INTEREST RATE SETTING BEHAVIORS OF COMMERCIAL BANKS OVER THE POST-2008-ERA

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ABSTRACT

Except for the case of Malaysia, competitive pricing behaviors by commercial banks in the U.S. and Asian countries in the post-U.S. subprime mortgage crisis were documented. These findings make significant contributions to the literature. The investigation also found bidirectional Granger causality between the lending rates and the Central Bank's policy-related/discount rates in all economies, except in the Philippines and the presence of the GARCH (r, s)-M effects on the intermediation premia and their variances in each of these economies. These findings suggest that monetary policymakers intervene more frequently, and by making small policy adjustments to achieve their macroeconomic objectives. **JEL Classification:** C22, E44, G21

INTRODUCTION

Classical theorists such as Schumpeter (1912), Patrick (1966), and McKinnon (1973) have articulated that financial intermediation is a critical facilitator of investment and economic growth and hence social progress. Nguyen (2019-a, p. 1) argued, "Commercial banks play a crucial role in determining the spread between the lending rate and the cost of funds or the intermediation premium. In addition to creating interest income to financial intermediaries, the spread affects the economy's savings, investment and consumption levels and hence the effectiveness of a Central Bank's countercyclical monetary policies."

Moreover, Nguyen (2019-a, p. 1) posited that "Some of the spread is due to risk related to the instrument; that is, the intermediation premium above the 'cost of funds'. This 'risk' portion provides useful insights into banks' behaviors, which this paper uses to study Latin American banks—with an emphasis on the factors that affect the dynamics of the spread between their lending rates and policy-related rates. Moreover, understanding how commercial banks responded to their Central Bank's countercyclical monetary policy measures as reflected in changes in the lending rates in response to changes in Central Bank's policy-related rates in different interest rate environments, specifically in the new phenomenon of Zero Lower Bound interest rate environment, is of substantial interest to policy-makers."

After the U.S. subprime mortgage crisis, economies in South and Southeast

Asia have outperformed emerging and advanced economies around the world. This observation motivates an investigation of the rate-setting behaviors of commercial banks in some countries where the data is available for this region of the globe. To this end, this empirical study utilizes the model that Nguyen (2019-a) applied to study the behaviors of commercial banks in Latin America and compared theirs to the U.S. commercial banks' over the January 2009- November 2019.

More specifically, this paper follows Nguyen (2019-b, p. 2) to investigate "if the commercial banks' lending rate and the Central Bank's monetary policy-related/ discount rate (depending upon which one is available), in each of the economies under consideration, are co-integrated; and if they are, the nature linear or nonlinear co-integration is analysed. The study also explores whether asymmetries exist in lending policy-related rate spread in these transition economies and, if such asymmetries are present, how lending and Central Bank's policy-related rates respond to these asymmetries. Furthermore, this investigation explores whether responses to such asymmetries are independent or are dynamically interrelated in each of these selected economies. Besides, this analysis seeks to determine whether the lending institutions in each of these economies exhibit competitive or predatory pricing behaviors, and to what extent."

In addition, this paper follows Nguyen (2015, p. 3) to "investigate whether the variance of the intermediation premium from one month affects the variances and spreads in the subsequent months. This information is very important for countercyclical monetary policy-makers concerning whether they should intervene to bring the economy to its long-term trend less frequently and by making large policy measures or more frequently and by making small policy measures because these two alternative policy actions result in a different variance of the spread."

As usual, the formidable challenge in empirical studies of emerging economies is the unavailability of data. Due to this challenge, this paper can only study the economies of Malaysia, the Philippines, Singapore, Thailand, and Vietnam over the January 2009 through January 2019 period. As a benchmark for comparisons, the U.S. economy is also included in this study.

Since this study uses the model that Nguyen (2019-a) utilized to investigate the Latin American commercial banks' rating behaviors to investigate those of the South-Southeast Asian commercial banks, the components of the empirical model are briefly stated; but, a literature review is not included in this paper.

This study is organized as follows. Section 2, briefly captures the subparts of the model used in the investigation. Section 3 describes the data and the descriptive statistics used in the analysis. Section 4 reports the estimation results. Section 5 discusses the empirical findings. Section 6 provides a summary of the study and offers concluding remarks.

COMPONENTS OF THE EMPIRICAL MODEL

The model, utilized by Nguyen (2019-a) has the following five subparts. First, the Perron's (1997) endogenous unit-root-test function, testing for the structural breaks in the spread between lending and policy-related/discount rates, is specified and estimated to endogenously search for a structural break in the relationship between the lending and policy-related/discount rates. Second, Breitung's (2001) nonparametric

testing procedures, testing for the linear/non-linear co-integration between lending and policy-related/discount rates. Third, the Threshold Autoregressive (TAR) model, investigating the asymmetric dynamic behaviors of the lending rates and policy-related/discount rates. Forth, the Asymmetric Error-Correction Model, investigating the nature of the Granger causality between lending and policy-related/discount rates. Finally, the GARCH(s, r)-in-Mean (GARCH-M) model, testing whether the fluctuation in the intermediation premium and hence its variance in one month affects the premia and the variances in the future months. Readers who are interested in detailed justifications and specifications of the model are referred to the above paper.

Structural Break

Denoting as the spread between the commercial banks' lending rate (LR_t) and the Central Bank's policy-related/discount rate, (DR_t), or the intermediation premium, Nguyen (2019-a, p. 3) argued that we may "endogenously searched for the structural break in by estimating "Perron's (1997) endogenous unit root test function with the intercept, slope, and the trend dummy as follows:

$$SP_t = \mu + \theta DU + \sigma t + \gamma DT + \delta D(T_b) + \beta SP_{t-1} + \Sigma^k_{i=1} \psi_i \Delta SP_{t-i} + v_t \qquad (1)$$

where $DU = 1\ (t > T_b)$ is a post-break constant dummy variable; t is a time trend; $DT = 1\ (t > T_b)$ is a post-break slope dummy variable; $DT\ (T_b) = 1\ (t = T_b + 1)$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 $\beta = 1$, Perron (1997.)"

Linear and Nonlinear Co-integration

Let $R_T\ (LR_t)$ [of LR_t among LR_1 ,..., LR_T] and $R_T\ (PR_t)$ be respectively the sorted from smallest to the largest values of the two-time series data LR_t and PR_t, Nguyen (2015, p. 6) argued that "Breitung's two-sided rank test statistic, testing for no nonlinear co-integration, denoted by Ξ^*_T, may be calculated as follows:

$$\Xi^*_T = T^{-3} \sum_{i=1}^{T} (r_i^R)^2 / (\sigma^2_{\Delta r}) \qquad (2)$$

where T is the sample size, r^R_i is the least-squares residual from a regression of $R_T\ (LR_t)$ on $R_T\ (PR_t)$. According to Haug and Basher (2011), $\sigma^2_{\Delta r}$ is the variance of Δr^R_i, which is included to adjust for the potential correlation between the two time series LR_t and PR_t. The critical values for this rank test are provided in Table 1 of Breitung (2001)."

