The Behavior of Taiwanese Consumer Loan, Deposit Rates and Consumer Loan Premium in Post 1997 Asian Financial Crisis

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Abstract

Asymmetries in the Taiwanese consumer loan-deposit rate spread (consumer loan premium) were documented. Empirical results revealed that the consumer loan premium adjusts to the threshold faster when the deposit rates fall relative to the lending rates than when the deposit rates move in the opposite direction. This competitive rate setting behavior is consistent within the observed Taiwanese lending institutions, operating in a deregulated and liberated, competitive market over the post Asian financial crisis of 1997. Empirical results also revealed Granger causality from the deposit rate to the consumer loan rate indicating that the consumer loan rate is influenced by the 1-month deposit rate. This finding suggests that the Taiwan countercyclical monetary policy does matter in the short run.

Key Words: Asymmetry; consumer loan rate; 1-month deposit rate; consumer loan premium; Taiwan; predatory pricing behavior

JEL classification codes: C22; E44; G21.

1. Introduction

One of the most important roles commercial banks play in the economic development of a nation hinges on the spread between the lending rate they charge borrowers and the deposit rate they pay savers. This spread or "consumer loan premium" also reveals how commercial banks respond to counter cyclical monetary policy and hence the effectiveness of central banks' monetary policymaking. Consequently, analysis of this consumer loan premium illuminates and provides insights into banking behavior. Modern economic theory articulates that nominal interest rates can be decomposed into the real rate and the inflation expectation premium; hence, the difference between these two nominal rates is the real spread. In this context, the consumer loan premium may be considered as real measure in nature. Accordingly, this paper examines the behavior of Taiwanese banks with a focus on their consumer lending-deposit rate setting, the behavior of the consumer loan premium, and in turn, the dynamic interrelationship of the elements that determine them.

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 rates paid savers and the rates charged consumer borrowers—the consumer loan premium. If banks set a loan premium either too high or too low, market forces would force an adjustment back to some equilibrium spread. Monopolistic/oligopolistic concentration thwarts the operation of such free market forces and leads to wider, asymmetric spreads and larger consumer loan premium. However, Lin and Kao (2011) argued that while deregulation in the late 1990s and early 2000s increased the size and scope of local financial firms, the playing field is leveled somewhat by the entrance of larger foreign competitors.

It can therefore be argued that focused financial firms will not only face competitions with their domestic financial holding companies but also from large foreign entrants. The Taiwanese financial sector illustrates this process as economic conditions influenced separately the rate charged consumer borrowers and the rate paid savers resulting in a consumer loan premium that is consistent with a free market determined spread.

Across the spectrum of changes that took place in Taiwan in the post 1997 Asian financial crisis, discussed below in Section 3, the banking industry in this country has become more competitive due to deregulations and liberalization.

Economic theory and banking experience suggest that competition inevitably leads to competitive 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 that theoretic proposition and more specifically probes the question: do asymmetries exist in the Taiwanese consumer loan/deposit rates spreads, and if such asymmetries are present, how do consumer loan rates 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 briefly reviews the literature on asymmetries in lending-deposit rate setting behavior by commercial banks, the next section summarizes the Taiwanese banking sector, the section that follows describes the data and the descriptive statistics used in the analysis, the next section describes the methodology used and the empirical results, and the concluding section provides observations and remarks.

2. A Brief Literature Review

The rationale for theoretically hypothesizing asymmetric responses to the national countercyclical monetary policy can be attributed to the documented asymmetric rate-setting behavior of the commercial banks in the context of rates of return on financial market instruments. Dueker (2000) and Tkacz (2001) have reported asymmetries in the U.S. prime lending rate in the past. Thompson (2006) found asymmetries in the U.S. prime lending-deposit rate spread. Sarno and Thornton (2003) found asymmetries in U.S. Treasury securities in their studies. Frost and Bowden (1999) and Scholnick (1999) reported asymmetries in mortgage rates in New Zealand and Canada. Hofmann and Mizen (2004) indicated asymmetric behavior of retail rates in the United Kingdom. Hannan and Berger (1991), and Neumark and Sharpe (1992)) examined various deposit rates for the same behavior. Several studies have found asymmetric cointegration between bank lending and deposit rates. For instance, Nguyen et al. (2008) documented similar asymmetries in Mexican lending and deposit rates. Nguyen and Islam (2010) reported asymmetries in the Thai bank lending and deposit rates. Nguyen et al. (2010) found asymmetries in the Bangladeshi lending deposit rates. Chang and Su (2010) reported nonlinear cointegration between the lending and the deposit rate in ten Eastern European countries. Lastly, Haug and Basher (2011) found nonlinear cointegration in the purchasing power parity relationships for Canada, Japan, Switzerland, the U.K., Belgium, France, Germany, Italy and Netherlands.

