Labuan Bulletin
OF INTERNATIONAL BUSINESS & FINANCE
Volume 10, 2012 ISSN 1675-7262

EXCHANGE RATES AND MACROECONOMIC DETERMINANTS OF ASEAN-5 COUNTRIES[§]

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Abstract

Previous studies often provide evidence of the inadequacy of the monetary model of exchange rate. Numerous exchange rate researchers have advocated that omission of important variables may have led to such outcome. This study finds that standard monetary fundamentals together with stock prices differential and current accounts differential could establish stable relationship with exchange rates for majority of the ASEAN-5 countries. This finding suggests that besides the monetary variables, the differentials of stock prices or current accounts are crucial variables that cannot be neglected in the monitoring of exchange rate movements.

JEL Classification: F3
Keywords: Exchange Rate, Stock Prices, Current Accounts, ASEAN-5, ARDL

[§]Research grant FRGS/05(16)/729/2010(15) funded by the Malaysian Higher Ministry of Education is gratefully acknowledged by the first author.
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1. Introduction

The relationship between exchange rate and its determinants is now well established in the literature. Theoretically, the exchange rate behavior is determined by monetary fundamentals such as money supply, income and interest rate. However, exchange rate determination models are often proven inadequate and exchange rate researchers are still searching for exchange rate determinants that could establish stable relationship with the movement of exchange rate[1]. Some researchers have put forward that omission of important variables in testing the link between macroeconomic fundamentals and exchange rates may lead to failure of the exchange rate models[2]. In this respect, it can be argued that current accounts and stock prices are among those omitted variables. Home currency is expected to depreciate (appreciate) with respect to foreign currency in the case of domestic current account deficits (surpluses)[3]. Thus, the movement of exchange rate is affected by current account balance. On the other hand, the relationship between stock prices and exchange rate depends on whether substitution or income effect is dominant. In case of income effect, higher stock price will lead to increasing real domestic output, and hence higher demand for domestic money. As such, exchange rate will appreciate. Conversely, from the perspective of substitution effect, if stock price increase, the domestic money demand may decrease because of equity is more influential in the portfolio as compared to money. Thus, increase in real stock prices will lead to lower domestic money demand and exchange rate will depreciates (see for instance, Friedman, 1988; Choudhry, 1996 and Thornton, 1998).

Previous studies that included stock prices or current accounts in the exchange rate model were able to find supportive roles of these variables in the model. For instance, Baharumshah and Masih (2005) show that current accounts have significant impact and predictive power on the Japanese yen denominated exchange rates for Singapore and Malaysia[4]. Employing the standard multivariate cointegration methodology developed by Johansen (1988, 1991) and Johansen and Juselius (1990), the empirical results obtained reveal that exchange rates not only adjust to changes monetary fundamentals, but also current accounts.

[1] Meese and Rogoff (1983), Meese (1986), McNown and Wallace (1989), Coughlin and Koedijk (1990), Edison and Pauls (1993), Throop (1994) and Rose (1996), Evans and Lyons (2002), Neely and Sarno (2002), Kilian and Taylor (2003), Cheung *et al.* (2005), among others have provided empirical evidence on the failure of the exchange rate determination models in explaining exchange rate movements.

[2] For example, Campbell and Clarida (1987) and Meese and Rogoff (1988), Kearney and MacDonald (1990) and Edison and Pauls (1993) suggest that the monetary fundamentals are not sufficient to drive exchange rate.

[3] It can be shown from the national income identity that Current Account = Private Saving – Investment – Government Deficit (p. 306, Krugman and Obstfeld, 2003). It is clear that current account deficit among others may reflect fiscal mismanagement. Under such circumstances, capital outflow due to lack of confidence on the government will lead to exchange rate depreciation.

[4] Previously, Cushman *et al.* (1996), Jhy-Liu (1999) and Edison and Melick (1999) also find significant influence of current accounts on the movements of exchange rate for other countries.

Moreover, the study demonstrates that to improve the predictive power of the standard monetary model, one should consider the current account balances as well. On the other hand, Baharumshah *et al*. (2002) and Morley (2007) suggest that stock prices should be treated as additional variable to improve monetary models in order to explain exchange rate behavior better. Using the same multivariate cointegration technique to determine the relationship among exchange rates and the macroeconomic fundamentals (real incomes, money supplies, short-term interest rates, stock prices), Baharumshah *et al*. (2002) find that stock prices are important determinant in the case of Malaysia exchange rate denominated in Japan and the United States. Morley (2007) also incorporates stock price effects in the conventional monetary model of exchange rate. Using the autoregressive distributed lag (ARDL) bounds testing approach to cointegration, Morley (2007) has also shown that stock price must be included in order to examine long-run cointegration among variables for United Kingdom against the United States. Hence, it is argued that the equilibrium exchange rate must be extended to include equity markets in addition to bond markets; otherwise there are excessively strong restrictions on the monetary model.