Additionally, as Nguyen (2019-a) indicated, Breitung's score statistic for a rank test of neglected nonlinear co-integration may also be calculated by first regressing the lending rate, LR_t, on a constant, the deposit rate, PR_t, the ranked series of the deposit rate, $R_T\ (PR_t)$, and the disturbance ζ_t.

$$LP_t = \delta_0 + \delta_1 PR_t + \delta_2 R^*_T\ (PR_i) + \zeta_t \qquad (3)$$

where $\delta_0 + \delta_1 PR_t$ is the linear part."

Breitung (2001) argued that the null hypothesis that LR_t and PR_t are linearly co-

integrated can be stated as; while under the alternate hypothes is that LR_t and PR_t are nonlinearly co-integrated can be stated as $R^*_T(PR_t) \neq 0$. Nguyen (2019-a, p. 4) indicated "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 time series PR_t, the ranked series of the deposit, R_T (PR_t), and a disturbance term. T is the sample size. Breitung (2001) proved that under the null hypothesis of linear co-integration, the score statistic for a rank test of neglected nonlinear co-integration is asymptotically Chi-Square distributed with one degree of freedom." As pointed out by Haug and Basher (2011), this test can be applied only if the rank test suggests co-integration.

Threshold Autoregressive (TAR) Model

As posited by Nguyen (2015, p. 7), "the Threshold Autoregressive Model may be constructed by regressing the intermediation premium, SP_t, on a constant, a linear trend and an intercept dummy to examine the relationships among LR_t , PR_t, and SP_t of any country under consideration. The saved residuals from the estimation of this model, denoted by $\hat{e}_t$, are then used to estimate the following TAR model:

$$\Delta\varepsilon t = I_t\rho_1\varepsilon_{t-1}+(1 - I_t)\rho_2\varepsilon_{t-1}+ \Sigma^p_{i=1}\alpha_i\Delta\varepsilon_{t-i}+ u_t \quad (4)$$

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

$$I_t = \begin{cases} 1 & f\ \hat{\varepsilon}_{t-1} \geq \tau \\ 0 & f\ \hat{\varepsilon}_{t-1} < \tau \end{cases} \quad (5)$$

Nguyen (2019-a, p. 6) indicated that "The threshold value,τ, is endogenously determined using Chan's (1993) procedure, which obtains τ by minimizing the sum of squared residuals after sorting the estimated residuals in ascending order and eliminating the largest and smallest 15 percent of values. The elimination of the largest and the smallest values assures that the $\hat{e}_t$ series crosses through the threshold in the sample period."

In describing the model, Nguyen (2017, p. 6) articulated, "The threshold autoregressive (TAR) model allows the degree of autoregressive decay to depend on the state of the intermediation premium, i.e. the 'deepness' of cycles. The estimated TAR model shows whether the intermediation premium reverts to the long-run time path faster when the premium is above or below the threshold. Therefore, the estimated TAR model reveals whether troughs or peaks persist more when countercyclical monetary policy actions or economic shocks push the premium out of its long-run equilibrium. The author posited that the null hypothesis (that the intermediation premium contains a unit root) is expressed as $\rho_1 = \rho_2 = 0$, while the hypothesis that the premium is stationary with symmetric adjustments is expressed as $\rho_1 = \rho_2$."

In addition, Nguyen (2019-a, p. 6) argued, "In this model's specification, the intermediation premium, in a given economy, tends to decay at the rate of the estimated value of $|\rho_1|$ for $\hat{e}_{t-1}$ above the threshold τ and at the rate of the estimated value $|\rho_2|$ of for $\hat{e}_{t-1}$ below the threshold. Therefore, if the estimation results for an economy reveal that $|\rho_2| > |\rho_1|$, then the adjustment of the intermediation premium, in that economy,

toward the long-run equilibrium tends to persist more when the premium is widening than when it is shrinking. Economically, this finding may also be interpreted as that commercial banks in this economy react differently to expansionary monetary policy than to contractionary monetary policy and *exhibited the predatory pricing behavior.* Otherwise,$|\rho_2| \leq |\rho_1|$ is viewed as lending institutions in the economy *exhibited competitive pricing behavior.*"

Nguyen (2019-a, p. 6) stated, "in this model's specification $|\rho_1|$ is the speed of adjustment of the intermediation premium when an economic shock or an expansionary countercyclical monetary policy action lowers the policy-related rate, which in turn increases the spread between the new policy-related rate and the existing lending rate in the economy, i.e., $\hat{e}_{t-1}$ is above the threshold τ. On the other hand, $|\rho_2|$ is the speed of adjustment of the intermediation premium when an economic shock or a contractionary countercyclical monetary policy measure raises the policy-related rate, which consequently decreases the spread between the new policy-related rate and the existing lending rate in the economy, i.e., $\hat{e}_{t-1}$ is below the threshold τ."

The Asymmetric Error-Correction Model

As to the Asymmetric Error-Correction Model, Nguyen 2019-a, p. 7) suggested, "to further investigate the asymmetric dynamic behavior of the lending rate (LR_t) and the Central Bank's policy-related rate (PR_t), a Threshold Autoregressive Vector Error-Correction (TAR-VEC) model has to be specified and estimated. The TAR-VEC model is specified by equations (5), (6) and (7). The estimation results of this model will reveal the nature of the Granger causality between the lending rates and the Central Bank's policy-related rates. The statistical nature of the Granger causality will help empirically evaluate whether, and how the lending rates and the Central Bank's policy-related rates respond to changes in the lending-Central Bank's policy-related rate spread.

$$\Delta LR_t = \alpha_0 + \rho_1 I_t \varepsilon_{t-1} + \rho_2(1 - I_t)\varepsilon_{t-1} + \Sigma^n_{i=1}\alpha_i \Delta LR_{t-i} + \Sigma^q_{i=1}\gamma_i \Delta PR_{t-i} + u_{1t} \quad (6)$$

$$\Delta PR_t = \tilde{\alpha}_0 + \tilde{\rho}_1 I_t \varepsilon_{t-1} + \tilde{\rho}_2(1 - I_t)\varepsilon_{t-1} + \Sigma^n_{i=1}\tilde{\alpha}_i \Delta LR_{t-i} + \Sigma^q_{i=1}\tilde{\gamma}_i \Delta PR_{t-i} + u_{2t} \quad (7)$$

where $u_{i,t} \sim i.i.d(0,\sigma^2)$, $i = 1, 2$ and I_t is set by equation (6).

Additionally as pointed out by Thompson (2006), the above-specified TAR-VEC model differs from the conventional error-correction models by allowing asymmetric adjustments toward the long-run equilibrium."