From the theoretical perspective, there are three main approaches which help explain the rate-setting behavior of the banking sector: the bank concentration hypothesis, the consumer characteristic hypothesis, and the consumer reaction hypothesis[1]. 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 are slower to reduce the rates charged borrowers (Neumark and Sharpe, 1992; Hannan and Berger, 1991). The consumer characteristic and consumer reaction hypotheses each posit that a greater proportion of unsophisticated consumers, coupled with higher search and switching costs, provide bankers with heightened opportunities to adjust rates and widen the spread, thereby increasing the banks' advantage and producing incremental profits, (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).

3. The Taiwanese Banking Sector

Recent empirical studies suggest that the recent reforms have delivered what they were intended to achieve. Hsiao et al. (2010) report that commercial banks which are often an important part of larger financial holding companies, exhibit higher operating efficiency in the post-reform period after an initial decline during the implementation period.

Since 1991, the Taiwan financial authority has granted new bank charters. Bank charters were issued in response to over-regulation that stifled market competition and restrained market mechanisms (Lin and Kao 2011). In fact, at its peak in 2001, the Taiwanese banking industry consisted of 53 local banks and 38 foreign bank branches.

However, in this small market, rapid expansion had negatively affected small market shares and the low degree of product differentiation among banks.

The liberalization of the banking industry provided the benefit of increasing competition but it also resulted in profit margins being squeezed. Possibly as a result of competition, banks began acquiring riskier assets during the 1990s.

Further evidence of the decline in the quality of assets can be found in the report by the Financial Supervisory Commission. In particular, local Taiwanese banks experienced significant declines in return on equity from 20.79% to 3.60% and return on assets (ROA) from 0.9% to 0.27% between 1995 and 2001. An additional troubling trend was seen in non-performing loan ratios which increased from 2.88% to 11.27% during this same period.

In response to these issues, the Financial Institutions Merger Act and the Financial Holding Companies Act were passed in 2000 and 2001 respectively. This legislation had the benefit of removing barriers to mergers among banks, insurance companies, and securities firms. Additionally, these reforms required the regulated financial institutions to lower their non-performing loan ratios and to improve their bank liquidity. Another benefit of these acts was the removal of the separation between commercial and investment banking activities that had been required of financial firms. The acts actually encouraged domestic banks to engage in mergers with other financial institutions such as insurance companies and asset management firms.

Another goal of these financial reforms was to increase the competitiveness of domestic institutions. As a condition for membership in the World Trade Organization, Taiwan had to allow foreign financial institutions to compete directly with domestic financial firms over the range of financial products. The ability to merge among local firms had the effect of leveling the competitive environment between locals and international entrants in the financial services industry. Thus the scope of the competition among financial institutions in Taiwan increased from purely domestic to both domestic and international firms.

Another effort to strengthen Taiwanese financial institutions can be found in the Act for the Establishment and Administration of the Financial Restructuring Fund of 2001. This act set up funds to assist troubled financial institutions through the Resolution Trust Corporation. These troubled institutions were encouraged to merge with other financial institutions or to liquidate. One benefit from this legislation was the reduction of non-performing loan ratios from 2.78% in 2004 to 1.54% in 2008.

While the implementation of these firms initially showed a decline in operating efficiency among commercial banks, over time commercial banks operating efficiency has improved beyond their pre-legislation levels (Hsiao et al, 2010). This improved efficiency has resulted in lower non-performing loan ratios and higher capital adequacy ratios.

