexico}_i + \beta_8 \text{Brazil}_i + \beta_9 \text{Foreign}_i + u_i \quad (5)$$

Where the β's are the parameters that will be estimated and u_i is a normally distributed error term with mean 0 and variance σ^2. The variables contained in equations (1) to (5) are defined above in sections 3.1 through 3.8 and are further clarified regarding their construction and source in the following sections.

Since the dependent variable of equation (1) is censored (*i.e.*, a large number of banks do not use derivatives are assigned a value of zero while the remaining banks that do use derivatives are assigned the total notional value of derivatives use) we estimate equation (1) using a Tobit model. Since the

Tobit models often violate the assumption of homoskedasticity, which leads to inefficient and inconsistent parameter estimates (Maddala & Nelson, 1975); we test for the presence of heteroskedasticity. To perform the heteroskedasticity test, we first estimate a Tobit model with robust standard errors. Next, we estimate a Tobit model in which the disturbance term is specified as:

$$var\ \varepsilon_i = \sigma^2 \exp\ \gamma' Z_i \tag{6}$$

where Z_i represents the variable TOTAL ASSETS and γ is an unknown parameter that will be estimated. Lastly, we use the log likelihood values of both models to perform a likelihood ratio test.

IV. DATA AND SUMMARY STATISTICS

The data used in this study were obtained from the Bankscope4 (2009) database and information published by the Central Bank of each Latin American country. These data sources contained the income statement and balance sheet of state, private, and foreign banks operating in Latin America. The financial statements were critically examined in order to identify the banks, which contain information regarding derivative usage. The result of this extensive and detailed examination indicated that only the banks from Brazil, Chile, and Mexico contained information relating to derivative usage. As such, we limited our analysis to these three Latin American Countries. After eliminating the banks with missing values, our final data set consisted of 133 Brazilian banks, 27 Chilean banks, and 41 Mexican banks.

Depending on the country under study, the variable DERIVATIVE was obtained either from the Banscope database or the information published by the country's Central Bank. For the Mexican banks, the variable DERIVATIVE was obtained from the raw data section of the Bankscope database. For the Chilean banks, the notional value of derivatives used by a bank was obtained from the data published by the Superintendencia de Bancos e Instituciones Financieras Chile (2009). Lastly, the notional value of derivative used by Brazilian banks was obtained from the Bankscope database. If the sum of derivatives is greater than zero, the variable takes on a value of 1, 0 otherwise.

The variable NIM was computed as the difference between total interest income and total interest expenses scaled by total assets. The variable

[4] Bankscope is a database containing financial information on 13,000 world banks.

LIQUID was computed as the sum of cash, securities and other liquid assets held in the bank's trading account scaled by total assets. The variable GAP was calculated as the absolute difference between asset re-pricing within a year (federal fund sold, assets held in trading accounts, customer acceptances liabilities, investment maturing in less than one year) and liabilities re-pricing within a year (federal fund purchased, banker's acceptances liabilities, certificate of deposits maturing in less than a year). The variable EQRATIO was calculated as the ratio of equity to total asset. The data used to construct the above variables were obtained from the bank balance sheet and income statement found in the Bankscope database. The variables NETCO scaled by total assets and LNTASS were directly obtained from the Bankscope database.

Table 2 presents the derivatives activities of Latin American banks during the year 2008. Two important observations stand out: the number of user banks and the notional value of derivative usage.

Table 2
Derivatives activities of Latin American Banks in 2008

				Derivatives Value	
Country	Groups		Number of Banks	Notional[a]	Mean[b]
Brazil	Nonusers	National	19	-	-
		Foreign	29	-	-
		Total	48	-	-
	Users	National	42	403,433	9,606
		Foreign	43	425,549	9,896
		Total	85	828,981	9,753
	Total	National	61		
		Foreign	72		
		Total	133		
Chile	Nonusers	National	2	-	-
		Foreign	2	-	-
		Total	4	-	-
	Users	National	12	20,189	1,682
		Foreign	11	14,783	1,344
		Total	23	34,972	1,521
	Total	National	14		
		Foreign	13		
		Total	27		
Mexico	Nonusers	National	7	-	-
		Foreign	6	-	-
		Total	13	-	-
	Users	National	11	453	41
		Foreign	17	392	23
		Total	28	845	30
	Total	National	18		
		Foreign	23		
		Total	41		

Table 2
Derivatives activities of Latin American Banks in 2008

Country	Groups		Number of Banks	Derivatives Value Notional[a]	Mean[b]
Total	Nonusers	National	28	-	-
		Foreign	37	-	-
		Total	65	-	-
	Users	National	65	424,075	6,524
		Foreign	71	440,724	6,207
		Total	136	864,798	6,359
	Total	National	93		
		Foreign	108		
		Total	201		

[a] Notional value of derivatives by group banks in million of US dollars.
[b] The mean is calculated as notional value divided by the number of user banks.