This study attempts to extend the study of Baharumshah *et al*. (2002) and Baharumshah and Masih (2005), by incorporating current accounts and stock prices in the standard monetary model for broader set of sample data from the ASEAN-5 countries. It contributes to the literature by providing more evidence to support the urge in the extending the standard monetary model to include current accounts and stock prices. This study differs from Baharumshah *et al*. (2002) and Baharumshah and Masih (2005) in two-fold. First, instead of considering the effects of the variables separately, it combines the two variables by incorporating them into the monetary model simultaneously. The exclusion tests performed in this study show that these two variables cannot be excluded in determining the long-run relationship between exchange rate and its determinants. Moreover, stability tests results suggest stable relationship among exchange rate and its determinants including current accounts and stock prices. Second, the current study follows Morley (2007) in adopting the ARDL bounds testing approach to cointegration. This could help to avoid estimation problems as mentioned in Morley (2007)[5].

The remainder of this paper is structured as follows. Section 2 specifies extended monetary model that incorporates current accounts and stock prices. Section 3 describes data and Section 4 explains the estimation

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[5] Morley (2007) points out that the reasons for the failure of exchange rate models could be due inappropriate empirical techniques, apart from inappropriately specified model.

procedures. Section 5 presents empirical results, whereas Section 6 concludes.

2. Exchange Rate Model

A version of the standard monetary exchange rate model is given as[6]:

$$s_t = \varphi_0 + \varphi_1(m_t - m_t^*) + \varphi_2(y_t - y_t^*) + \varphi_3(i_t - i_t^*) + e_t, \quad (1)$$

where s represents nominal exchange rate, defined as domestic price of foreign currency, m is the domestic nominal demand for money, y the domestic real income level, i the domestic nominal interest rate; and the foreign counterparts of these variables are marked with asterisk (*). $(m - m^*)$ is known as money supply differential, $(y - y^*)$ denotes real income differential, $(i - i^*)$ is nominal interest rate differential, respectively. e denotes error term (residual). $\varphi's$ are regression coefficients to be estimated.

Baharumshah *et al.* (2002) and Morley (2007) extend Equation (1) by including the real stock price differential $(\zeta - \zeta^*)$. In a separate study, Baharumshah and Masih (2005) incorporates current account differential ($ca - ca^*$) into Equation (1). Empirical evidence has shown that both of these variables having important roles in the exchange rate determination models. In order to avoid misspecification due to omission of important variables in testing the link between macroeconomic fundamentals and exchange rates, the current study introduces both these differentials in Equation (1):

$$s_t = \varphi_0 + \varphi_1(m_t - m_t^*) + \varphi_2(y_t - y_t^*) + \varphi_3(i_t - i_t^*) + \varphi_4(\zeta_t - \zeta_t^*) + \varphi_5(ca_t - ca_t^*) + e_t \quad (2)$$

Note that φ_1 >0, φ_2, φ_5 <0, φ_3 and φ_4 can be positive or negative. This implies that, an increase in relative money supply will cause domestic currency to depreciate (φ_1 >0), while a rise in relative income will induce demand for money to increase and causes domestic currency to appreciate (φ_3 <0). Besides, an increase in interest rate differential will lead to capital inflow. Consequently, domestic currency will appreciate (φ_3 <0). However, home currency could depreciation if inflation rate increases and thereby causing depress in relative interest rate (φ_3 >0). Furthermore, an appreciation in home currency will occur if relative

[6] Interested readers may refer to, among others, Baharumshah and Masih (2005) or Morley (2007) for the derivation of the various forms of standard monetary models.

stock price increase which will subsequently lead to an increase in real income and also a rise in money demand (φ_4 <0). However, if substitution effect is dominant, then domestic currency will depreciate. This is because a rise in relative stock price will make equity more attractive than money and therefore a decrease in demand for money (φ_3 >0). Lastly, for relative current account, when current account surpluses, home currency will appreciate (φ_3 <0).

