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Examining the Threshold Effect of Exchange Rate Changes on Monetary Policy Reaction Function of ASEAN-5: A Panel Threshold Approach

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Abstract

In small open economies, the connection between exchange rate and monetary policy function is well-recognised either in the form of theoretical concept or empirical literature. Unlike others, this paper revisits the study by utilising the panel threshold approach of Hansen (1999) to investigate how the monetary policy function of ASEAN-5 responding to exchange rate changes in two different policy regimes, pre-crisis (1980Q1-1996Q4) and post-crisis (1999Q1-2015Q4). The results exhibit asymmetric effect of exchange rate changes on monetary policy function in both sub-periods. The double threshold effect in the pre-crisis, showing exchange rate changes influencing the policy function in a limited threshold value. Conversely, in the post-crisis, the single threshold effect illustrating exchange rate changes having stronger effect on the policy function in various magnitudes at all threshold values. Although claiming the execution of flexible exchange rate system aftermath crisis, there exist policymakers' intervention in stabilising the exchange rate changes with respect to 'fear of floating' behaviour in ASEAN-5. Lastly, in each sub-period, the threshold effect of exchange rate changes relative to inflation variation is highly significant while trivial to output gap in triggering the policy function. This witnessing, by and large, the ultimate goal of ASEAN-5 is to achieve price stability.

Keywords: Panel threshold; Asymmetric effect; Fear of floating.

1. Introduction

In a small and open emerging country, the vulnerability of such economy towards external shocks especially to exchange rate changes is one of the common characteristics (Mohanty and Klau, 2004). This is for two crucial reasons. Firstly, from the liability dollarization effect on the balance sheet, as most emerging countries possess their debts in foreign currency but the assets are in local currency. Secondly, from the price levels effect, where pass-through from the exchange rate changes into inflation is much greater in emerging economies (Devereux and Lane, 2006). On the surface, these are the leading factors causing most policymakers to intervene in restricting their exchange rate changes even officially declaring the execution of flexible exchange rate system. This is theoretically termed as 'fear of floating' behaviour (Calvo and Reinhart, 2002) which can be noticed empirically when the monetary policy reaction function is alternatively reacting to exchange rate changes instead of focusing on other macroeconomic variables (Mohanty and Klau, 2004). Hence, it is interesting to investigate the response of monetary policy reaction function based on exchange rate changes in a small open economy situation.

Therefore, in the present study, we focused on small open economy of ASEAN-5 by observing the behaviour of monetary policy reaction function from the effect of exchange rate changes. For this, the panel threshold method of Hansen (1999) is executed to compare the results between two policy regimes, the pre- and post-crisis periods. Since the majority of these countries have switched from a rigid (fixed) exchange rate to a flexible (floating) exchange rate regime accompanied with inflation targeting policy aftermath financial crisis of 1997-98. We further extended the studies by capturing the asymmetric effects (if any) of the exchange rate changes (external shock) on monetary policy reaction function. Then, we determine the threshold level of exchange rate changes which trigger significant reaction in the policy function. Finally, we also seek to compare the threshold effect of exchange rate changes relative to inflation variation and the output gap in stimulating the monetary policy reaction function.

This study deviates from past research in two aspects. Firstly, we use the panel threshold approach of Hansen (1999), which seems not have applied in this area of studies. Secondly, the existing research to examine the asymmetric effect of exchange rate changes on monetary policy reaction function in ASEAN-5 are with whole sample data-set. Conversely, in this research, we focus on two-panel data-sets by comparing the asymmetric effect of exchange rate changes on policy function between pre- and post-crisis periods as of the major shift in the monetary policy regime thereafter the financial crisis (1997-98).

