ASYMMETRIC ADJUSTMENTS OF MEXICAN BANK LENDING RATES IN THE NAFTA AND WTO ERA

Chu V. Nguyen, University of Houston-Downtown

ABSTRACT

Asymmetries in the Mexican lending-T-bill rate spread (loan premium) were documented. Empirical results revealed that the loan premium adjusts to the threshold faster when the T-bill rates fall relative to the lending rates than when the T-bill rates move in the opposite direction. This predatory rate setting behavior is consistent with in the observed highly concentrated market over the NAFTA and WTO era. The empirical results also revealed the bidirectional Granger causality between the lending rate and the T-bill rate, indicating that the lending rate and the T-bill rate affect each other's movement. **JEL Classifications:** C22, E44, G21

INTRODUCTION

One of the most important roles commercial banks play in economic development hinges on the spread between the lending rate they charge borrowers and the deposit rate they pay savers. This spread not only provides interest income to financial intermediaries, but it also influences a country's level of savings and investment, and it influences the effectiveness of central banks' monetary policymaking. One portion of the spread is risk related; the remainder— the portion which exceeds a "risk free" level as measured by the Treasury bill rate—constitutes a risk premium or loan premium. Analysis of this "risk or loan premium" portion illuminates and provides insights into bank behavior. Accordingly, this paper examines the Mexican financial sector in general and the behavior of Mexican banks in particular with a focus on the factors that affect the spread and the "loan premium," and in turn the dynamic, interrelationship of the elements that determine them.

As discussed in the section on the Mexican financial sector, across the spectrum of changes that took place in the country in the last thirty years, the banking industry can be characterized as highly monopolistic/oligopolistic. Economic theory and banking experience suggest that monopolistic and oligopolistic concentration inevitably lead to predatory pricing behavior as indicated by the asymmetric spread between the interest rates charged borrowers and the interest rates paid savers. The focus of this paper explores this proposition and more specifically probes the question: do asymmetries exist in the Mexican lending—deposit rates spread, and if such asymmetries are present, how do lending and deposit rates respond to these asymmetries? Are the responses independent or dynamically interrelated? The remainder of this study is organized as follows: The following section summarizes the Mexican financial sector; the next section describes the data and the descriptive statistics used in the analysis. The following section describes the methodology used and the empirical results; the concluding section provides observations and remarks.

From the theoretical perspective of interest rate settings, banks in a free market economy would incorporate all elements of risk and set a risk free equilibrium spread between the rate paid lenders and the rate charged borrowers. If banks set a loan premium either too high or too low, market forces would force an adjustment back to some equilibrium spread. Oligopolistic concentration thwarts the operation of free market forces and leads to wider, asymmetric spreads and larger "loan premiums." Asymmetries in the Mexican financial sector illustrate this process as conditions influenced separately the rate charged borrowers and the rate paid lenders and resulted in a "loan premium" larger than a free market determined spread.

Three main theoretical explanations help explain the rate-setting behavior of the banking sector: the bank concentration hypothesis, the consumer characteristic hypothesis, and the consumer reaction hypothesis. The bank concentration hypothesis posits that oligopolistic banks raise lending rates quickly in reaction to favorable market forces but are much slower in raising deposit rates. The reverse is the case in declining markets as they react quickly to adjust downward the rates paid depositors and slower to reduce the rates charged borrowers (Neumark and Sharpe, 1992; Hannan and Berger, 1991). The consumer characteristic and consumer reaction hypotheses posit that the greater the proportion of unsophisticated consumers coupled with higher search and switching costs, the greater the banks' ability to adjust rates to widen the spread and hence increase the banks' advantage (Calem and Mester, 1995; Hutchison, 1995; Rosen, 2002).

Interestingly, the asymmetric adjustment in lending rates may be influenced by a further asymmetry. Banks may be reluctant to raise rates to the full extent allowed by a rising market because to do so could lead to an adverse selection pool of predominantly higher risk loans. Restraint in maximizing lending rates encourages a broader base of loans with an inherent lower detrimental risk pool (Stiglitz and Weiss, 1981).