Moreover, Nguyen (2019-a, p.7) indicated, "The asymmetric error correctional model replaces the single symmetric error correction term with two error correction terms. Thus, in addition to estimating the long-run equilibrium relationship and asymmetric adjustment, the model also allows for tests of the short-run effects (dynamics) between changes in the lending rate and the Central Bank discount rate. This, in turn, reveals the nature of Granger causality.

Finally, in this model's specification, the longest retained coefficient α_i, of the estimation results for equation (6), is the time lag or the number of months for commercial banks, in a country, to adjust their lending rate to the long-run path when an economic shock or a countercyclical monetary policy measure pushed it out of the long-run time path. The estimated coefficient γ_i is the time lag for the commercial

banks to respond to the monetary policies completely. Similarly, the longest retained coefficient $\acute{\alpha}_i$ of the estimation results for equation (7) is the number of months of commercial banks' lending rates that the monetary authority looked back in formulating its countercyclical monetary policies. The longest retained coefficient $\gamma`_i$ is the time lag for the monetary policymakers to complete a cyclical monetary policy."

GARCH(s, r)-M Model

Finally, to investigate whether the fluctuation in the intermediation premium and hence its variance in one month affect the premia and the variances in the future months, Nguyen (2017, p. 16) suggested that this investigation specifies and estimate "the following GARCH(s, r)-in-Mean (GARCH-M) model.

$$SP_t = c + \omega IP_{t-1} + \acute{\lambda}(\omega^2_t) + \varepsilon_t \quad (8)$$

$$\omega_t^2 = \alpha + \sum_{l=1}^{r} \beta_l \varepsilon_{t-l}^2 + \sum_{m=1}^{s} \eta_m \omega_{t-m}^2 \quad (9)$$

where SP_t is the intermediation premium, SP_{t-l} is the value of the premium in the previous month, and ω^2_t is its variance at time t; ε_t is a disturbance; c is a constant; $\acute{\lambda}$, $\acute{\alpha}$, β_l, ω, and n_m are the parameters to be estimated of the model. The retentions of these estimated coefficients are determined by the calculated z-statistics at the 5 percent level of significance. The r and s indices are the highest subscripts l and m of retained β_l and n_m.

DATA AND DESCRIPTIVE STATISTICS

Due to the unavailability of data, this study could investigate only the economies of the U.S., as a benchmark for comparison, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. The monthly lending rates were used for all six countries under consideration. However, the monetary policy-related rates were for Malaysia, Singapore, Thailand, and Vietnam; the Central Bank's discount rates were used for the U.S. and the Philippines. All data were extracted from the International Financial Statistics database maintained by the International Monetary Fund. The monthly lending rates, monetary policy-related/discount rates, and their spread are denoted by, LR_t, PR_t, and SP_t, respectively. Table 1 summarizes the descriptive statistics of the data set.

EMPIRICAL RESULTS

The estimation results for the model using the above set of data for all six economies under consideration are reported in Tables 2 to 6. More specifically, Table 2 summarizes the results of Breitung's non-parametric tests for the nature of co-integration between the lending rate and policy-related/discount rate in the U.S. and five Asian economies under investigation. Table 3 encapsulates the testing Results of Perron's Endogenous Unit Root Test. Table 4 reports the estimation results for the Threshold Autoregressive Model, which were used to calculate the co-integration

tests allowing for asymmetric adjustment for the economies of the U.S., Malaysia, the Philippines, Singapore, Thailand, and Vietnam.

Table 5 encapsulates the empirical results for the Asymmetric Error-Correction Model. As explained by Nguyen (2019-a, p. 9) in the summary of the estimation results, "the partial F_{ij} represents the calculated partial *F-statistics* with the p-value in square brackets testing the null hypothesis that all coefficients *ij* are equal to zero. $Q_{LB\ (10)}$ is the Ljung-Box statistics and its significance is in square brackets, testing for the first ten of the residual autocorrelations to be jointly equal to zero. *lnL* is the log-likelihood. The overall *F-statistic* with the p-value in square brackets tests the overall fitness of the model. The retained estimated coefficients α_i, γ_i, $\acute{\alpha}_i$, and $\gamma`_i$ are based on the 5 percent level of significance of the calculated *t-statistics*."

Finally, Table 6 summarizes the final estimation results for GARCH (s, r)-M model for the U.S., Malaysia, Singapore, the Philippines, Thailand, and Vietnam. The retention of these estimated coefficients of these final models is determined by the calculated z-statistics at the 5 percent level of significance. The *r* and *s* indices are the highest subscripts *l* and *m* of retained β_l's and n_m's.

COMPARING THE EMPIRICAL RESULTS

An examination of the descriptive statistics of the lending and policy-related/discount rates and their intermediation premia in the U.S., Malaysia, Singapore, the Philippines, Thailand, and Vietnam), summarized in Table 1, showed that they were quite different. Over the sample period, the mean U.S. lending rate, the mean discount rate, and the mean intermediation premium were 3.55%, 1.03%, and 2.52%, respectively. In the South and Southeast Asian economies, over the same period, Vietnam had the highest average lending rate at 10.11% and the highest average policy-related rate at 8.00%, while Singapore had the highest intermediation premium at 4.56%. The U.S. had the lowest mean lending rate at 3.55%, Singapore had the lowest mean policy-related rate at 0.79% and Malaysia had the lowest mean intermediation premium at 1.85%.

Based on the strengths of the calculated Breitung's nonparametric rank test statistics, reported in Table 2, the null hypothesis of no-nonlinear co-integration between the lending rate and Central Bank's policy-related/discount rate should be rejected for all, but Malaysia. Additionally, the calculated score test results suggested that the null hypothesis of nonlinearity co-integration between lending rate and policy-related/discount rate be rejected for Malaysia, the Philippines, Singapore, Thailand, and Vietnam; but failed to reject this null hypothesis for the U.S. These testing results indicate that the lending rate and policy-related/discount rate in the Philippines, Singapore, Thailand, and Vietnam are linear, while these two rates in the U.S. are non-linearly co-integrated and the score test in Malaysia was not applicable since the nonparametric rank test failed to confirm the co-integration (Haug and Basher, 2011.)

A close look at the estimation results for equation (1), summarized in Table 3, revealed that Perron's endogenous unit root test identified the structural break between lending and policy-related/discount rates in each of the countries under consideration. However, the break dates are different from one country to another. In addition, the strengths of the calculated Perron's test statistics *t's(α=1)* ranging from being highly significant for the U.S., the Philippines and Vietnam; while only being marginal

significant for Malaysia, Singapore, and Thailand. To account for the structural break in the subsequent investigations, a dummy variable is introduced, which is assigned a value of 1.00 on the month of structural break onward and a value of 0.00 elsewhere.