4. The Data

One of the challenges in empirical studies of developing economies is the lack of desirable data. This study uses 1-month deposit rates and consumer loan rates over the period January, 1997 to April, 2013 where the data is available. The data was collected from the central bank of Taiwan. The consumer loan rates and 1-month deposit rates are denoted by LR_t and DR_t, respectively. These rates will be referred to as lending rates and deposit rates, respectively. The difference between the lending rate and the deposit rate is defined as the consumer loan premium and is denoted by CP_t.

Figure 1 displays the behavior of the respective lending rates, deposit rates and the consumer loan premium over the sample period. As Figure 1 suggests, the Taiwanese consumer lending rate oscillated around its downward trend from the beginning of the sample period until the end of 2001 while the 1-month deposit rate stayed fairly flat for the first half of 1997, took a small jump and then maintained at the new level until the end of 1997. The 1-month deposit rate took a huge jump at the beginning of 1998, oscillated around a moderately downward trend for a few months, sharply dropped during the remainder of 1998, and then maintained flat until the later part of 2001. Both the 1-month deposit rate and the consumer lending rate oscillated around their very steep downward trends during 2002. However, the 1-month deposit rate dropped faster resulting in sharp increases in the consumer loan premium. Both the 1-month deposit rate and the consumer lending rate oscillated around their moderate upward trends from 2002 to early 2008, took sharp drops and resumed their moderate upward trend over the remainder of the sample period. The Taiwanese consumer loan premium oscillated around its moderately upward trend until late 2001, increased fairly quickly until late in 2002, dropped sharply at the end of 2002, and then oscillated around a flat trend over the remainder of the sample period.

TAIWANESE CONSUMER LOANS RATES, ONE-MONTH DEPOSIT RATES, AND CONSUMER LOAN PREMIUM

Januar 1997 to April 2013
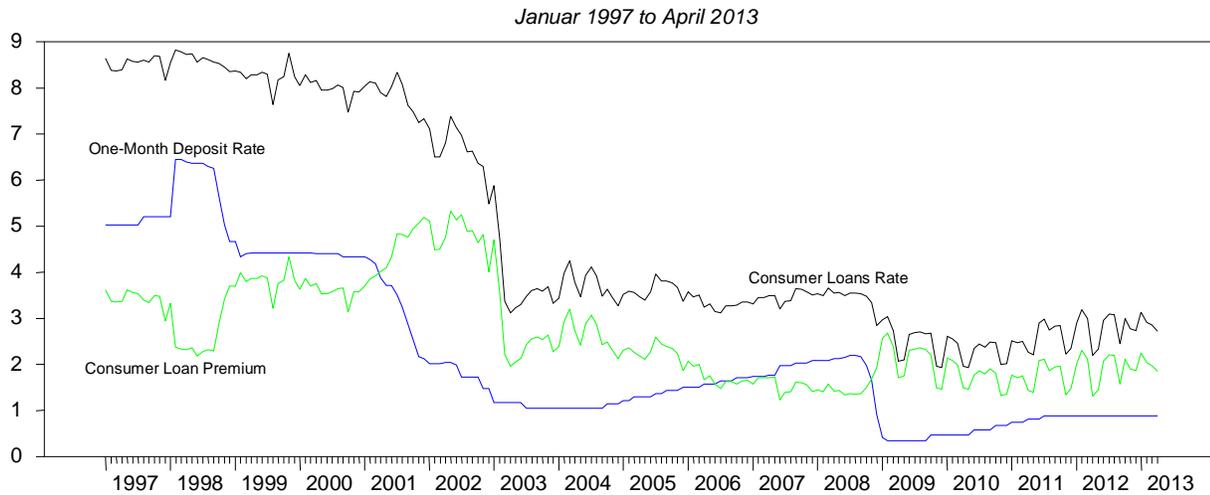
Figure1: Taiwanese Consumer Loan, Deposit Rates, and Consumer loan Premium, 1997:11-2013:04.

The mean lending rate during the sample period was 4.92 percent, and ranged from 1.93 percent to 8.82 percent with a standard error of 2.25 percent. The mean deposit rate over the same period was 2.27 percent, and ranged from 0.35 percent to 6.45 percent with a standard error of 1.73 percent. Their correlation was 91.83 percent which is fairly high. The mean consumer loan premium during the sample period was 2.65 percent, and ranged from 1.23 percent to 5.33 percent with a standard error of 1.08 percent. Moreover, as suggested by Figure 1, it is likely that the Taiwanese consumer loan premium experienced a structural shift over the sample period.