THE MEXICAN FINANCIAL SECTOR

Before exploring bank rates further, it is useful to consider several salient characteristics of the Mexican banking sector. Mexican commercial banks were nationalized in 1982 by presidential decree under the presidential administration of Jose Lopez Portillo (1976-1982). During the following Presidential administration of Miguel de la Madrid Hurtado (1982-1988), private sector institutions were allowed to perform non-bank functions. The subsequent Presidential administration under Carlos Salina de Gortari (1988-1994) brought in an extensive liberalization and privatization policy which was completed in 1991-1992. These banking reforms coincided with the ratification of NAFTA in January 1994 and one year later –to the day—the creation of the World Trade Organization. The evolution from private banking to nationalized banking to re-privatized banking resulted in an increased concentration of private banking and further to an increased domination of the sector by foreign banks. Of the six largest banks in Mexico – BBVA Bancomer, Banco

Mercantil del Norte, Banco Nacional de Mexico, Banco Santander, HSBC and Scotiabank Inverlat—five are foreign owned. Moreover, since 1998 the total assets of foreign-owned banks in Mexico have increased from 24% to over 50% by 2000 and will exceed 70% when the purchase of Banamex by Citigroup is completed.

Two critical periods paralleled and deepened this evolution of oligopolistic concentration. First, the currency crisis of 1994, known as the "Tequila Attack" led the Mexican government to raise interest rates sharply to retain existing short-term foreign investment, attract new financial capital inflows, and in turn protect the value of the Peso. Second, the new banking environment ushered in by the 1994 implementation of NAFTA, and the 1995 inauguration of the WTO provided the support for increased concentration of foreign banking in Mexico.

In the wake of these events, higher interest rates during 1995 sharply increased the payments owed by both Mexican individual and business borrowers many of whom could not shoulder the increased burden. As a result, the share of non-performing loans held by Mexican banks rose significantly and created a major crisis in the financial sector. Since the majority of mortgage lending in the early 1990's had adjustable interest rates, the financial crisis triggered a wave of bank mortgage defaults. Further, commercial banks relinquished almost entirely the origination of real estate mortgages to nonbank financial intermediaries and public sector entities. Overall, following the "Tequila Attack", assets of the Mexican banking system declined from 55 percent of GDP in 1994 to 37 percent of GDP at the end of 2000. Even more spectacular was the contraction of bank credit extended to the private sector – it represented 76 percent of bank assets (43 percent of GDP) at the end of 1994, and fell to the equivalent of 22 percent of bank assets (10 percent of GDP) at the end of 2000. These conditions fed the forces of consolidation in Mexican banking.

Interestingly, the Mexican financial market structure and the domination of commercial banks in the economy have not changed over the last decade in the face of changes in the international arena. As articulated in IMF (Country Report No. 12/65, 2012, 13-15) Mexico's financial system is still small, relatively concentrated and dominated by banks. The three largest banks account for 55 percent and the seven large banks hold 82 percent of bank assets, respective; five of these banks are foreign-owned subsidiaries of major international banks. The remaining 34 banks represent a very heterogeneous group focused on corporate and consumer lending as well as niche banking, creating a two-tiered industrial organization. Larger banks compete for "blue chip" companies that could fund themselves abroad, and in the credit card and mortgage markets. As of June 2011, 42 commercial banks had more than half the assets of the financial system.

IMF Country Report No. 12/65 further indicates that the second largest group of financial intermediaries (in terms of assets) is the 14 pension fund managers (AFORES), which manage 86 pension funds (SIEFORES). The 43 mutual fund management companies manage 549 funds. The government has nine development banks and public sector funds, in addition to two large public mortgage entities—the Institute of the National Housing Fund for the Workers (INFONAVIT) and the Housing Fund of the Social Security Institute of Public Sector Workers (FOVISSTE). The rest of the system is dispersed and small.

Also, seven large financial groups anchored by a commercial bank include multiple nonbank financial intermediaries. These groups control or manage about 73 percent of all financial assets. These close interconnections pose systemic risk, undermine competition, and create conflicts of interest, depending on whether profit is maximized at the level of the group or of individual financial entities. In this environment, transparency of intra-group transactions and exposures, as well as strong consumer protection, are essential for stability and market development.

Moreover, Quintanilla, et al. (2011, p. 85) point that the 1994 Mexican banking crisis led to wholesale changes in the deposit insurance fund in the country's banking system. Poor lending decisions allowed banks to transfer risk to the fund, resulting in their capturing returns on performing loans, while limiting downside exposure when the fund covered losses on non-performing loans. Through a series of regulatory initiatives, the Mexican banking system now uses performance bonds in concert with the insurance fund. Additionally, IMF (Press Release No. 12/1111, 2012) reports that following economic recovery in 2010; stress tests conducted by the IMF suggest the Mexican banking system is able to withstand severe shocks. Actually, the strength of capital buffers has made it possible for the authorities to aim to complete the introduction of the new Basel III capital requirements in 2012, well ahead of other countries. Herrerias and Moreno (2011) point out another interesting characteristic of Mexican banking system, which is contrary to common view, that the diffusion and spillover effects of credit risk, measured by non-performing loans, among banks within banking system is bidirectional between small and large banks, rather than only one type affecting the other.