To investigate the co-integration allowing for asymmetric adjustments, the TAR model was estimated and the results were reported in Table 4. The empirical results for all six economies are without serial correlation and have good predicting power, as evidenced by the Ljung-Box statistics and the overall F-statistics, respectively. Based on the strength of calculated Φ_{μ}-statistics, the null hypothesis that the intermediation premium of a country contains a unit root, expressed as $\rho_1 = \rho_2 = 0$, should be rejected at any conventional level of significance for all South and Southeast Asian economies; but failed to reject the null hypothesis for the U.S. These empirical findings indicated that the lending rates and the Central Banks' policy-related/discount rates in Malaysia, the Philippines, Singapore, Thailand, and Vietnam are stationary and co-integrated. The U.S.'s case (failing to reject the null hypothesis that $\rho_1 = \rho_2 = 0$) may be an indication that in the Zero Lower Bound interest rate environment, the Federal Reserve System has relied heavily on the Quantitative Easing program, which marginalized the impact of the discount rate as a monetary policy instrument.

As to the symmetric/asymmetric lending rate adjustment, based on the strength of calculated F-statistics, the hypothesis that the intermediation premium is stationary with *symmetric* adjustments, expressed as $\rho_1 = \rho_2$, could not be rejected at any conventional level of significance for the economies of the Philippines, Singapore, Thailand, and Vietnam. The null hypothesis is rejected at the 5% level for Malaysia. For the U.S.'s case, this null hypothesis can only be rejected at the 10% level of significance in addition to the failure to reject the null hypothesis: $\rho_1 = \rho_2 = 0$. As pointed out by Nguyen (2019-a), these findings indicated that, after being pushed out of their long-run paths by economic shocks or countercyclical monetary policy measures, the intermediation premia in the Philippines, Singapore, Thailand, and Vietnam adjusted *symmetrically* around their thresholds, while this adjustment in the Malaysian economy is asymmetric. As aforementioned, failure to reject the null hypothesis: $\rho_1 = \rho_2$ and $|\rho_2| \leq |\rho_1|$ indicate that the U.S. commercial banks exhibited asymmetrically competitive.

The above findings indicated that lending institutions in the Philippines, Singapore, Thailand, and Vietnam exhibited competitive pricing behaviors; while commercial banks in Malaysia practiced predatory pricing in credit markets. Also, as aforementioned, failure to reject the null hypothesis: $\rho_1 = \rho_2$ and $|\rho_2| \leq |\rho_1|$ indicate that the U.S. commercial banks exhibited asymmetrically competitive pricing behavior. The findings of competitive pricing behaviors in the U.S., the Philippines, Singapore, and Thailand are interesting also significant contributions to the current literature since earlier studies using data before the subprime mortgage crisis found that they exhibited predatory pricing behaviors (Thompson, 2003; Sarno and Thornton, 2003; and Nguyen and Henney, 2013.) However, these findings are consistent with the behaviors reported for the U.S., the U.K. over the post-subprime mortgage crisis by Apergis, and Cooray (2015.)

An analysis of the estimation results of the asymmetric error correction model, equations (6) and (7), revealed that the empirical results for all six economies under consideration are without serial correlation and have good predicting power as indicated by the Ljung-Box statistics and the overall *F-statistics*, respectively. The calculated partial *F-statistics* in equations (6) and (7) suggest bidirectional Granger-

causality between the lending and Central Bank's policy-related/discount rates in the economies of the U.S., Malaysia, Singapore, Thailand, and Vietnam, while the Philippine lending rate is exogenous from the Central Bank's discount rate. These results, in turn, indicate that only the adjustments of the lending rates and Central Bank policy-related/discount rates in the U.S., Malaysia, Singapore, Thailand, and Vietnam affected each other's movements.

It is also interesting to note that not only the levels of lending rates, policy-related rates, the intermediation premia, structural break dates, and the symmetric/asymmetric adjustments of lending rates were different from one economy to the others; their adjustments' time lags are also quite different. The estimation results of equations (6) and (7), summarized in Table 5, indicated that the time lags (the estimated values for α_i) for commercial banks in these six economies to adjust their lending rates to the long-run paths were also quite diverse. Specifically, these time lags ranged somewhere between 20 months (Vietnamese and the U.S. banks) and 24 months (Singaporean, Thai, and Vietnamese banks); when the lending rate was pushed out of the long run time path by an economic shock or a countercyclical monetary policy measure. The time lags (the estimated values for γ_i) for commercial banks in these economies to respond to their Central Banks' monetary policies completely/discount were reported between 2 months (the Philippine banks) and 25 months (Thai banks), as compared to the corresponding figure of 12 months for the U.S. banks.

Additionally, the estimation results, described in Table 5, showed that these Central Banks considered their commercial banks' lending rates between 4 months (the Philippine Central Bank) and 25 months (Thai Central Bank) back (the estimated values for $\acute{\alpha}_i$) in formulating their countercyclical monetary policies, while the estimated figure for the U.S. Federal Reserve System was 20 months. As to the time lags (the estimated values for $\gamma`_i$) for the monetary policymakers in South and Southeast Asia to complete their cyclical monetary policies are between 18 months (Malaysian and the Philippine Central Banks) and 24 months (Singaporean and Thai Central Banks), while the corresponding U.S.'s figure was 6 months.

Finally, an analysis of the estimation results of the GARCH(r, s)-M model, reported in Table 6, revealed that the estimated values for *r* for these economies were between 1 (in Malaysia, Thailand, and Vietnam) and 3 (in the Philippines); while figure for the U.S. was 2. The estimation results also indicated that the estimated values for *s* for these economies were between 1 (in Singapore and Thailand) and 2 (in all other economies under consideration, including the U.S.'s). These empirical findings indicated presences of the GARCH (r, s)-M effects on the intermediation premia and their variances in all six economies. These empirical results suggested that the fluctuations in the premia and hence their variances from the one month affect the premia and the variances in the subsequent months in all economies under consideration.

CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

This investigation estimated the threshold autoregressive (TAR) model developed

by Enders and Siklos (2001) to study the behavior the commercial banks' lending rates, the Central Banks' policy/discount rates and the intermediation premia in the United States, in the economies of Malaysia, the Philippines, Singapore, Thailand, and Vietnam.

First, the estimation results of the Perron's (1997) endogenous unit-root-test function with the intercept, slope, and trend indicated that the relationship between the commercial lending rates and the Central Bank's policy-related/discount rates in each of the six countries under investigation experienced a structural break and their break dates are all different. Additionally, their degrees of statistical significance ranged from being marginal (Malaysia, Singapore, and Thailand) to highly (the U.S., the Philippines, and Vietnam) significant over the sample period.

Second, Breitung's nonparametric rank tests suggested that lending rates and policy-related/discount rates in the Philippines, Singapore, Thailand, and Vietnam are linear. However, the lending and discount rates in the U.S. are non-linearly co-integrated.