Note that Brazil has both the largest number of user banks (85 of 133 banks), and the largest notional value of derivative usage (US$ 8,292 million), additionally more foreign banks in Brazil have larger notional value of derivatives usage than national banks. Mexico has the second most number of user banks (28 out of 41 banks) but has the third largest notional value of derivative usage (US$ 844 million). In Mexican case, more foreign banks have larger amount of notional value of derivative usage. Lastly, Chile has the thirds most number of user banks (23 of 27 banks) and the second largest notional value of derivative usage (US$ 34,971 million). In the case of Chilean banks, more national banks and has larger notional value of derivatives usage than the foreign banks in Chile.

Table 3
Differences in means for Brazilian, Chilean, and Mexican banks: derivatives users vs. nonusers

	Group Means		Differences in Mean	
Variables	Users	Nonusers	User–Nonusers	Statistics
Panel A: Brazil				
TASS	US$ 5,210,342.00	US$ 2,018,410.00	US$ 3,191,932.00	0.056*
NIM	0.062	0.098	–0.036	0.035**
EQRATIO	0.155	0.396	–0.241	0.000***
LIQUID	0.420	0.457	–0.037	0.436
GAP	0.286	0.189	0.097	0.011**
NETCO	0.014	0.007	0.007	0.072**
Panel B: Chile				
TASS	US$ 2,509,295.00	US$ 213,037.20	US$ 2,296,257.80	0.001***
NIM	0.034	0.105	–0.072	0.183
EQRATIO	0.149	0.403	–0.254	0.269
LIQUID	0.336	0.184	0.152	0.254

GAP	0.060	0.240	–0.180	0.271
NETCO	0.002	0.000	0.002	0.007*
Panel C: Mexico				
TASS	US$ 9,512,146.00	US$ 1,593,101.00	US$ 7,919,045.00	0.009***
NIM	0.037	0.059	–0.022	0.199
EQRATIO	0.125	0.252	–0.127	0.091*
LIQUID	0.305	0.228	0.077	0.322
GAP	0.167	0.176	–0.009	0.874
NETCO	0.002	0.000	0.002	0.056*

Note: The financial data are for year-end 2008. The t-statistics are based on unequal group variance. Man-Whiney nonparametric test was also performed and showed similar results to these presented in this table. Lastly, significance is indicated as follows: * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3 provides a comparison between banks that use derivatives and those that do not use derivatives within Brazil, Chile, and Mexico. Panel A presents the comparison for the case of Brazil. Note that five out of the six variables have differences in means that are statistically significant. On average Brazilian derivatives user banks are about three times larger than nonusers banks, larger maturity GAPs, and more NETCO. However, Brazilian user banks have less LIQUID, less NIM, and lower EQRATIO compared to nonuser banks.

Panel C in Table 3 presents the comparisons for Mexican banks. The differences in means between derivatives user and nonuser Mexican banks are statistically significant for three of the six variables. This suggests that Mexican derivative user banks are about 7 times larger than nonuser banks, have on average greater LIQUID, and more NETCO. However, Mexican user banks have lower EQRATIO, lower NIM, and smaller maturity GAPs compared to Mexican nonuser banks.

V. EMPIRICAL RESULTS AND DISCUSSION

In this section we present the results of our estimation procedure. Table 4 reports the coefficient estimates for the relation between the likelihood of derivative use with the independent variables as specified in each of our five models.

The results for the five models are quite similar and in some cases accord with the hypotheses formulated earlier. The use of derivatives is directly associated with size. As can be observed in Table 4 for Model 1, the estimated coefficient for the variable LNTASS is positive and significant. The result for size provides evidence that only those banks with sufficient scale and scope

of activities can justify the resources needed to participate in derivatives activities.