DATA

The analysis uses monthly data from International Financial Statistics, published by the IMF, over the period of 1995:07 to 2011:01 to describe Mexican lending rates, T-Bill rates, and their spread. The relationship of these rates defines the spread which in turn is used to understand the market behavior and the exercise of power of Mexican banks in the decade and a half after the creation of NAFTA and transition of GATT into the WTO. These are summarized in the following.

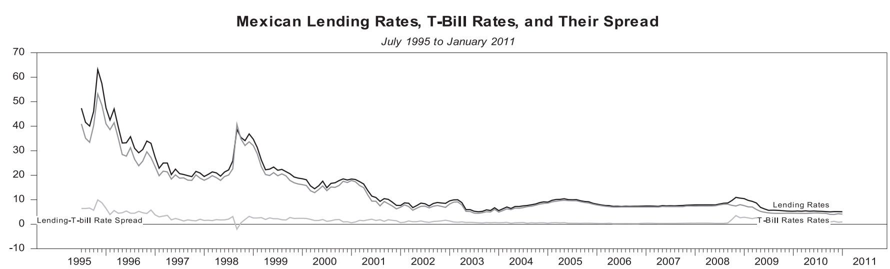

Figure 1

Figure 1 displays the behavior of the respective lending, risk free rates and their spread—the loan premium—over the sample period (correlation = 0.9959). The mean lending rate during this period is 14.88 percent, and ranges from 5.04 to 63.12. The mean T-bill rate over the same period is 13.25 percent, and ranges from 3.97 to 53.16. The mean loan premium during this period is 1.63 percent, and ranges from -2.04 to 9.96. These descriptive statistics indicate that the lending rates and the risk free rates were very high while the loan premium was very low by international standards, causing intellectual curiosity about the post NAFTA and WTO phenomenon in Mexico. In addition, Figure 1 also suggests the Mexican loan premium experiences a structural shift in 2008 which coincides with the contagion of the U.S. sub-prime financial crisis to Mexico.

METHODOLOGIES AND EMPIRICAL RESULTS

To discern the structural break possibility and to allow for the possibility of endogenous breaks in the Mexican loan premium, following Perron's (1997) procedure, an endogenous unit root test function with the intercept, slope, and the trend dummy were specified and estimated to test the hypothesis that the Mexican loan premium, LP_t, has a unit root.

$$LP_t = \mu + \theta DU + \alpha t + \gamma DT + \delta D(T_b) + \beta LP_{t-1} + \sum_{i=1}^{k} \psi_i \Delta LP_{t-i} + \upsilon_t \qquad (1)$$

where $DU = 1(t > T_b)$ is a post-break constant dummy variable; t is a linear time trend; $DU = 1(t > T_b)$ is a post-break slope dummy variable; $D(T_b) = 1(t = T_b + 1)$ is the break dummy variable; and ε_t are white-noise error terms. The null hypothesis of a unit root is stated as $\beta = 1$. The break date, T_b, is selected based on the minimum t-statistic for testing $\beta = 1$ (see Perron, 1997, pp. 358-359).

The estimation results of Perron's endogenous unit root tests are summarized in Table 1. The post-break intercept dummy variable, *DU*, is positive while the post-break slope dummy variable, *DT*, is negative and both are significant at any conventional level. Also, the break dummy is negative and marginally significant. These empirical results suggest the Mexican loan premium followed a stationary trend process with a break date of August 2008, corresponding to the impact from the contagion of the American sub prime crisis.

An important implicit assumption of the Dickey-Fuller standard unit

Table 1: Perron's Endogenous Unit Root Test, Mexican Data, 1995:07 to 2011:01

$$LP_t = 0.84734 + 6.46464\ DU - 0.00556\ t - 0.03385\ DT - 0.77832\ D(T_b) + 0.68192\ LP_{t-1} + \upsilon_t$$

(3.8121*) (2.7318*) (-3.1389*) (-2.4906*) (-1.2634***) (13.2982*)

Number of augmented lags: $k = 8$ Break Date: Aug. 2008 $t(\alpha = 1) = -6.2029^*$

Notes: *Critical values for t-statistics in parentheses: Critical values based n = 100 sample for the break date (Perron, 1997). "*" and "***" indicate significance at 1 and 10 percent levels.*

root tests and their extension is that the adjustment process is symmetric. If the adjustment process is asymmetric, then the implicitly assumed restrictive symmetric adjustment is indicative of model misspecification. To formally investigate the possibility of asymmetric adjustment process, the threshold autoregressive (TAR) model and the momentum threshold autoregressive (M-TAR) model developed by Enders and Siklos (2001) are estimated to examine the behavior of the Mexican loan premium in the period following the advent of NAFTA and the WTO.