Third, the estimation results of the TAR model suggested only the intermediation premium in Malaysia and the U.S, adjusted ***asymmetrically***; while these spreads in the Philippines, Singapore, Thailand, and Vietnam adjusted ***symmetrically*** around their thresholds. These empirical findings indicated that only commercial banks in Malaysia and the U.S. reacted differently to Central Banks' expansionary than contractionary countercyclical monetary policies. Additionally, the results suggested that *commercial banks in* the U.S. (since $\rho_2| \leq | \rho_1|$), the Philippines, Singapore, Thailand, and Vietnam *exhibited competitive pricing behaviors; while lending institutions in Malaysia practiced predatory pricing behaviors and the U.S. discount rate became marginalized as a policy instrument over the sample period. As Nguyen (2019-a, p. 19) argued, "these findings are particularly interesting and significant contributions to the literature because* earlier studies using data before the subprime mortgage crisis found that commercial banks in most economies exhibited predatory pricing behaviors."

Fourth, as to Granger causality between the lending rates and the Central Bank's policy-related/discount rates, the empirical results revealed that the lending rates in the Philippines are exogenous from the Central Bank's discount rates and bidirectional Granger causalities between these rates in all other economies under consideration. These findings confirm the abilities of the monetary authorities in Malaysia, Singapore, Thailand, and Vietnam to use their countercyclical monetary policy instruments to achieve their macroeconomic objectives. One possible explanation for the seemingly contradicting empirical results that the discount rate has become marginalized and yet has the aforementioned bidirectional Granger causality is because Granger causality is only predictability rather than a normal cause and consequence and when conducting countercyclical monetary policy, the Fed uses all instruments not just only the discount window.

Last but not least, the empirical results for the GARCH(r,s)-M model suggest presences of the GARCH (r, s) effects on the intermediation premia and their variances in *all the economies under investigation*. As Nguyen (2019) recommended, "these findings recommend that monetary policymakers in these countries intervene to bring their economies to their long-term trends more frequently and by making small policy adjustments to minimize the conditional variance of the intermediation premium to minimize the magnitude of the lending rate over business cycles."

This study utilizes average interest rates that are macro-economic data from

different countries, which is a limitation, as the rate-setting behaviors of financial intermediaries may also depend on the characteristics of the cultures, depositors, temperaments of the management of these financial institutions, borrowers, and geographical areas of the economy. Thus, micro-based, firm level analyses using data on lending and policy-related/discount rates from these countries would be a useful complement to this study.

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TABLE 1: DESCRIPTIVE STATISTICS OF THE DATA SET

		Mean	Std. Dev.	Correlation[1]	Min.	Max.
	Lending Rate	3.5436	0.5657		3.2500	5.5000
The U.S.:	Discount Rate	1.0268	0.6019	0.9902	0.5000	3.0000
	Spread	2.5167	0.0894		2.2800	2.7500
	Lending Rate	4.7673	0.2255		4.4438	5.7700
Malaysia:	Policy-related Rate	2.9236	0.3776	-0.4919	2.0000	3.2500
	Spread	1.8438	0.5264		1.2358	3.4900
	Lending Rate	6.2922	1.0552		5.0980	10.2010
Philippines:	Discount Rate	3.9019	0.5441	0.2451	3.0596	6.2033
	Spread	2.3903	1.0621		- 0.4753	0.8385
	Lending Rate	5.3551	0.0322		5.2500	5.3800
Singapore:	Policy-related Rate	0.7927	0.6335	-0.7882	0.1700	2.6500
	Spread	4.5624	0.6592		2.6000	5.2100
	Lending Rate	4.7091	0.3813		4.1200	5.5652
Thailand:	Policy-related Rate	1.9463	0.6384	0.7989	1.2500	3.5000
	Spread	2.7629	0.4109		1.8182	3.9055
	Lending Rate	10.1101	3.3231		6.9400	18.0900
Vietnam:	Policy-related Rate	7.9979	2.5053	0.8913	6.2500	15.0000
	Spread	2.1122	1.5745		0.3150	6.3000

Notes: "1" the correlation between the lending rate and policy-related or discount rate series.

TABLE 2: RESULTS OF BREITUNG'S NONPARAMETRIC TEST

Statistics	$\Xi_T^* = T^{-3}\sum_{i=1}^{T}(r_i^R)^2/(\sigma_{\Delta r}^2)$	$T.R^2$
The U.S.	0.0001*: Rejects the null hypothesis	0.0000: Fail to rejects the null hypothesis
Malaysia	0.0387: Fail to rejects the null hypothesis	n/a
Philippines	0.0005*: Rejects the null hypothesis	32.0502*: Rejects the null hypothesis
Singapore	0.0009*: Rejects the null hypothesis	12.4999*: Rejects the null hypothesis
Thailand	0.0010*: Rejects the null hypothesis	37.7545*: Rejects the null hypothesis
Vietnam	0.0007*: Rejects the null hypothesis	16.2772*: Rejects the null hypothesis

Note: **"*"** indicates the significant level at the 1 percent. Simultaneously ejections of both null hypotheses indicate that the two time series data are nonlinearly co-integrated

TABLE 3: RESULTS OF PERRON'S ENDOGENOUS UNIT ROOT TEST

The United States-Monthly Data: 2009:01 - 2019:01

$$SP_t = 2.6863 + 0.1563\ DU - 0.0002\ t - 0.0019\ DT - 0.1328\ D(T_b) - 0.0741\ SP_{t-1} + \upsilon_t$$

(13.7322*) (4.2816*) (-0.0963) (-4.7952*) (-5.7530*) (-0.9671)

Number of augmented lags: $k = 12$ Break Date: November 2015 $t(\alpha = 1) = -14.0175$*

Malaysia-Monthly Data: 2009:01 - 2019:01

$$SP_t = 0.4611 - 0.3099\ DU - 0.0043\ t + 0.0055\ DT + 0.0986\ D(T_b) + 0.8294\ SP_{t-1} + \upsilon_t$$

(2.8194*) (-2.7057*) (-2.4275*) (2.7430*) (1.3537*) (16.3336)

Number of augmented lags: $k = 1$ Break Date: July 2013 $t(\alpha = 1) = -3.3594$***

The Philippines-Monthly Data: 2009:01 - 2019:01

$$SP_t = 0.9357 + 1.6730\ DU - 0.0072\ t - 0.0115\ DT - 2.2004\ D(T_b) + 0.7137\ SP_{t-1} + \upsilon_t$$

(2.9145*) (2.4765*) (-2.2698**) (-1.6074) (-6.2611*) (10.2804*)

Number of augmented lags: $k = 12$ Break Date: February 2016 $t(\alpha = 1) = -4.1240$*