By fixing the threshold variable as exchange rate changes *(DLREER)*, the results from pre- and post-crisis periods proving the influences of exchange rate changes on monetary policy reaction function. In a deeper manner, through observing the unequal values of the coefficient in each threshold value. We also rectify the existence of asymmetric effect of exchange rate changes on monetary policy function in both policy regimes. In the case of pre-crisis, the double threshold effect displays that exchange rate changes only impact the policy function in a restricted

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interval (-0.0070 < *DLREER* ≤ 0.0126). This reflects the fixed exchange rate system of ASEAN-5. In contrast, using a single threshold affect the exchange rate changes have multiple impacts on the monetary policy in the post-crisis period. Where, when *DLREER* ≤ -0.0231, policy rate is reduced to cater appreciation of local currency. While, when *DLREER* > -0.0231, policy rate is increased to accommodate depreciation of the local currency. Next, observing the threshold effect of exchange rate changes in two different angles either relative to inflation variation or relative to output gap in triggering the monetary policy function. The results in both regimes illustrating that the policy function is strongly reactive to inflation variation while not all to the output gap.

The remainder of this paper proceeds as follows. Section two presents the literature review. Section three is about data, model, and method. Section four interprets the results and findings. Finally, section five concludes.

2. Literature Review

2.1. Reflection – Monetary policy of ASEAN-5

Prior to Asian financial crisis 1997-98, ASEAN-5 was well-known with continuous outperforming economic growth which was motivated by a market-friendly ideology and outward-oriented liberalised foreign policies (Muniandy and Uning, 2006);(Quan, 1998). The financial crisis attack in July 1997, depreciated all ASEAN-5 currencies which started from Thailand and later extended to Malaysia, Indonesia, Philippines as well as Singapore (Mohammad, 2006). In such the maximum level of depreciation was felt by Indonesian rupiah and the minimum depreciation was on Singaporean dollar (Lloyd and Smith, 2004).

In the wake of the crisis, several transformations, especially in the monetary policy setup and financial reformation, remarkably implemented. In order to achieve price stability and sustainable output growth, adoption of inflation targeting monetary policy framework became essential (Chang and Jong, 2002). In such Indonesia and Thailand adopted inflation targeting policy in January and April 2000 respectively, while the Philippines adopted inflation targeting in January 2002 (Ito, 2010). Concurrently, all the ASEAN-5 countries except Malaysia (MYR-USD pegged) shifted towards greater flexibility in their exchange rate system (Muniandy and Uning, 2006). Besides that, the ASEAN-5 also experienced greater accumulation of foreign reserves. This coincides with persistent current account surplus in the majority of these countries (Eliza *et al.*, 2008).

Although exchange rate system was not the sole factor that instigated the financial turmoil in ASEAN-5. Yet, considering exchange rate variation in policymakers' decision making is still being crucial as this variable accounts in determining the economic performance of ASEAN-5 (Muniandy and Uning, 2006); (Rana, 1998).

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2.2. Empirical Results – Effect of Exchange Rate Changes on Monetary Policy Reaction Function

Most empirical studies supervised on small open economies recorded significant influences of exchange rate on the monetary policy reaction function. To address a few, studies conducted by Mohanty and Klau (2004) on thirteen emerging market economies affirmed that the exchange rate changes affect most of the monetary policy reaction functions. Sek (2009) on studies in three East-Asian countries, confirmed tiny response in the monetary policy functions pertaining to exchange rate changes. Inoue and Hamori (2009) affirmed that monetary policy reaction of India is influenced by exchange rate changes. In view of ASEAN-3 countries, Gan and Kwek (2010) evidently defined that exchange rate changes have significant impact on the policy reaction functions. Likewise, in Thailand, (Lueangwilai, 2012) detected the policy reaction function was reactive to exchange rate changes. Meanwhile, in Indonesia, Adenan (2014) identified that the policy reaction function is influenced by exchange rate changes. By the same token, Khalid *et al.* (2014) validated the importance of exchange rate changes in the policy reaction function of Malaysia.

In particular, focusing on ASEAN-5, (Manogaran and Sek, 2016) applied two different methods, the nonlinear autoregressive distributed lag (NARDL) using yearly time-series data coupled with a pooled mean group (PMG) using yearly panel data. On another study, (Manogaran and Sek, 2017) employed the NARDL method to estimate the quarterly time-series data for individual ASEAN-5 countries. To sum up, the outcome of both these studies revealed the influences of exchange rate changes on the monetary policy function. Another key point of these two studies is the presence of asymmetric effect of exchange rate changes on the policy reaction function.