5. Methodological Issues and Analytical Framework

5.1 Structural Break

To search endogenously for the possibility of any structural break in the Taiwanese consumer loan premium, this study utilized Perron's (1997) endogenous unit root test function with the intercept, slope, and the trend dummy to test the hypothesis that the Taiwanese consumer loan premium has a unit root.

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

where $DU = 1(t > T_b)$ is a post-break constant dummy variable; t is a linear time trend; $DT = 1(t > T_b)$ 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).

Table 1: Perron's Endogenous Unit Root Test, Taiwanese Monthly Data 1997:1 to 2013:04

$$CP_t = 0.7242 + 0.1350\,DU + 0.0125\,t - 0.0142\,DT + 1.4222\,D(T_b) + 0.6729\,CP_{t-1} + \upsilon_t$$

(4.6345*)   (0.8299)   (4.0452*)   (-3.9708*)   (4.5370*)   (11.8838*)

No. of augmented lags: $k = 12$ Break Date: Dec. 2002 $t(\alpha = 1) = -5.7766*$

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

The estimation results of Perron's endogenous unit root tests are summarized in Table 1. The post-break intercept dummy variable, *DU,* is positive and is insignificant at any conventional level. The post-break slope dummy variable, *DT*, is negative and is significant at 1 percent significant level.

The time trend is positive and is significant at any significant level. The empirical results of these tests suggest that the Taiwanese consumer loan premium followed a stationary trend process with a break date of December 2002, as the consequence of the aforementioned Taiwanese government's restructuring program of banking sector, Lin and Kao (2011).

5.2 Nonlinear Cointegration

Additionally, as posited by Breitung (2001, p. 331), economic theory suggests in many cases a nonlinear relationship between economic and financial time series. This implies that LR_t and DR_t may be nonlinearly cointegrated. To discern this possibility, Breitung's nonparametric procedure is applied to test for their nonlinear cointegration.

Breitung's nonparametric testing procedure consists of the cointegration test, known as the rank test for cointegration, and the nonlinearity test, referred to as the score statistic for a rank test of neglected nonlinear cointegration. Following Breitung (2001), this study defines a ranked series as $R_T(LR_t)$ [of LR_t among $LR_1,...,LR_T$] and $R_T(DR_t)$ accordingly. Breitung's two-sided rank test statistic, testing for cointegration, denoted by Ξ_T^*, is calculated as follows:

$$\Xi_T^* = T^{-3} \sum_{i=1}^{T} (r_i^R)^2 / (\sigma_{\Delta r}^2) \tag{2}$$

where T is the sample size and r_i^R is the least squares residual from a regression of $R_T(LR_t)$ on $R_T(DR_t)$. As pointed out by Haug and Basher (2011, p. 187), $\sigma_{\Delta r}^2$ is the variance of Δr_i^R, which is included to adjust for the potential correlation between the two time series LR_t and DR_t. The critical values for this rank test are given in Table 1 in Breitung (2001, p. 334).

Given the positive result of the rank test, the first step in calculating Breitung's score statistic for a rank test of neglected nonlinear cointegration (testing for nonlinearity) is to regress the Taiwanese consumer loan rate, LR_t, on a constant, the deposit rate, DR_t, the ranked series of the deposit rate, $R_T(DR_t)$, and the disturbance ζ_t.

$$LR_t = \delta_0 + \delta_1 DR_t + R_t^*(DR_i) + \zeta_t \tag{3}$$

where $\delta_0 + \delta_1 DR_t$ is the linear part. Under the null hypothesis, $R_t^*(DR_i) = 0$ implying that LR_t and DR_t are linearly cointegrated. Under the alternate hypothesis, $R_t^*(DR_i) \neq 0$ implying that LR_t and DR_t are nonlinearly cointegrated. The score test statistic is given by $T.R^2$, where R^2 is the coefficient of determination of the least squares regression of ζ_t, under the null hypothesis, on a constant, the ranked series of the deposit rate, $R_T(DR_t)$, and a disturbance term. T is again the sample size. As articulated by Breitung (2001, p. 337), under the null hypothesis of linear cointegration, the score statistic for a rank test of neglected nonlinear cointegration is asymptotically Chi-Square distributed with one degree of freedom.