The regression results for intermediation spreads are not very strong in support of the hypothesis that banks with a positive and significant coefficient on NIM are locking-in their spread by using derivatives. NIM is negatively associated with participation in derivative use since the coefficient for this variable is negative and significant.

Table 4 also presents the results for the variables EQRATIO, which is a proxy for the regulatory environment under which the banks operate. As can be observed in Table 4, the estimated coefficient for the variable EQRATIO is negative and significant. This finding again does not support the market/regulatory-discipline hypothesis. On contrast, it suggests the use of derivatives for hedging by riskier banks and that capital is an important factor for the extent of derivative use.

Table 4

Tobit estimates of derivatives usage by Latin American banks

	Model 1 All banks	Model 2 All banks w/foreign dummy	Model 3 All banks w/size dummy	Model 4 Small banks only	Model 5 Large banks only
Constant	-2.5036	-2.1546	-2.6151	15.2744***	16.7550***
	(0.183)	(0.259)	(0.224)	(0.000)	(0.000)
LNTASS	0.3000**	0.2896**	0.3052**	-0.9231***	-0.9807***
	(0.013)	(0.017)	(0.027)	(0.000)	(0.000)
NIM	-6.4543**	-6.6409**	-5.9343*	-11.0048**	18.5481
	(0.047)	(0.041)	(0.061)	(0.014)	(0.142)
EQRATIO	-6.4453***	-6.3007***	-6.1029***	-7.2659***	-4.7498
	(0.000)	(0.000)	(0.000)	(0.000)	(0.125)
LIQUID	2.8976**	2.8055**	2.5535**	-0.8787	2.6749
	(0.013)	(0.016)	(0.025)	(0.594)	(0.272)
GAP	-4.6312***	-4.5056***	-3.2724**	-1.7865	-2.2299
	(0.001)	(0.001)	(0.029)	(0.389)	(0.334)
NETCO	2.7244	2.2017	2.2169	10.7075	-50.0736
	(0.778)	(0.819)	(0.815)	(0.427)	(0.199)
Mexico	17.5487***	17.4332***	18.3353***		
	(0.000)	(0.000)	(0.000)		
Brazil	0.8411	0.8527	0.7260		
	(0.240)	(0.232)	(0.297)		
Foreign		-0.4143	-0.4327	-0.4867	-0.4575
		(0.354)	(0.328)	(0.532)	(0.517)
Small			-2.1169*		
			(0.089)		

Small*LNTASS			0.2756**		
			(0.012)		
Small*GAP			-4.3807		
			(0.127)		
Observations	199	199	199	134	65

P-values in parentheses. Significance is indicated as follows: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4 also shows the estimated coefficient for the variable GAP (a proxy for interest-rate risk exposure) to be negative and insignificant. These findings indicate the hedging of balance sheet positions is not an important motivation for derivatives usage. Thus, this result does not support the view that banks use derivative instruments to hedge against interest rate risk.

Also related to risk exposure (although indirectly), the estimated coefficient for the variable NETCO (a proxy for credit risk exposure) is presented in Table 4. The estimated coefficient for NETCO is positive but not significant. This indicates that NETCO has no bearing on the use of derivatives by Brazilian, Chilean and Mexican banks. Sinkey and Carter (2000) have suggested that if the estimated coefficients for GAP and NETCO are both positive and significant, banks are practicing coordinated risk management. This implies that the banks in these three Latin American countries are not practicing coordinated risk management.

The hedging substitute's hypothesis also receives very limited support. Table 4 also presents the results for the variable LIQUID, which is a proxy for on-balance sheet alternatives to hedging. As can be observed, the estimated coefficient for the variable LIQUID is significant; however, it does not carry the expected sign. This indicates that LIQUID is not an alternative to derivatives for the case of Brazilian, Chilean, and Mexican banks.

Since equation (1) are estimated using the derivative use from the three Latin American countries in a pooled model, the variables Mexico and Brazil are included to control for economic and regulatory differences between the three countries. For the dummy variable Mexico the estimate is positive and statistically significant. However, for the case of Brazil is positive but not significant. These results imply that there exist differences among Brazilian, Mexican and Chilean banks when deciding to use financial instruments such as derivatives.