3. Data, Model and Method

In this study, we apply the threshold regression (with fixed-effects) model to estimate the panel data consist of five countries namely Indonesia, Malaysia, Philippines, Thailand and Singapore which is so-called the ASEAN-5. The panel threshold regression method is utilised to investigate how influential exchange rate (external shock) can affect the monetary policy reaction function in pre-(1980Q1-1996Q4) and post-(1999Q1-2015Q4) crisis periods. As our intention is to compare monetary policy between two policy regimes (pre- and post-crisis). Thus, the financial crisis term (1997-98) is excluded in our analysis as to avoid any biasness in the results.

This method is designed for a balanced panel, hence we use 320 and 335 quarterly balanced datasets extracted from Datastream for the pre- and post-crisis analysis respectively. The main variables are namely, central bank interest rate (INTR) in percentage, consumer price index (CPI) in index form, gross domestic product (GDP) in US dollar and real exchange rate (REER) per US dollar. All the variables involved are converted to natural logarithm, except the interest rates which are in percentages form with the purpose to streamline the data. Further, CPI inflation (CINF) is obtained using log CPI (LCPI) deviates from its lagged 4 (proxy for annual rate). On the other hand,

output gap (GAP) is constructed as log gross domestic product (LGDP) deviates from its trend obtained via the Hodrick-Prescott filter (Hodrick and Prescott, 1997), which typically used by many researchers in generating a smooth estimate of the long-term trend component in GDP series and recognised as potential GDP. Then, the exchange rate changes (DLREER) is the first-differenced of log REER.

In order, to consider threshold effect of exchange rate changes (exogenous variable) relative to inflation variation and output gap (regressors) on monetary policy reaction function (dependent variable), we estimate the policy reaction function by utilising the panel static threshold model developed by Hansen (1999). In such the modeltakes the following form for a single threshold model (equation **(2)**) and double threshold model (equation **(3)**:

$$INTR_{it} = \alpha_i + (\beta_1 CINF_{it} + \lambda_1 GDP_{it}) I(DLREER_{it} \le \gamma) + (\beta_2 CINF_{it} + \lambda_2 GDP_{it}) I(DLREER_{it} \le \gamma) + \varepsilon_{it} \quad \textbf{(2)}$$

$$INTR_{it} = \alpha_i + (\beta_1 CINF_{it} + \lambda_1 GDP_{it}) I(DLREER_{it} \le \gamma_1) + (\beta_2 CINF_{it} + \lambda_2 GDP_{it}) I(\gamma_1 < DLREER_{it} \le \gamma_2) + (\beta_3 CINF_{it} + \lambda_3 GDP_{it}) I(\gamma_2 < DLREER_{it}) + \varepsilon_{it} \quad \textbf{(3)}$$

Where, β and λ indicate the regression slope of *CINF* and *GDP* respectively, γ indicates the threshold values, ε_{it} indicates the error term, $i : 1 \le i \le n$ indicates the cross-section and $t : 1 \le t \le T$ indicates the time. The assumption holds that the threshold variable (*DLREER*) is not time-invariant, error term (ε_{it}) to be independent and identically distributed *(iid)* with zero mean and finite variance. In equation **(1)** the observations are divided into two regimes depending on whether the threshold variable (*DLREER*) is smaller or larger than the threshold value, γ. While in equation **(2)** the thresholds are ordered so that $\gamma_1 < \gamma_2$ and there are either no thresholds, one threshold, or two thresholds.

Prior to the estimations, panel unit-root tests are performed to check the stationary of each variable. Then, to decide a well-suited model, the significance of threshold effect is observed with a null hypothesis of $H_0 : \beta_1 = \beta_2$ and $H_0 : \lambda_1 = \lambda_2$ referring equation **(2)** while $H_0 : \beta_1 = \beta_2 = \beta_3$ and $H_0 : \lambda_1 = \lambda_2 = \lambda_3$ based on equation **(3)**. In such the rejection of the first or the second null hypothesis implies the existence of single threshold effect or double threshold effect respectively.