Singapore-Monthly Data: 2009:01 - 2019:01

$$SP_t = 2.8521 + 1.7003\ DU - 0.0071\ t - 0.0178\ DT - 0.5912\ D(T_b) + 0.7611\ SP_{t-1} + \upsilon_t$$

(3.2818*) (1.6830) (2.3500*) (-3.0686*) (-2.1641**) (3.1085**)

Number of augmented lags: $k = 10$ Break Date: Feb. 2017 $t(\alpha = 1) = -3.3034$***

Thailand-Monthly Data: 2009:01 - 2019:01

$$SP_t = 0.1321 + 0.4420DU + 0.0010t - 0.0047DT - 0.1202D(T_b) + 0.9294SP_{t-1} + \upsilon_t$$

(2.3175*) (1.2242) (2.9031*) (-1.4312) (-1.2937) (43.3283*)

Number of augmented lags: $k = 4$ Break Date: April 2017 $t(\alpha = 1) = -3.2914$***

Vietnam-Monthly Data: 2009:01 - 2019:01

$$SP_t = 1.8242 - 3.2798DU - 0.0179t + 0.0342DT + 0.0290D(T_b) + 0.6504SP_{t-1} + \upsilon_t$$

(4.1984*) (-2.0680*) (-4.0048*) (2.2984*) (0.0603) (8.1881*)

Number of augmented lags: $k = 12$ Break Date: Dec. 2016 $t(\alpha = 1) = -4.4009$***

Notes: Critical values for t-statistics in parentheses. Critical values based on n = 100 sample for the break date (Perron, 1997). The t-statistics are in the parentheses. "*", "**" and "***" indicate significances at the 1 percent, the 5 percent, and the 10 percent levels, respectively.

TABLE 4: RESULTS FOR UNIT ROOT AND TESTS OF ASYMMETRY

The United States-Monthly Data: 2009:01 – 2019:01

ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$		sic
0.3962	-0.1757*	0.0541	$\phi_\mu = 1.8167$	-6.1908	-6.1908	-6.0499
$Q_{LB\,(10)} = 13.4720[0.1985]$			ln L = 203.8222	$F_{(5,112)} = 23.0339^*$	D.W. = 1.6459	

Malaysia-Monthly Data: 2009:01 – 2019:01

ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$	aic	sic
-0.0224	-0.4906*	-0.1796	$\phi_\mu = 4.0012^{**}$	$F = 6.5397^{**}$	-5.1925	-5.0516
$Q_{LB\,(10)} = 15.0210[0.1313]$			ln L = 144.9239	$F_{(5,112)} = 2.1520^{***}$	D.W. = 1.9749	

The Philippines-Monthly Data: 2009:01 – 2019:01

ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$	aic	sic
-0.5711*	-0.7072*	-0.4143	$\phi_\mu = 13.7818^*$	F = 0.3836	-1.6512	-1.5104
$Q_{LB\,(10)} = 5.3260[0.8684]$			ln L = -64.0094	$F_{(5,112)} = 8.5798^*$	D.W. = 1.9590	

Singapore-Monthly Data: 2009:01 – 2019:01

ρ_1	ρ_2	τ	$H_0: \rho_1 = \rho_2 = 0$	$H_0: \rho_1 = \rho_2$	aic	sic
-1.5052^{**}	-0.5601*	0.2550	$\phi_\mu = 9.4555^*$	F = 1.8121	-2.7717	-2.6309
$Q_{LB\,(10)} = 25.0420[0.0053]$			ln L = 2.0982	$F_{(5,336)} = 12.9115^*$	D.W. = 2.0095	

Thailand-Monthly Data: 2009:01 - 2019:01

ρ_1	ρ_2	τ	$H_0 : \rho_1 = \rho_2 = 0$	$H_0 : \rho_1 = \rho_2$	aic	sic
-0.0523***	-0.2923**	-0.4715	$\Phi_\mu = 3.7717^{**}$	F = 2.6183	-4.8907	-4.7499
$Q_{LB\,(10)}$ = 8.6330[0.5672]			ln L = 127.1182	$F_{(5,112)}$= 2.7306**	D.W. = 1.9284	

Vietnam-Monthly Data: 2009:01 - 2019:01

ρ_1	ρ_2	τ	$H_0 : \rho_1 = \rho_2 = 0$	$H_0 : \rho_1 = \rho_2$	aic	sic
-0.3532*	-0.1687**	0.2464	$\Phi_\mu = 6.9778^{*}$	F = 1.8479	-0.6689	-0.5880
$Q_{LB\,(10)}$ = 17.0930[0.0723]			ln L = -76.6651	$F_{(5,112)}$= 3.3998*	D.W. = 1.9070	

Notes: The null hypothesis of a unit root, $H_0 : \rho_1 = \rho_2 = 0$, uses the critical values from Enders and Siklos (2001). The p-values are in the squared brackets. " *", "**" and "***" indicate the 1 percent, the 5 percent, and the 10 percent levels of significance, respectively. Testing 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. $Q_{LB\,(10)}$ denotes the Ljung-Box Q-statistic with ten lags.

TABLE 5: ESTIMATION RESULTS FOR ASYMMETRIC ERROR -CORRECTION MODEL

The United States-Monthly Data: 2009:01 - 2019:01

Eq. (6)	**Independent Variable**			
	Overall $F_{(11,88)} = 44.2446[00000]$; *lnL= 250.2637* $Q_{(10)} = 4.2450[0.9356]$; $\bar{R}^2 = 0.8277$			
ΔLR_t	$\alpha_3 = \alpha_2 = \alpha_{19} = \alpha_{20} = 0$	$\gamma_1 = \gamma_4 = \gamma_6 = \gamma_7 = \gamma_{12} = 0$	ρ_1	ρ_2
	Partial $F_{11} = 13.2738[0.0000]$	*Partial* $F_{12} = 33.9892[0.0000]$	0.6558*	0.0628
Eq. (7)	**Independent Variable**			
	Overall $F_{(8,91)} = 37.1152[0.0000]$; *lnL= 194.3455* $Q_{(10)} = 2.7130[0.9874]$; $\bar{R}^2 = 0.7448$			
ΔPR_t	$\tilde{\alpha}_{12} = \tilde{\alpha}_{13} = \tilde{\alpha}_{14} = \tilde{\alpha}_{20} = 0$	$\tilde{\gamma}_3 = \tilde{\gamma}_6 = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 21.2938[0.0000]$	*Partial* $F_{22} = 10.6705[0.0000]$	1.2059*	0.1058