Table 4 also presents the results of Models 2, 3, 4 and 5, which include the dummy variable Foreign. In both Models 2 and 3 the results are similar having LNTASS, NIM, EQRATIO, LIQUID, GAP, and Mexico statistically significant. The variable Foreign is negative but not statistically significant in either Model 2 or 3. However, the lack of a statistically significant coefficient

for the foreign variable in the results for all the banks (including large and small banks) does not suggest that the fact that a bank is a foreign bank does not matter. Rather, it implies that when considering the whole sample of the banks, Foreign is not an important determinant of whether a bank uses derivatives.

Furthermore, Model 3 is a modification of Model 2 with the inclusion of the dummy variable Small, and two interaction terms of the Small dummy with LNTASS and GAP. Results in this model are consistent with previous ones. Again the same variables (LNTASS, NIM, EQRATIO, LIQUID, and Mexico) are statistically significant. Additionally, the variable Small is negative and significant, and the interaction term of Small with LNTASS is positive statistically significant, indicating that the effect of the total assets is different for small banks as compared to large banks.

Therefore in order to determine is there exist a difference between large and small banks when deciding in the use of derivative we ran the model only for those small banks in Brazil, Chile, and Mexico. The results for small banks (Model 4) are again similar to the previous results. With the exception of the variable LIQUID and Mexico, these resulted not significant, even though they carry the same sign as the previous models. However, for Model 5 with only large banks, the results show that only size is important for the use of derivatives.

An important finding is that the variable Foreign is negative and statistically insignificant. Therefore, the fact that a bank is foreign is not a factor in helping deciding whether the bank should use derivatives instruments or not.

Examining the findings, the results are not consistent with the hypotheses that banks are using derivatives for hedging purposes; in other words, banks are not locking-in their spread by using derivatives. On the contrary, we find that Brazilian, Chilean, and Mexican banks may attempt to increase fee income by selling derivatives products or by speculating in derivative markets. That is, banks may use derivatives as a means of augmenting their earnings to offset reduced spreads on traditional banking activities. Fee-based derivative activities seem to complement traditional activities for Latin American banks. These results go in line with the finding of Shyu and Reichert (2002) about the use of derivatives by international dealer banks.

VI. CONCLUSION

In this study, we employed a Tobit model on financial data to examine whether Latin America banks use derivatives: (1) to hedge against detrimental changes in interest rate, (2) to coordinate their risk management

activities, (3) as substitutes for other on-balance sheet hedging activities, and (4) in accordance to regulatory directives. We find some similarities among the three countries despite differences in the regulatory environment and economics conditions. Brazilian, Chilean and Mexican derivatives user banks are larger than nonuser banks, have more credit risk, have less spread (lower intermediation profitability), and lower equity ratio than nonuser banks.

Using data from 2008, we have analyzed the factors influencing a bank's decision to participate in the derivatives market. The first result we wish to emphasize is a positive relationship between size of the bank and the decision to use derivatives. This result supports the view that larger banks have the economies of scale to be able to engage derivative activities. Another primary result of our study is that a weak capital is a factor in the decision for Latin American banks to engage in derivatives activities. This finding does not support the regulatory hypothesis in which banks must have stronger capital positions to engage in derivative activities.

Another important finding is the negative relationship between interest rate risk exposure, as measured by a one-year maturity gap, and the decision to use derivatives. This finding indicates the hedging of balance sheet positions is not an important motivation for banks' involvement in derivatives activities and that probably Latin American banks are not using derivative instruments for hedging changes in interest rate risk.

Additionally, we find that Latin American banks are not using derivatives to coordinate their interest-rate risk and credit risk management strategies. Nor Latin American banks are not using derivatives as substitutes for on-balance sheet activities such as liquidity. Finally, in this study we find that foreign banks are not significant different in the use of derivatives.

Our findings indicates that financial policy makers in Latin American countries should closely monitor the use of derivatives by banks in their respective countries since the possible use of derivatives by banks posses a significant threat to their banking system and can lead to an increase in financial system instability. As such, Latin American Financial policy makers should consider the need for new banking regulations and restrictions that promote the use of derivatives for hedging purposes and thereby maintain a safe and sound banking system.

ACKNOWLEDGEMENT

The authors are grateful to the Newhaus Center and the Computing and Information Technology Center at The University of Texas–Pan

American located in Edinburg, Texas for their financial support. We thank Dr. David Carter for the valuable comments.