6. Threshold Autoregressive (TAR) model

If the results of Breitung's nonparametric tests are positive, this study follows Thompson (2006) to regress the spread, CP_t, on a constant and an intercept dummy (with values of zero prior to December 2002 and values of one for December 2002 and thereafter.

As reported in Appendix I, the estimated coefficient for the time trend is insignificant at any conventional level and therefore, the time trend was excluded in the final estimation) to formally examine the Taiwanese lending, deposit rates and their consumer loan premium .The saved residuals from the above estimated model, denoted by $\hat{\varepsilon}_t$, are then used to estimate the following TAR model:

$$\Delta\hat{\varepsilon}_t = I_t \rho_1 \hat{\varepsilon}_{t-1} + (1-I_t)\rho_2 \hat{\varepsilon}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta\hat{\varepsilon}_{t-p} + \hat{u}_t \tag{4}$$

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, 1987), the Heaviside indicator function for the TAR specification is given as:

$$I_t = \begin{cases} 1 & if \ \hat{\varepsilon}_{t-1} \geq \tau \\ 0 & if \ \hat{\varepsilon}_{t-1} < \tau \end{cases} \tag{5}$$

The threshold value, τ, is endogenously determined using the Chan (1993) procedure, which obtains τ 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.

The threshold autoregressive (TAR) model allows the degree of autoregressive decay to depend on the state of the consumer loan premium, i.e. the "deepness" of cycles. The estimated TAR model empirically reveals if the consumer loan premium tends to revert back to the long run position faster when the premium is above or below the threshold. Therefore, the TAR model indicates whether troughs or peaks persist more when shocks or countercyclical monetary policy actions push the consumer loan premium out of its long-run equilibrium path. In this model's specification, the null hypothesis that the consumer 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 $\rho_1 = \rho_2$.

7. *Results of the Cointegration Test with Asymmetric Adjustment*

Empirical calculations indicate that Breitung's nonparametric rank tests and score test are 0.000026, which fails to reject the null hypothesis of cointegration, and 165.1265 which rejects the null hypothesis of linear cointegration, respectively. These test results reveal that the Taiwanese consumer loan and deposit rates are non-linearly cointegrated at all conventional levels of significance. Additionally, the estimation results of the TAR model are summarized in Table 2.

Table 2: Unit Root and Tests of Asymmetry, Taiwanese Monthly Data, 1997:01 to 2013:04

ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$	aic	sic
-0.4472*	-0.1059**	0.3949	$\Phi_\mu = 6.7489^*$	$F = 5.6610^*$	-2.1213	-2.0199
$Q_{LB(4)} = 7.0040[0.1357]$			$\ln L = -63.1459$	$F_{(5,187)} = 6.1141^*$	D.W. = 2.0848	

Notes: *The null hypothesis of a unit root, $H_0: \rho_1 = \rho_2 = 0$, uses the critical values from Enders and Siklos (2001, p. 170, Table 1 for four lagged changes and n = 100). "*" and "**" indicate 1 percent and 10 percent 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. $Q_{LB(4)}$ denotes the Ljung-Box Q-statistic with 4 lags*

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. Also, 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 $(1+\rho_1)(1+\rho_2) < 1$. The calculated statistic $\Phi_\mu = 6.7489$ 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 Taiwanese consumer loan premium is stationary. 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 Taiwan consumer loan premium tends to decay at the rate of $|\rho_1| = 0.4472$ for $\hat{\varepsilon}_{t-1}$ above the threshold, $\tau = 0.3949$, and at the rate of $|\rho_2| = 0.1059$ for $\hat{\varepsilon}_{t-1}$ below the threshold. Additionally, the empirical results also reveal that, based on the partial *F = 5.6610,* the null hypothesis of symmetry, $\rho_1 = \rho_2$, should be rejected at any conventional significant level, indicating statistically that adjustments around the threshold value of the Taiwanese consumer loan premium are asymmetric.