Malaysia-Monthly Data: 2009:01 - 2019:01

Eq. (6)	**Independent Variable**			
	Overall $F_{(10,85)} = 6.1520[0.0000]$; *lnL= 162.3092* $Q_{(10)} = 6.2170[0.7967]$; $\bar{R}^2 = 0.3516$			
ΔLR_t	$\alpha_8 = \alpha_{20} = 0$	$\gamma_1 = \gamma_7 = \gamma_{14} = \gamma_{16} = \gamma_{23} = \gamma_{24} = 0$	ρ_1	ρ_2
	Partial $F_{11} = 6.5655[0.0022]$	*Partial* $F_{12} = 7.7545[0.0000]$	0.0626***	-0.0395
Eq. (7)	**Independent Variable**			
	Overall $F_{(8,87)} = 4.1442[0.0003]$; *lnL= 164.4127* $Q_{(10)} = 3.2470[0.9750]$; $\bar{R}^2 = 0.2093$			
ΔPR_t	$\tilde{\alpha}_6 = \tilde{\alpha}_7 = \tilde{\alpha}_{13} = \tilde{\alpha}_{24} = 0$	$\tilde{\gamma}_{14} = \tilde{\gamma}_{18} = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 4.8683[0.0014]$	*Partial* $F_{22} = 7.3591[0.0011]$	0.0837**	-0.0387

Philippines-Monthly Data: 2009:01 - 2019:01

	Independent Variable			
Eq. (6)	*Overall* $F_{(9,89)} = 10.7341[0.0000]$; *lnL= 6.5630* $Q_{(10)} = 10.0430[0.4367]$; $\bar{R}^2 = 0.4720$			
ΔLR_t	$\alpha_1 = \alpha_3 = \alpha_{10} = \alpha_{12} = \alpha_{21} = 0$	$\gamma_1 = \gamma_2 = 0$	ρ_1	ρ_2
	Partial $F_{11} = 15.6785[0.0000]$	*Partial* $F_{12} = 0.4137[0.6625]$	-0.0857	-0.0146
	Independent Variables			
Eq. (7)	*Overall* $F_{(9,92)} = 8.6250[0.0000]$; *lnL= 27.9806* $Q_{(10)} = 6.2780[0.7914]$; $\bar{R}^2 = 0.4046$			
ΔPR_t	$\tilde{\alpha}_1 = \tilde{\alpha}_2 = \tilde{\alpha}_3 = \tilde{\alpha}_4 = 0$	$\tilde{\gamma}_1 = \tilde{\gamma}_{16} = \tilde{\gamma}_{18} = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 4.0341[0.0046]$	*Partial* $F_{22} = 5.7953[0.0011]$	0.2071**	0.3296*

Singapore-Monthly Data: 2009:01 - 2019:01

	Independent Variable			
Eq. (6)	*Overall* $F_{(19,76)} = 19.5842[0.0000]$; *lnL= 371.1700* $Q_{(10)} = 6.6190[0.7609]$; $\bar{R}^2 = 0.7880$			
ΔLR_t	$\alpha_1 = \alpha_9 = \alpha_{10} = \alpha_{12} = \alpha_{19} = \alpha_{24} = 0$	$\gamma_1 = \gamma_3 = \gamma_7 = \gamma_{10} = \gamma_{15} = \gamma_{16} = \gamma_{17} = \gamma_{18} = \gamma_{19} = \gamma_{20} = \gamma_{22} = 0$	ρ_1	ρ_2
	Partial $F_{11} = 24.7689[0.0000]$	*Partial* $F_{12} = 10.9965[0.0000]$	-0.0011	-0.0026
	Independent Variables			
Eq. (7)	*Overall* $F_{(15,80)} = 12.3840[0.0000]$; *lnL= 27.7343* $Q_{(10)} = 8.4810[0.5819]$; $\bar{R}^2 = 0.6425$			
ΔPR_t	$\tilde{\alpha}_2 = \tilde{\alpha}_5 = \tilde{\alpha}_6 = \tilde{\alpha}_{11} = \tilde{\alpha}_{12} = \tilde{\alpha}_{17} = \tilde{\alpha}_{22} = 0$	$\tilde{\gamma}_1 = \tilde{\gamma}_2 = \tilde{\gamma}_3 = \tilde{\gamma}_{13} = \tilde{\gamma}_{17} = \tilde{\gamma}_{24} = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 10.7040[0.0000]$	*Partial* $F_{22} = 8.0694[0.0000]$	0.1875	0.2747**

Thailand-Monthly Data: 2009:01 - 2019:01

Eq. (6)	**Independent Variable** *Overall* $F_{(10,84)} = 8.4573[0.0000]$; *lnL= 180.6651* $Q_{(10)} = 7.4100[0.6821]$; $\bar{R}^2 = 0.4424$			
ΔLR_t	$\alpha_9 = \alpha_{13} = \alpha_{15} = \alpha_{20} = \alpha_{24} = 0$	$\gamma_1 = \gamma_5 = \gamma_{25} = 0$	ρ_1	ρ_2
	Partial $F_{11} = 8.4137[0.0000]$	*Partial* $F_{12} = 5.1549[0.0025]$	-0.0591*	-0.0999*
Eq. (7)	**Independent Variable** *Overall* $F_{(12,82)} = 5.7846[0.0000]$; *lnL= 117.1278* $Q_{(10)} = 3.2360[0.1982]$; $\bar{R}^2 = 0.3792$			
ΔPR_t	$\tilde{\alpha}_5 = \tilde{\alpha}_{10} = \tilde{\alpha}_{21} = \tilde{\alpha}_{24} = \tilde{\alpha}_{25} = 0$	$\tilde{\gamma}_5 = \tilde{\gamma}_{13} = \tilde{\gamma}_{15} = \tilde{\gamma}_{22} = \tilde{\gamma}_{24} = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 12.1131[0.0000]$	*Partial* $F_{22} = 5.5181[0.0000]$	-0.0109	0.0202

Vietnam-Monthly Data: 2009:01 - 2019:01

Eq. (6)	**Independent Variable** *Overall* $F_{(18,77)} = 8.8072[0.0000]$; *lnL= 10.0945* $Q_{(10)} = 26.4410[0.0032]$; $\bar{R}^2 = 0.5967$			
ΔLR_t	$\alpha_2 = \alpha_4 = \alpha_6 = \alpha_7 = \alpha_{12}$ $= \alpha_{13} = \alpha_{17} = \alpha_{19} = \alpha_{24} = 0$	$\gamma_6 = \gamma_7 = \gamma_8 = \gamma_{10}$ $= \gamma_{15} = \gamma_{16} = \gamma_{17} = 0$	ρ_1	ρ_2
	Partial $F_{11} = 12.6132[0.0000]$	*Partial* $F_{12} = 14.2450[0.0000]$	0.0256	-0.0309
Eq. (7)	**Independent Variable** *Overall* $F_{(22,73)} = 16.6487[0.0000]$; *lnL= 35.2338* $Q_{(10)} = 11.7360[0.3031]$; $\bar{R}^2 = 0.7837$			
ΔPR_t	$\tilde{\alpha}_1 = \tilde{\alpha}_6 = \tilde{\alpha}_{10} = \tilde{\alpha}_{11} = \tilde{\alpha}_{14} = \tilde{\alpha}_{15}$ $= \tilde{\alpha}_{21} = \tilde{\alpha}_{22} = \tilde{\alpha}_{23} = \tilde{\alpha}_{24} = 0$	$\tilde{\gamma}_1 = \tilde{\gamma}_2 = \tilde{\gamma}_4 = \tilde{\gamma}_{11} = \tilde{\gamma}_{12} = \tilde{\gamma}_{13}$ $= \tilde{\gamma}_{16} = \tilde{\gamma}_{18} = \tilde{\gamma}_{20} = \tilde{\gamma}_{22} = 0$	$\tilde{\rho}_1$	$\tilde{\rho}_2$
	Partial $F_{21} = 10.2735[0.0000]$	*Partial* $F_{22} = 9.8181[0.0000]$	0.2389*	0.0210