4. Results and Findings

Firstly, a battery of panel unit-root tests are employed namely the Levin, Lin & Chu test (Levin *et al.*, 2002), (Breitung, 1999), Im, Pesaran and Shin test (Im *et al.*, 2003) and Fisher-type test using ADF and PP (Choi, 2001); (Hadri, 2000); (Maddala and Wu, 1999). All these tests are with individual intercept and trend specification as well as automatic lag length selection using Schwarz Info Criterion (SIC) to measure the unit-root properties of the datasets. The results of unit-root tests for both sub-periods and whole sample period, rectify all variables (INTR, CINF, GDP, DLREER) are stationary at levels or I(0). As to limit space our results are omitted here.

Thence, we move on using these stationary variables to estimate the monetary policy function up to triple threshold model with specification using a bootstrap of 300, grid of 400 and trim of 0.1. This bootstrap procedure is simple to compute and beneficial in assessing the variability of the estimated p-value in order to construct the related intervals with the presence of boundary issues. Hence, by comparing the three breaks in each pre- and post-crisis periods (refer Table 1) suggesting a different number of threshold for different sub-periods (refer Table 1). Where in the pre-crisis, the single threshold effect's *p*-value (0.8600) for *F*-statistics (0.48) is insignificant and H_0 cannot be rejected. Consequently, the double threshold effect's *p*-value (0.0033) for *F*-statistics (12.27) showing a strong rejection of H_0. This affirming the double threshold model of estimation is appropriate. Turning to the post-crisis, the results of *p*-value (0.0000) for *F*-statistics (19.34) is strongly significant, hence the single threshold model is adequate.

Table-1. Threshold Effect Tests

Test	Pre-crisis	Post-crisis
Single Threshold		
***F*-stat**	0.48	19.34***
Bootstrap *p*-value	0.8600	0.0000
(10%, 5%, 1% critical values)	(6.28, 7.72, 14.96)	(5.25, 6.69, 8.64)
Double Threshold		
***F*-stat**	12.27***	1.99
Bootstrap *p*-value	0.0033	0.1633
(10%, 5%, 1% critical values)	(6.03, 7.06, 9.49)	(2.26, 3.18, 6.54)
Triple Threshold		
***F*-stat**	1.65	2.61
Bootstrap *p*-value	0.9300	0.5667
(10%, 5%, 1% critical values)	(10.63, 13.21, 16.26)	(6.36, 8.19, 10.33)

Note: *** denotes the statistical significance level at 1%.

Under the above circumstances, Table 2 reports the results of estimations for pre- and post-crisis with a double threshold and single threshold respectively. The varying values of coefficients in each threshold breaks are validating the asymmetric effect of changes in the exchange rate *(DLREER)* on monetary policy reaction function *(INTR)* in both sub-periods.

By observing the results of pre-crisis, the double threshold is showing the influences of *DLREER* on *INTR* in three threshold breaks (*DLREER* ≤ -0.0070, -0.0070 < *DLREER* ≤ 0.0126 and *DLREER* > 0.0146). However, the influences of changes in exchange rate towards monetary policy reaction function can only be noticed when the threshold value is -0.0070 < *DLREER* ≤ 0.0126, where the coefficient of *DLREER* is with a larger value and stronger adverse effect on *INTR*. This means appreciation of ASEAN-5 currencies leads the policymakers to reduce the policy rate at this threshold value. Apparently, this situation arises because most of these countries were implementing a fixed exchange rate system in the pre-crisis period. So, under a more rigid exchange rate system, the monetary policy is only allowed to react in a narrow interval when the exchange rate appreciation is between -0.7% and 1.26%.