The threshold autoregressive (TAR) model allows the degree of autoregressive decay to depend on the state of the Mexican loan premium in the previous period, i.e., the "deepness" of cycles. For instance, if the autoregressive decay is fast when the Mexican loan premium is above the trend and slow when the spread is below the trend, troughs will be more persistent than peaks. Likewise, if the autoregressive decay is slow when the Mexican loan premium is above trend and fast when the premium is below trend, peaks will be more persistent than troughs.

The momentum-threshold autoregressive (M-TAR) model allows the Mexican loan premium to display differing amounts of autoregressive decay, depending on whether the change in the premium in the previous period is increasing or decreasing. Thus, the M-TAR model captures the possibility of asymmetrically “sharp” movements in the changes of the Mexican loan premium. Enders and Siklos (2001) also argued that the distinction with respect to asymmetries is important given that standard co-integration tests have low power in the presence of an asymmetric adjustment process (see Ewing et al. 2006, p. 15). The M-TAR model is especially valuable when the adjustment is believed to exhibit more momentum in one direction than the other. In these models’ specification, the null hypothesis that the Mexican loan premium contains a unit root can be expressed as $\rho_1 = \rho_2 = 0$, while the hypothesis that the premium is stationary with symmetric adjustments can be stated as $\rho_1 = \rho_2$.

To formally examine the behavior of the Mexican loan premium, the loan premium, LP_t, is regressed on a constant, linear trend and intercept dummy (with values of zero prior to August 2008 and values of one for August 2008 and thereafter). The saved residuals, denoted by $\hat{\varepsilon}_t$, are then used to estimate the following TAR and M-TAR models:

$$\Delta\hat{\varepsilon}_t = I_t \rho_1 \hat{\varepsilon}_{t-1} + (1 - I_t)\rho_2 \hat{\varepsilon}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta\hat{\varepsilon}_{t-p} + \hat{u}_t \tag{2}$$

where $\hat{u}_t \sim i.i.d.\ (0,\sigma^2)$, and the lagged values of $\Delta\hat{\varepsilon}_t$ are meant to yield uncorrelated residuals. As defined by Enders and Granger (1998), the Heaviside indicator function for the TAR specification is given as:

$$I_t = \begin{cases} 1 & \text{if } \hat{\varepsilon}_{t-1} \geq \tau \\ 0 & \text{if } \hat{\varepsilon}_{t-1} < \tau \end{cases} \tag{3}$$

while indicator function for the M-TAR specification is stated as:

$$I_t = \begin{cases} 1 & \text{if } \Delta\hat{\varepsilon}_{t-1} \geq \tau \\ 0 & \text{if } \Delta\hat{\varepsilon}_{t-1} < \tau \end{cases} \tag{4}$$

The threshold value, $\boldsymbol{\tau}$, is endogenously determined using the Chan’s (1993) procedure, which obtains $\boldsymbol{\tau}$ by minimizing the sum of squared residuals after sorting the estimated residuals in ascending order, and eliminating 15 percent of the largest and smallest values. The elimination of the largest and the smallest values is to assure that the $\hat{\varepsilon}_t$ series crosses through the threshold in the sample period. Throughout this study, the included lags are selected by the statistical significances of their estimated coefficients as determined by the t-statistics. The model selection for further empirical investigation is based on their fitness to the data as measured by the Akaike's information criterion (aic) and the Schwarz information criterion (sic) from the empirical estimations.

RESULTS OF THE COINTEGRATION TEST WITH ASYMMETRIC ADJUSTMENT

The empirical results of these estimations of the TAR model specified by equations (2) and (3), and the M-TAR model described by equations (2) and (4), are reported in Table 2. In regard to the TAR model, specified by equations (2) and (3), an analysis of the overall estimation results indicates that the estimation results are devoid of serial correlation and have good predicting power as evidenced by the Ljung-Box statistics and the overall F-statistics, respectively. The calculated statistic $\Phi_\mu = 9.7609$ indicates that the null hypothesis of no co-integration, $\rho_1 = \rho_2 = 0$, should be rejected at the 1 percent significant level, confirming that the Mexican loan premium is stationary. With regard to the stationarity of the premium, Ewing et al. (2006, p. 14) pointed out that this simple finding of stationarity is consistent with the two underlying series comprising the premium (the Mexican lending rates and the T-bill rates) being co-integrated in the conventional, linear combination sense.