Notes: *Partial F-statistics for lagged values of changes in the lending rate and policy-related rate, respectively, are reported under the specified null hypotheses. The p-values are in the squared brackets.* $Q_{(10)}$ *is the Ljung-Box Q-statistic to test for serial correlation up to 10 lags. "*," "**", and "***" indicate the 1 percent, the 5 percent, and the 10 percent levels of significance, respectively.*

TABLE 6: ESTIMATION RESULTS FOR GARCH(s,r)-M MODEL

U.S. Data: 2009:01 - 2019:01- GARCH (2, 2)-M

$$SP_t = 0.7537 + 0.7700\, SP_{t-1} + 0.0249\, Ln(\omega_t^2) + \varepsilon_t$$

(6,180.448*) (3,220.400*) (71.3068*)

$$\omega_t^2 = 0.0004 + 0.1079\, \varepsilon_{t-1}^2 + 0.8247\, \varepsilon_{t-2}^2 + 0.5383\, \omega_{t-1}^2 - 0.3753\, \omega_{t-2}^2$$

(5.7865*) (2.4910**) (10.0872*) (22.5993*) (-19.4141*)

Notes: *Akaike info criterion=-3.5287; Schwarz criterion =-3.3429; Hannan-Quinn Criterion=-3.4533; Log likelihood = 219.7235; Durbin-Watson Statistic = 1.7793.* $\bar{R}^2$ *= 0.3608.*

Malaysian Data: 2009:01 - 2019:01- GARCH (1, 2)-M

$$SP_t = 0.9475\, SP_{t-1} - 0.0166\, Log(\omega_t^2) + \varepsilon_t$$

(69.7248*) (-3.6363*)

$$\omega_t^2 = 0.0006 - 0.0579\, \varepsilon_{t-1}^2 + 0.0146\, \varepsilon_{t-2}^2 + 1.6082\, \omega_{t-1}^2 - 0.6769\, \omega_{t-2}^2$$

(10.1171*) (-5.3149*) (1.5474) (4,905.844*) (-3,790.276*)

Notes: *Akaike info criterion=-2.4414; Schwarz criterion =-2.2788; Hannan-Quinn Criterion=-2.3754; Log likelihood = 153.4855; Durbin-Watson Statistic = 2.3767.* $\bar{R}^2$ *= 0.9762.*

Philippine Data: 2009:01 - 2019:01- GARCH (3, 2)-M

$$SP_t = -0.0946 + 1.0727\, SP_{t-1} + 0.8102\, (\omega_t^2) + \varepsilon_t$$

(-3.2456*) (35.0765*) (1.9730**)

$$\omega_t^2 = 0.0171 + 0.6210\, \varepsilon_{t-1}^2 - 0.3880\, \varepsilon_{t-2}^2 + 0.4230\, \varepsilon_{t-3}^2 + 0.6033\, \omega_{t-1}^2 - 0.6564\, \omega_{t-2}^2$$

(3.8177*) (3.8772*) (-2.1540**) (0.4230*) (3.1618*) (-4.7529*)

Notes: *Akaike info criterion= -0.6505; Schwarz criterion =-0.4416; Hannan-Quinn Criterion=-0.5656; Log likelihood = 48.0315; Durbin-Watson Statistic = 1.5588.* $\bar{R}^2$ *= 0.7622.*

Singaporean Data: 2009:01 - 2019:01- GARCH (2, 1)-M

$$SP_t = -0.0072 + 1.0249\, SP_{t-1} + 0.0072\, Ln(\omega_t^2) + \varepsilon_t$$

(-7.4350*) (51,315.55*) (4.6100*)

$$\omega_t^2 = 0.0001 + 3.9207\, \varepsilon_{t-1}^2 - 1.6666\, \varepsilon_{t-2}^2 + 0.4677\, \omega_{t-1}^2$$

(1.6734***) (5.7869*) (-2.9822*) (3.7953*)

Notes: *Akaike info criterion= -0.9070; Schwarz criterion =-0.7444; Hannan-Quinn Criterion=0.8410; Log likelihood = 61.4211; Durbin-Watson Statistic = 2.7450.* $\bar{R}^2$ *= 0.7847.*

Thai Data: 2009:01 - 2019:01- GARCH (1, 1)-M

$$SP_t = 0.1426 + 0.9700\ SP_{t-1} + 0.0134\ Ln(\omega_t^2) + \varepsilon_t$$

(4.6101*) (1,106.366*) (2.4654*)

$$\omega_t^2 = 0.0028 - 0.1097\ \varepsilon_{t-1}^2 + 0.7426\ \omega_{t-1}^2$$

(8.8667*) (-8.0505*) (24.8753)

Notes: *Akaike info criterion=-2.0163; Schwarz criterion =-1.8769; Hannan-Quinn Criterion=-1.9597; Log likelihood = 126.9781; Durbin-Watson Statistic = 1.9105.* $\bar{R}^2$ *= 0.9470.*

Vietnamese Data: 2009:01 - 2019:01- GARCH (1, 2)-M

$$SP_t = -0.0207 + 1.0865\ SP_{t-1} - 0.0902\ (\omega_t^2) + \varepsilon_t$$

(-0.7992) (90.4262*) (-2.0698**)

$$\omega_t^2 = 0.0014 + 1.8715\ \varepsilon_{t-1}^2 - 0.0145\ \omega_{t-1}^2 + 0.2205\ \omega_{t-2}^2$$

(0.5590) (4.6427*) (-0.7504) (4.1951*)

Notes: *Akaike info criterion=0.8074; Schwarz criterion =0.7008; Hannan-Quinn Criterion=0.8734; Log likelihood = -41.4439; Durbin-Watson Statistic = 2.0724.* $\bar{R}^2$ *= 0.8851.*

Notes: The z-statistics are in the parentheses. *"*", "*" and "***" indicate the 1 percent, the 5 percent and the 10 percent levels of significance, respectively.*