On the other hand, in the post-crisis, the single threshold model illustrates the threshold in two different breaks namely *DLREER* ≤ -0.0231 and *DLREER* > -0.0231. In this sub-period, the exchange rate changes trigger strong significant reaction in monetary policy function in all threshold breaks but with different magnitudes. This is a situation when the *DLREER* threshold value is on the lower side (*DLREER* ≤ -0.0231) the policymakers are responding towards appreciation of local currency through the implementation of a loosening monetary policy system by reducing the policy rate in order to boost the economic growth. In comparison, when the *DLREER* threshold value is on the higher side (*DLREER* > -0.0231) or depreciation rate is larger than 2.31%, the policymakers tend to react towards depreciation of local currency by increasing the policy rate through implementation of a tightening monetary policy as a measure to control the increase in price level or inflation. The inconsistent movements in the policy function based on exchange rate changes at different thresholds clearly demonstrating policymakers' actions to limit the exchange rate changes. Although, aftermath financial crisis, the majority of the ASEAN-5 countries adopted inflation targeting policy accompanied by free-floating exchange rate system. Yet, our results evidently proving the intervention of policymakers to restrain the fully-flexible exchange rate system. Hence, confirming the existence of 'fear of floating' behaviour in ASEAN-5.

Table-2. Threshold Estimations (Dependent Variable: *INTR*, Transparency Index: *DLREER*)

Pre-crisis		**Post-crisis**	
Variable	**Coefficient**	**Variable**	**Coefficient**
CINF	50.3555***	***CINF***	35.4459***
GAP	0.7584	***GAP***	-2.2546
Threshold: *DLREER*		**Threshold: *DLREER***	
Threshold estimate	0.0146	**Threshold estimate**	-0.0231
95% confidence interval	(0.0140, 0.0149)	**95% confidence interval**	(-0.0232, -0.0230)
***DLREER* ≤ -0.0070**	-5.9556	***DLREER* ≤ -0.0231**	-20.9393***
-0.0070 < *DLREER* ≤ 0.0126	-215.9636***	***DLREER* > -0.0231**	17.8736***
***DLREER* > 0.0146**	-12.2960	**C**	2.9002***
C	7.5044***	**No. of observations**	335
No. of observations	320	**No. of groups**	5
No. of groups	5		

Note: **** denotes the statistical significance level at 1%.*

Besides that, we can ascertain that there is a strong direct response from inflation variation *(CINF)* towards policy function *(INTR)* in both sub-periods when exchange rate changes being the threshold variable. Such strong reaction of policy function on inflation variation proving that achieving low inflation rate is the main policy target of ASEAN-5. Where the policymakers tend to increase the policy rate in response to close the positive inflation gap with respect to achieving the targeted low inflation rate. On the contrary, there is no effect of the output gap *(GAP)* towards policy function *(INTR)* in any of the regimes relative to exchange rate changes. At these threshold breaks, the output gap is not a matter of the policymakers, probably because the economy of ASEAN-5 has achieved sustainable output growth as per targeted level throughout the sample periods of our analysis.

5. Conclusion

By using the panel threshold approach suggested by Hansen (1999) in either pre-and post-crisis case, we explored the existence of asymmetric effects of exchange rate changes (exogenous variable) on monetary policy reaction function of ASEAN-5.

In such, before the crisis, a double threshold effect captures only one limited threshold level of exchange rate changes that trigger significant reaction in the policy function. Alternatively, aftermath crisis, the single threshold effect illustrating all threshold level of exchange rate changes actively responding in diversified magnitudes to the policy function. Hence, we may conclude that external shock (exchange rate changes) plays a very crucial role in the monetary policy reaction function of ASEAN-5 especially aftermath crisis. Where most of these countries adopted

inflation targeting framework co-exist with flexible exchange rate system. Despite, declaring themselves as free-floaters, the monetary policy reaction function is still behaving asymmetrically towards exchange rate changes. This implies that the policymakers are accommodating the policy function to stabilise the exchange rate changes which obviously remarking the presence of 'fear of floating' behaviour among the policymakers of ASEAN-5.

In the final analysis, comparing the threshold effect of exchange rate changes relative to inflation variation and the output gap in triggering the monetary policy reaction function. In both policy regimes, the inflation variation has stronger positive influences on monetary policy function, whereas output gap is negligible. Therefore, we may summarise that the utmost objective of policymakers in ASEAN-5 is to achieve price stability through inflation targeting policy aftermath crisis.

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Reference

Adenan, M. (2014). Reaction function model of monetary policy under inflation targeting framework in Indonesia. *International Review of Management and Business Research*, 3: 211-21.