The estimation results further reveal that both ρ_1 and ρ_2 are statistically significant at 1 percent level. In fact, the point estimates suggest that the Mexican loan premium tends to decay at the rate of $|\rho_1| = 0.3015$ for $\hat{\varepsilon}_{t-1}$ above the threshold, $\boldsymbol{\tau}$ = 0.3444, and at the rate of $|\rho_2| = 0.3475$ for $\hat{\varepsilon}_{t-1}$ below the threshold. However, the empirical results also reveal that, based on the partial *F = 0.2331*, the null hypothesis of symmetry, $\rho_1 = \rho_2$, cannot be rejected at any conventional significant level, indicating statistically that adjustments around the threshold value of the spread are symmetric.

As to the M-TAR model, specified by equations (2) and (4), overall, the

Table 2: Unit Root and Tests of Asymmetry, Mexican Data, 1995:07 to 2011:01

Model	ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$	aic	sic
TAR	-0.3015*	-0.3475*	0.3444	$\Phi_\mu = 9.7609^*$	$F_{(1,239)} = 0.1211$	0.0349	*0.0234*
	$Q_{(6)} = 11.431$ [0.0759]			$\ln L = -189.6839$	$F_{(4,230)} = 11.1208^*$		
M-TAR	-0.1190	-0.2255*	0.3197	$\Phi_\mu = 10.1154^*$	$F_{(1,239)} = 10.6228^*$	0.0325	*0.0220*
	$Q_{(6)} = 9.541$ [0.1454]			$\ln L = -165.6119$	$F_{(4,239)} = 25.0938^*$		

Notes: *The null hypothesis of a unit root,* $H_0: \rho_1 = \rho_2 = 0$*, uses the critical values from Enders (2001, p. 259, Table 2, for four lagged changes and n = 100)." *", " **"and " ***" indicate 1%, 5% and 10% levels of significance. The null hypothesis of symmetry,* $H_0: \rho_1 = \rho_2$*, uses the standard F distribution.* τ *is the threshold value determined via the Chan (1993) method.* $Q_{(6)}$ *denotes the Ljung-Box Q-statistic with 6 lags.*

estimation results are also absent of serial correlation and have good predicting power as evidenced by the Ljung-Box statistics and the overall F-statistics, respectively. The calculated statistic $\Phi_\mu = 10.1154$ indicates that the null hypothesis of no co-integration, $\rho_1 = \rho_2 = 0$, should be rejected at the 1 percent significance level, confirming stationarity of the Mexican loan premium and hence the lending rates and the T-bill rates series, is being co-integrated in the conventional, linear combination sense.

In regard to the question of asymmetry, the empirical results reveal that, based on the partial F = 10.6228, the null hypothesis of symmetry, $\rho_1 = \rho_2$, should also be rejected at the 1 percent significant level, indicating statistically that adjustments around the threshold value of the Mexican loan premium are asymmetric. The estimation results reveal that ρ_2 is significant at 1 percent level, but ρ_1 is not significant at any conventional levels. The point estimates suggest that the Mexican loan premium tends to decay at the rate of $|\rho_1| = 0.1190$ for $\Delta\hat{\varepsilon}_{t-1}$ above the threshold, $\boldsymbol{\tau} = 0.3197$, and at the rate of $|\rho_2| = 0.2255$ for $\Delta\hat{\varepsilon}_{t-1}$ below the threshold.

Additionally, given the finding of $|\rho_2| > |\rho_1|$ in the M-TAR specification, the adjustment of the Mexican loan premium toward the long-run equilibrium tends to persist more when the spread is widening than when the spread is narrowing. These findings reveal that Mexican lending institutions adjust their lending rates differently to rising versus declining central bank's T-bill rates. These findings can also be interpreted to show that these institutions react differently to expansionary monetary policy than to contractionary. More interestingly, the finding of $|\rho_2| > |\rho_1|$ seems to suggest the predatory pricing behavior of the Mexican lending institutions which is consistent with the market concentration and consumer characteristic hypotheses, as well as the observed monopolistic/oligopolistic nature of the Mexican financial sector. Finally, the aic and the Schwarz information criterion (sic) indicate that the M-TAR model fits the sample data better than the TAR model. Therefore, the M-TAR model's specification will be used for further investigation in this study.