More specifically, given the finding of $|\rho_1| > |\rho_2|$, the adjustment of the Taiwanese consumer loan premium toward the long-run equilibrium tends to persist more when the premium is narrowing than when it is widening. These findings reveal that Taiwanese lending institutions adjust their lending rates differently to rising versus declining deposit rates.

These findings can also be interpreted to show that these institutions react differently to expansionary monetary policy than to contractionary. Given $|\rho_1| > |\rho_2|$, the adjustment toward the long run equilibrium tends to persist more when the Taiwanese consumer loan premium is narrowing than when the spread is widening.   This result contradicts those reported by Thompson (2006) for the U.S. and supports the hypothesis that banks adjust their lending rates differently to rising versus declining market rates. Therefore, the finding of $|\rho_1| > |\rho_2|$ seems to suggest the competitive pricing behavior of the Taiwanese lending institutions which is consistent the consumer reaction hypothesis, as well as the observed competitive market structure of the Taiwanese banking sector.

8. Results of the Asymmetric Error-Correction Model

Given the results of the above asymmetric co-integration tests, an Asymmetric Threshold Autoregressive Vector Error-Correction (TAR-VEC) model is estimated to further investigate the asymmetric short-run dynamics with respect to the Taiwan consumer loan (LR_t) and deposit (DR_t) rates. The estimation results of this model can be used to study the nature of the Granger causality between the Taiwanese consumer loan and deposit rates. The empirically determined nature of the Granger causality will help to evaluate empirically whether and how the Taiwanese consumer loan and the deposit rates respond to changes in consumer loan premium, induced by external economic shocks or countercyclical policy measures. Additionally the following TAR-VEC model differs from the conventional error-correction models by allowing asymmetric adjustments toward the long-run equilibrium.

$$\Delta LR_t = \alpha_0 + \rho_1 I_t \hat{\varepsilon}_{t-1} + \rho_2 (1 - I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta LR_{t-i} + A_{12}(L)\Delta DR_{t-i} + u_{1t} \qquad (6)$$

$$\Delta DR_t = \tilde{\alpha}_0 + \tilde{\rho}_1 I_t \hat{\varepsilon}_{t-1} + \tilde{\rho}_2 (1 - I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta LR_{t-i} + A_{22}(L)\Delta DR_{t-i} + u_{2t} \qquad (7)$$

where $u_{1,2t} \sim i.i.d.(0,\sigma^2)$ and the Heaviside indicator function is set in accord with (5). This model specification recognizes the fact that the Taiwanese consumer loan and deposit rates may respond differently, depending on whether the consumer loan premium is widening or narrowing (i.e., expansionary or contractionary monetary policy or economic shock).

The following are the estimation results for the TAR VEC model specified by equations (5), (6), and (7), using the Taiwanese consumer loan and deposit rates. In reporting 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. $Q_{(4)}$ is the Ljung-Box statistics and its significance is in squared brackets, testing for the first four 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. An analysis of the overall empirical results indicates that the estimated equations (6) and (7) 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 (6) of the TAR-VEC model reveal that both ρ_2 and ρ_1 are statistically significant at 1 percent level. This finding indicates that when introducing the short-run dynamic adjustment to the model, the Taiwanese consumer loan rates respond to the narrowing and the widening of the consumer loan premium. This empirical result suggests that in setting their lending rates, Taiwanese lending institutions respond to contractionary and expansionary monetary policy in the long-run. With regard to the long-term adjustment of the 1-month deposit rates, the estimation results of equation (7) show that $\tilde{\rho}_2$ is significant at 1 percent; while $\tilde{\rho}_1$ is not significant at any conventional level. These findings suggest that in setting deposit rates, Taiwanese lending institutions respond only to the narrowing but not to the widening of the consumer loan premium.

This finding suggests that Taiwanese lending institutions respond to contractionary but not expansionary monetary policy in setting their deposit rates in the long run.