Breitung, J. (1999). The local power of some unit root tests for panel data. Discussion papers, interdisciplinary research project 373. *Quantification and Simulation of Economic Processes*, 69: 1-40.

Calvo, G. A. and Reinhart, C. M. (2002). Fear of floating. *The Quarterly Journal of Economics*, 117: 379-408.

Chang, J. K. and Jong, W. L. (2002). Exchange rate regime and monetary policy independence in East Asia. KIEP working paper. 11: 1-37.

Choi, I. (2001). Unit root tests for panel data. *Journal of International Money and Finance*, 20: 249-72.

Devereux, M. B. and Lane, P. R. (2006). Exchange rates and monetary policy in emerging market economies. *The Economic Journal*, 116: 478-506.

Eliza, N., Law, S.-H. and Lee, C. (2008). Demand for international reserves in ASEAN-5 economies. MPRA Paper. 11735, 1-12.

Gan, P. T. and Kwek, K. T. (2010). The monetary policy reaction function: Evidence from ASEAN-3. *Asian Academy of Management Journal of Accounting and Finance*, 6: 1-24.

Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. *Econometrics Journal*, 3: 148-61.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels, Estimation, testing, and inference. *Journal of Econometrics*, 93: 345-68.

Hodrick, R. J. and Prescott, E. C. (1997). Postwar U.S. business cycles, An empirical investigation. *Journal of Money, Credit and Banking*, 29: 1-16.

Im, K. S., Pesaran, M. H. and Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115: 53-74.

Inoue, T. and Hamori, S. (2009). An empirical analysis of the monetary policy reaction function in India. *IDE Discussion Paper, 200*: 1-43.

Ito, T. (2010). Monetary policy and financial stability, Is inflation targeting passé? *ADB Economics Working Paper Series*, 206: 1-18.

Khalid, N., Karim, Z. A. and Yussof, I. (2014). Testing a non linear model of monetary policy reaction function, Evidence from Malaysia. *Jurnal Ekonomi Malaysia*, 48: 19-27.

Levin, A., Lin, C. F. and Chu, C. S. J. (2002). Unit root tests in panel data, Asymptotic and finite-sample properties. *Journal of Econometrics*, 108: 1-24.

Lloyd, P. and Smith, P. (2004). Global economic challenges to ASEAN integration and competitiveness: A prospective look. Paper presented at the REPSF Project 03/006a.

Lueangwilai, K. (2012). Monetary policy rules and exchange rate uncertainty, A structural investigation in Thailand. *Procedia Economics and Finance*, 2: 325-34.

Maddala, G. S. and Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple tes. *Oxford Bulletin of Economics and Statistics*, 61: 631-52.

Manogaran, L. and Sek, S. K. (2016). Can Taylor rule be a good representation of monetary policy function for ASEAN5? *Indian Journal of Science and Technology*, 9: 1-9.

Manogaran, L. and Sek, S. K., 2017. "Examining the reaction of monetary policy to exchange rate changes, A nonlinear ARDL approach." In *AIP Conference Proceedings.*

Mohammad, R., 2006. "Exchange rate determination in Indonesia." In *(Doctoral Thesis), Victoria University, Melbourne.*

Mohanty, M. S. and Klau, M. (2004). Monetary policy rules in emerging market economies: Issues and evidence. BIS Working Paper. 149: 205-45.

Muniandy, S. V. and Uning, R. (2006). Characterization of exchange rate regimes based on scaling and correlation properties of volatility for ASEAN-5 countries. *Physica A, Statistical Mechanics and its Applications*, 371(2): 585-98.

Quan, B. L. (1998). Currency crisis in Thailand, The leading indicators. In The park place economist. *Illinois Wesleyan University*, 8: 66-71.

Rana, P. B. (1998). The East Asian financial crisis-Implications for exchange rate management. *Asian Development Bank Economic and Development Resource Center*, 5: 1-15.

Sek, S. K. (2009). Economic structures , the nature of shocks and the role of exchange rate in the monetary policy formation in the emerging countries of East- Asia.