RESULTS OF THE ASYMMETRIC ERROR-COORECTION MODEL

The positive results of the above asymmetric co-integration tests and the aic's and the sic's that resulted from estimating the above TAR and M-TAR models necessitate the use of a Momentum Threshold Autoregressive Vector Error-Correction (M-TAR VEC) model to further investigate the asymmetric short-run dynamic behavior between the Mexican lending and T-bill rates. The estimation results of this model can be used to study the nature of the Granger causality between the Mexican lending and T-bill rates. The empirical determined nature of the Granger causality will help to evaluate empirically whether and how the Mexican lending and the T-bill rates respond to changes in loan premium, induced by external economic shocks or countercyclical policy measures. Additionally as aforementioned, the following M-TAR VEC model differs from the conventional error-correction models by allowing asymmetric adjustments toward the long-run equilibrium.

$$\Delta LR_t = \iota_0 + {}_1 I_t \hat{\varepsilon}_{t-1} + {}_2(1 - I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta LR_{t-i} + A_{12}(L)\Delta TR_{t-i} + u_{1t} \quad (5)$$

$$\Delta TR_t = \tilde{\alpha}_0 + \tilde{\rho}_1 I_t \hat{\varepsilon}_{t-1} + \tilde{\rho}_2(1 - I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta LR_{t-i} + A_{22}(L)\Delta TR_{t-i} + u_{2t} \quad (6)$$

where $\hat{u}_{1,2t} \sim i.i.d.\ (0,\sigma^2)$ and the Heaviside indicator function is set in accord with (4). This model specification recognizes the fact that the Mexican lending rates may respond differently, depending on whether the loan premium is widening or narrowing (i.e., expansionary or contractionary monetary policy).

The following are the estimation results for the M-TAR VEC model specified by equations (4), (5), and (6), using the Mexican lending rates and the T-bill rates. In the estimation results, $A_{ij}(L)$ represents the first-order polynomials in the lag operator L. The F_{ij} represents the calculated *F-statistics* with the p-value in squared brackets, testing the null hypothesis that all coefficients of A_{ij} are equal to zero. The *t-statistics* are reported with "*" indicating the 1 percent significant level, respectively. $Q_{(6)}$ is the Ljung-Box statistics and its significance is in squared brackets, testing for the first six of the residual autocorrelations to be jointly equal to zero. *ln L* is the log likelihood. The overall, *F-statistics* with "*", indicates the significant level of 1 percent.

Table 3: Mexican Lending and T-bill Rates Data, 1995:07 to 2011:01

$\Delta LR_t = -0.1030 + 0.4698\ I_t\hat{\varepsilon}_{t-1} - 0.1192\ (1 - I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta LR_{t-i} + A_{12}(L)\Delta TR_{t-i} + u_{1t}$		
(-0.8100) (1.8715***) (-0.5929)	F_{11}=10.3301[0.000]	F_{21}=8.1468[0.000]
$Q_{(6)}$ = 8.054[0.2341]	*ln L* = -283.9723	$F_{(9,150)}$-*statistic* =6.9315*
$\Delta TR_t = 0.0031 + 1.1958\ I_t\hat{\varepsilon}_{t-1} + 0.0885\ (1 - I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta LR_{t-i} + A_{22}(L)\Delta TR_{t-i} + u_{2t}$		
(0.0237) (4.3995*) (0.3892)	F_{21}=9.5563[0.000]	F_{22}=7.3264[0.000]
$Q_{(6)}$ =7.678[0.2627]	*ln L* = -309.2839	$F_{(13,156)}$-*statistic* =6.3611*

*Note:" *" and" ***" indicate 1%, and 10% levels of significance*

An analysis of the overall empirical results indicates that the estimated equations (5) and (6) are absent of serial correlation and have good predicting power as evidenced by the Ljung-Box statistics and the overall F-statistics, respectively. As to the long-run adjustment, the estimation results of equation (5) of the M-TAR VEC model reveal that ρ_2 is statistically significant at 1 percent level, while ρ_1 is only marginally significant. This finding indicates that when introducing the short-run dynamic adjustment to the model, the Mexican lending rates respond not only to the narrowing but also to the widening of the loan premium. This finding suggests that Mexican lending institutions respond to contractionary and expansionary monetary policy in the long-run. With regard to the long-term adjustment of the discount rates, the estimation results of equation (6) show that $\tilde{\rho}_1$ is statistically significant at 1 percent level, while $\tilde{\rho}_2$ is not significant at any conventional level.

In addition to estimating the long-run equilibrium relationship and asymmetric adjustment, the estimated M-TAR VEC model also allows for determinations of the Granger causality between the Mexican lending rates and the T-bill rates. The partial F-statistics in equation (5) reveals that the loan rate responds to both the lagged changes in the T-bill rate and its own lagged changes. Moreover, the estimation results also indicate that the T-bill rate responds both its own lagged changes and lagged changes of the lending rates. These findings suggest a bi-directional Granger-causality between the Mexican lending rate and the T-bill rate in the short run. These findings reveal that the Mexican lending rate and the T-bill rate affect movements of each other's rate in the short run during the period following the creation of NAFTA and the WTO.