Table 3: Taiwanese Lending and Deposit Rates, Monthly Data, 1997:01 to 2013:04

$$\Delta LR_t = -0.0359 - 0.2716\, I_t \hat{\varepsilon}_{t-1} - 0.1627\,(1-I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta LR_{t-i} + A_{12}(L)\Delta DR_{t-i} + u_{1t}$$

1.4699)	(-5.9853*)	(-3.1521*)	F_{11}= 5.9516[0.000]	F_{21}= 5.5728[0.0155]
$Q_{(4)}$ = 2.8010[0.5917]		$\ln L$ = -6.4841	$F_{(8,175)}$.statistic = 9.8172*	

$$\Delta DR_t = -0.0039 - 0.0080\, I_t \hat{\varepsilon}_{t-1} + 0.0799\,(1-I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta LR_{t-i} + A_{22}(L)\Delta DR_{t-i} + u_{2t}$$

0.3952)	(-0.4118)	(3.7969*)	F_{21} = 2.0634[0.1086]	F_{22}= 4.7356[0.0105]
$Q_{(4)}$ = 8.2750[0.0820]		$\ln L$ = 155.1971	$F_{(7,174)}$.statistic = 11.7136*	

Note: "" indicates 1 percent level of significance.*

In addition to estimating the long-run equilibrium relationship and asymmetric adjustment, the estimated TAR-VEC model also allows for determinations of the Granger causality between the Taiwanese consumer loan rates and deposit rates. The partial *F-statistics* in equation (6) reveals that the consumer loan rate responds only to its own lagged changes and the lagged changes in the deposit rates. Additionally, the estimation results also indicate that the Taiwanese deposit rate responds to its own lagged changes; but not the lagged changes of the consumer loan rates. These findings suggest that the Taiwanese 1-month deposit rate is independent of the consumer lending rate in the short run. Economically, this exogeneity indicates that the Taiwanese countercyclical monetary policy does not matter in consumer loan market in the short run over the sample period, despite of many concerted effort from the central bank to improve the banking sector.

9. Concluding Remark and Policy Implications

This study estimated the threshold autoregressive (TAR) model developed by Enders and Siklos (2001) to investigate the behavior the Taiwanese consumer loan rate, 1-month deposit rate and the consumer loan premium.

First, following Perron's (1997) procedure, an endogenous unit root test function with the intercept, slope, and trend were specified and estimated to test the hypothesis that the Taiwanese consumer loan premium has a unit root. The empirical results of these tests suggest that the Taiwanese consumer loan premium followed a stationary trend process with a break date of December 2002, as the consequence of Taiwanese government's restructuring program of banking sector (Lin and Kao, 2011). Additionally, that Breitung's nonparametric rank test and score test indicate that the Taiwanese consumer loan and 1-month deposit rates are nonlinearly cointegrated.

Second, the finding of $|\rho_1| > |\rho_2|$ indicates that the adjustments of the Taiwanese consumer loan premium toward the long-run equilibrium are asymmetric and tend to rise faster when countercyclical monetary policy or shocks cause the deposit rate to decrease and fall slower when the deposit is increasing. These findings can also be interpreted to demonstrate that banks react faster to expansionary than to contractionary monetary policy. The finding of $|\rho_1| > |\rho_2|$ seems to suggest the competitive pricing behaviour of the Taiwanese lending institutions which is consistent the consumer reaction hypothesis, as well as the observed competitive market structure of the Taiwanese banking sector. Finally, the empirical estimation of the TAR-VEC model reveals the Granger-causality between the Taiwanese consumer rates and the 1-month deposit rates in the short run.

The finding of Granger causality is important since it reveals that Taiwan commercial banks do respond to countercyclical monetary policy by changing the 1-month deposit rates. This finding should be surprising given the Taiwanese banking reforms initiated to increase the level of competition in the banking sector.

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Appendix

Table 4: Estimation Results, Taiwan Monthly Data, 2001:12 - 2013:01

$$CP_t = 3.8292 - 0.00090 Trent - 1.7199 Dummy_t + \varepsilon_t$$

$$(41.6374^*) \quad (0.6123) \quad (-10.0410^*)$$

$ln\ L$ = -184.0726	R^2 = 0.6525	DW statistic[a] = 0.3192	$F_{(1,132)}$ =184.0726*

**Notes*:* "*" *indicates significance at 1 percent level.*

(a)   *As articulated by Enders and Siklos (2001, p. 166), in this type of model specification, ε_t may be contemporaneously correlated.*