REFERENCES

1. Banco Central do Brasil. Economic and financial information report for 2001 English version, (http://www.bcb.gov.br/).
2. Banco de Mexico, Informacion financiera y economica para el 2001, (http://www.banxico.org.mx).
3. Bank for International Settlement, (2002), Triennial central bank survey. Foreign exchange and derivatives market activity in 2001, (http://www.bis.org/index.htm).
4. Barth J.R., Caprio, G, Levine, R., (2001), The regulation and supervision of banks around the world: a new database. World Bank working paper.
5. Brewer, E., III, Jackson, W.E., Moser, J.T., (1997), Alligators in the swamp: the impact of derivatives on the financial performance of depositary institutions. Journal of Money, Credit and Banking 28, 482-497.
6. Carter, D. A., Sinkey, J. F., Jr., (1998), The use of interest-rate derivatives by end users: the case of large community banks. Journal of Financial Services Research 14, 17-34.
7. Carter, D.A., (1996), Three essays on the use of derivatives by US commercial banks. ProQuest Digital Dissertation. University of Georgia.
8. Chaudhry, M.K., Christie-David, R., Koch, T.W., Reichert, A.K., (2000), The risk of foreign currency contingent claims at us commercial banks. Journal of Banking and Finance 24, 1399-1417.
9. Demsetz, R., Straham, P.E., (1997), Diversification, size and risk at banking holding companies. Journal of Money, Credit, and Banking 29, 300-313.
10. Greene, W.H., (1993), Econometric Analysis, Macmillan Publishing Company, New York.
11. Gunther, J.W., Siems, T.F., (1995a), Who's capitalizing on derivatives? Financial Industries Studies. Federal Reserve Bank of Dallas. July, 1-8.
12. Gunther, J.W., Siems, T.F., (1996), The likelihood and extent of bank participation in derivatives activities. Financial Industries Studies, Federal Reserve Bank of Dallas Working Paper No. 1-95.
13. Hefferman, S., (2001), Modern banking in theory and practice. New York, NY: Wiley.
14. Hirtle, B., (1997), Derivatives, portfolio composition, and bank holding company interest rate risk exposure. Journal of Financial Services Research 12, 243-266.

15. Kim, S.H., Koppenhaver, G.D., (1993), An empirical analysis of bank interest-rate swaps. Journal of Financial Services Research 7, 57-74.
16. Koch, T.W., MacDonald S.S, (2003), Bank Management 5th ed. Mason, OH: Thomson-Southwestern.
17. Koppenhaver, G.D., (1990), An empirical analysis of bank hedging in futures markets. Journal of Futures Markets 10, 1-12.
18. Latin Finance Magazine, (2001), Fine Tuning the Financial Framework. 36-42.
19. Levy, E., Micco, A., (2003), Banking competition in Latin America. OECD and Inter-American Development Bank, Working Paper.
20. Maddala, G., Nelson, F., (1995), Specification errors in limited dependent variables models. National Bureau of Economic Research, Working Paper 96.
21. Nance, D., Smith, C.W., Smithson, C.W., (1993), On the determinants of corporate hedging. The Journal of Finance, 48, 267-84.
22. Office of the Comptroller of the Currency, (2002), OCC Bank derivatives report 2002. Washington, DC., (http://www.occ.treas.gov/).
23. Schrand, C., Unal, H., (1998).,. Hedging and coordinated risk management: evidence from thrift conversions. Journal of Finance 53, 979-1013.
24. Shanker, L., (1996), Derivative usage and interest rate risk of large banking firms. The Journal of Future Markets 16, 459-474.
25. Shyu, Y.W., (1999), A comparison of interest rate and derivative activities of US and foreign banks. ProQuest Digital Dissertation, Cleveland State University.
26. Simons, K., (1995) Interest rate derivatives and asset-liability management by commercial banks. New England Economic Review, Federal Reserve Bank of Boston Working Paper 17-28.
27. Sinkey, J.F., Jr., Carter, D. A., (2000). Evidence on the financial characteristics of banks that do and do not use derivatives. The Quarterly Review of Economics and Finance 40, 431-449.
28. Superintendencia de Bancos e Instituciones Financieras Chile. Información Financiera Estados Financieros Anuales Bancos y Sociedades Financieras Diciembre de (2002), (http://www.sbif.cl/cgi-bin/financiera.pl).
29. Whidbee, D.A., Wohar, M., (1999), Derivative activities and managerial incentives in the banking industry. Journal of Corporate Finance 5, 251-276.