CONCLUDING REMARKS

This study estimated the threshold autoregressive (TAR) model and the Momentum Threshold autoregressive (M-TAR) model developed by Enders and Siklos (2001) to investigate the behavior the Mexican lending rate, T-bill rate and the loan premium. The Akaike's information criterion (aic) and the Schwarz information criterion (sic) indicate that the M-TAR model fits the sample data better than the TAR model. Therefore, estimation results of the M-TAR model's specification will be used for further investigation in this study.

First, following Perron (1997) procedure, an endogenous unit root test function with the intercept, slope, and trend were specified and estimated to test the hypothesis that the loan premium has a unit root. The results of this test suggest that the premium followed a stationary trend process with a break date of August 2008, corresponding to the impact of the contagion of the U.S. sub prime financial crisis.

Second, the finding of $|\rho_2| > |\rho_1|$ in the M-TAR specification indicates that the adjustments of the loan premium toward the long-run equilibrium are asymmetric and tend to rise faster when the T-bill rate is increasing and fall slower when the T-bill rate is declining. These findings can also be interpreted to demonstrate that banks react more slowly to expansionary than to contractionary monetary policy. The finding of $|\rho_2| > |\rho_1|$ seems to support the articulation by the consumer characteristic and market concentration hypotheses which underlie commercial bank interest rate asymmetries. This finding also reveals the predatory pricing behavior of Mexican financial institutions operating in a very concentrated market.

Third, the empirical estimation of the M-TAR VEC model reveals bi-directional Granger-causality between the lending rate and the T-bill rate in the short run. This finding indicates that the lending rate and the T-bill rate affect each other's movement in the short run. The finding of bi-directional Granger causality is important since it reveals asymmetric responses of financial markets to contractionary and expansionary monetary policy actions.

ENDNOTES

[1]Sellon (2002) provides a nice overview of the impact of the changing U.S. financial system on the interest rate channel for monetary policy transmission.

[2]Scholnick (1999) provides the survey on these three types of explanations for commercial banks' interest rate asymmetries in the literature.

[3]Mexican commercial banks were nationalized in 1982 by presidential decree under the presidential administration of Jose Lopez Portillo (1976 -1982). Under the presidential administration of Miguel de la Madrid Hurtado (1982-88), private sector institutions were allowed to perform the so-called nonbank functions of the banks, and the radical liberalization and privatization process of the Mexican commercial banking system began in 1987. This radical liberalization and privatization process was completed in 1991-92, under the presidential administration of Carlos Salina de Gortari (1988-94).

[4]As shown by Petrucelli and Woolford (1984), the necessary and sufficient condition for the basis to be stationary is: $\rho_1 < 0$, $\rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 1$.

REFERENCES

Arak, M., Englander, S., and Tang, E., 1983, Credit Cycles and the Pricing of the Prime Rate. Federal Reserve Bank of New York Quarterly Review, 12-18.

Blavy, R., and Souto, M., 2009, Estimating Default Frequencies and Macrofinancial Linkages in the Mexican Banking Sector. IMF Working Paper WP/09/109, International Monetary Fund, Washington, DC.

Calem, P.S., and Mester, L.J., 1995, Consumer Behavior and the Stickiness of Credit-Card Interest Rate. American Economic Review, 85(5): 1327-1336.

Chan, K.S., 1993, Consistency and Limiting Distribution of the Least Squares Estimator of a Threshold Autoregressive Model. Annals of Statistics, 21(2): 520-533.

Cook, T., and Hahn, T., 1989, The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s. Journal of Monetary Economics, 24: 331-351.

Diebold, F.X., and Sharpe, S.A., 1990, Post-Deregulation Bank-Deposit-Rate Pricing: The Multivariate Dynamics. Journal of Business & Economic Statistics, 8(3): 281-291.

Dueker, M.J., 2000, Are Prime Rate Changes Asymmetric? Federal Reserve Bank of St. Louis Economic Review, September/October, 33-40.

Enders, W., and Granger, C.W.J., 1998, Unit Root Tests and Asymmetric Adjustment with an Example Using the Term Structure of Interest Rates. Journal of Business and Economic Statistics, 16(3): 304-311.

Enders, W., and Siklos, P., 2001, Co-integration and Threshold Adjustment. Journal of Business & Economic Statistics, 19(2): 166-176.

Engle, R.F., and Granger, C.W.J., 1987, Co-integration and Error Correction: Representation, Estimation and Testing. Econometrica, 55: 251-276.

Ewing, B.T., Hammoudeh, S.M., and Thompson, M.A., 2006, Examining Asymmetric Behavior in US Petroleum Futures and Spot Prices. Energy Journal, 27(3): 9-23.

Forbes, S.M., and Mayne, L.S., 1989, A Friction Model of the Prime. Journal of Banking and Finance, 13: 127-135.

Frost, D., and Bowden, R., 1999, An Asymmetry Generator for Error-Correction Mechanisms, with Application to Bank Mortgage-Rate Dynamics. Journal of Business & Economic Statistics, 17(2): 253-263.

Goldberg, M.A., 1984, The Sensitivity of the Prime Rate to Money Market Conditions. Journal of Financial Research, 7(4): 269-280.

Hannan, T.H., and Berger, A.N., 1991, The Rigidity of Prices: Evidence from the Banking Industry. American Economic Review, 81(4): 938-945.

Heffernan, S.A., 1997, Modeling British Interest Rate Adjustment: An Error Correction Approach. Economica, 64: 211-231.

Herrerias, R. and Moreno, J. O., 2012, Spillovers and Long Run Diffusion of Non-Performing Loans Risk. Midwest Finance Association 2012 Annual Meetings Paper. Available at SSRN: http://ssrn.com/abstract=1927982 or http://dx.doi.org/10.2139/ssrn.1927982

Hofmann, B., Mizen, P., 2004, Interest Rate Pass-Through and Monetary Transmission: Evidence from Individual Financial Institutions' Retail

Rates. Economica, 71: 99-123.
Hutchison, D.E., 1995, Retail Bank Deposit Pricing: An Intertemporal Asset Pricing Approach. Journal of Money, Credit, and Banking, 27: 217-231.
IMF Country Report No. 12/65, 2012, Mexico: Financial System Stability Assessment. Washington, D.C.
IMF Press Release No. 12/1111, 2012, Mexico's Banking System is Resilient, but Global Risks Have Increased. Washington, D.C.
IMF Country Report No. 01/192, 2001, Mexico: Financial System Stability Assessment, including Reports on the Observance of Standards and Codes on the following topics: Monetary and Financial Policy Transparency; Payment Systems; Banking Supervision; Securities Regulation; and Insurance Supervision. Washington, D.C.
Levine, P., and Loeb, P.D., 1989, Asymmetric Behavior of the Prime Rate of Interest. American Economist, 33: 34-38.
Mester, L.J., and Saunders, A., 1995, When Does the Prime Rate Change? Journal of Banking and Finance, 19: 743-764.
Moazzami, B., 1999, Lending Rate Stickiness and Monetary Transmission Mechanism: The Case of Canada and the United States. Applied Financial Economics, 9: 533-538.
Neumark, D., and Sharpe, S., 1992, Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits. Quarterly Journal of Economics, 107(2): 657-680.
Perron, P., 1997, Further Evidence on Breaking Trend Functions in Macroeconomic Variables. Journal of Econometrics, 80(2): 355-385.
Petrucelli, J., and Woolford, S., 1984, A Threshold AR(1) Model. Journal of Applied Probability, 21: 270-286.
Quintanilla, B., Téllez, J. and Wolfskill, A. (2011) , Bank Risk Fundamentals and Regulatory Discipline in the Mexican Banking Sector. Accounting & Taxation, 3(2): 85-95. Available at SSRN: http://ssrn.com/abstract=1946930
Rosen, R.J., 2002, What Goes Up Must Come Down? Asymmetries and Persistence in Bank Deposit Rates. Journal of Financial Services Research, 21(3): 173-193.
Sarno L., and Thornton, D. L., 2003, The Dynamic Relationship Between the Federal Funds Rate and the Treasury Bill Rate: An Empirical Investigation. Journal of Banking and Finance, 27: 1079-1110.
Sellon G.H., 2002, The Changing U.S. Financial System: Some Implications for the Monetary Transmission Mechanism. Federal Reserve Bank of Kansas City Economic Review, First Quarter. 5-35.
Scholnick, B., 1999, Interest Rate Asymmetries in Long-Term Loan and Deposit Markets. Journal of Financial Services Research, 16: 5-26.
Stiglitz, J.E., and Weiss, A., 1981, Credit Rationing in Markets with Imperfect Information. American Economic Review, 71(3): 393-410.
Thompson, M.A., 2006, Asymmetric Adjustment in the Prime Lending-Deposit Rate Spread. Review of Financial Economics, 15(4),: 323-329.
Tkacz G., 2001, Endogenous Thresholds and Tests of Asymmetry in U.S. Prime Rate Movements. Economics Letters, 73: 207-211.
Zanforlin, L, and Espinosa, M., 2008, Housing Finance and Mortgage-Backed Securities in Mexico. IMF Working Paper WP/08/105, International Monetary Fund, Washington DC.