3. Data

This study utilizes the quarterly time series data that covers the period from 1981Q1 to 2007Q3 for ASEAN-5, namely Indonesia, the Philippines, Singapore, Thailand and Malaysia. The selected samples have different starting points based on the availability data of each country that are taken from the International Monetary Fund and the central banks for each country[7]. Data on Japanese yen denominated nominal exchange rates for the Indonesian Rupiah, the Philippines Peso, the Singapore Dollar, the Thailand Baht, the Malaysia Ringgit, relative money supply, relative interest rate, relative stock price, relative current account and relative income are included in this study[8]. Treasury bill rate is proxy to interest rates for Japan, Malaysia and Philippines (Baharumshah *et al*., 2002; Baharumshah and Masih, 2005; Islam and Hassan, 2006), and lending rate is proxy to interest rates for Thailand. Meanwhile, money market rates represent interest rates for Indonesia and Singapore. The aggregate income is represented by Gross domestic product (GDP) for all countries. Money supply is measured by M2 for all countries. The stock prices are represented by Osaka Stock Exchange (Nikkei 225) composite index for Japan, Jakarta Composite index (JKSE) for Indonesia, the stock exchange of Thailand (SET) composite index, Manila composite index for Philippines, Kuala Lumpur Composite Index (KLCI) and the Straits Times Index (SES) for Singapore. These stock indices data are obtained from Yahoo Finance Website. The last variables are current accounts for all countries, collected from International Monetary Fund. All variables except the interest rates are logarithmic transformed.

[7] Philippines: 1981Q1; Singapore: 1985Q1; Indonesia, Malaysia and Thailand; 1991Q1.

[8] Since the 1980s, Japan has been the major trading partners of Asian countries until present. In fact, Japan is the top five trading partners to ASEAN countries in the recent years (International Monetary Fund, 2008).

4. Estimation Procedures

The study employs the autoregressive-distributed lag (ARDL) framework pioneered by Pesaran *et al.* (2001) to test for cointegration. There are several advantages of this bound testing procedure. First, the ARDL procedure lies in the fact that it can be applied irrespective of the variables are integrated of order zero or one (I(0) or I(1)), unlike other techniques that require variables to be integrated of the same order to check the long-run relationship between variables (Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990; Philips and Oulirias, 2001, Morley, 2007). Second, ARDL model is appropriate for small sample sizes, whereas conventional multivariate cointegration test is only suitable for large sample sizes (Cheung and Lai, 1993; Tang, 2001; Choong *et al.*, 2005)[9].

Because of these advantages, it has been widely applied recently in the empirical studies of economics and finance[10]. In the area of exchange rate in particular, ARDL procedure has been employed in Morley (2007), Nieh and Wang (2005), Bahmani-Oskooee and Kara (2000) and Long and Samreth (2008). It is noted that, these studies adopt the version model with an intercept and no trend to testing their issues. Thus, this study attempts to apply the same model with an unrestricted intercept and no trend, which is referred to as Case III of Pesaran *et al.*, (2001). The bounds test is essentially based on an unrestricted error correction model (UECM) using OLS estimator. As such the model is also known as ARDL-UECM model. The ARDL-UECM ($p_1, p_2, p_3, p_4, p_5, p_6$) representation of the exchange rate model in this study can be specified as follows:

$$\Delta s_t = \alpha + \sum_{i=0}^{p1} b_{1i}\Delta m_{t-i} + \sum_{i=0}^{p2} b_{2i}\Delta y_{t-i} + \sum_{i=0}^{p3} b_{3i}\Delta i_{t-i} + \sum_{i=0}^{p4} b_{4i}\Delta sp_{t-i} + \sum_{i=0}^{p5} b_{5i}\Delta ca_{t-i} + \sum_{i=1}^{p6} b_{6i}\Delta s_{t-i} + b_7 s_{t-1} + b_8 m_{t-1} + b_9 y_{t-1} + b_{10} i_{t-1} + b_{11} sp_{t-1} + b_{12} ca_{t-1} + u_t \quad (3)$$

where Δ is the first difference operator, μ_{1t} is random error terms, $b_{1i}, b_{2i}, b_{3i}, b_{4i}$, b_{5i} and b_{6i} indicates the short-run dynamics of the model, $b_7, b_8, b_9, b_{10}, b_{11}$ and b_{12} denotes the long-run relationship. The symbols of m, y, i, sp and ca represents differentials of money supply, income, interest rate, stock price and current account, respectively. The long-run elasticity is the coefficient of the one lagged explanatory variable

[9] For instance, Cheung and Lai (1993) stated that finite sample size could yield a bias result in estimate likelihood ratio of Johansen's cointegration test.

[10] For instance, Atkins and Coe (2002) implement the bounds testing procedure in the examination of long-run Fisher effect. Payne (2003) and Akinlo (2006) estimate the money demand function using this approach; whereas Narayan (2005) uses it to examine the link between saving and investment, just to name a few.

(multiplied by a negative sign) divided by coefficient of the one lagged dependent variable (Pesaran *et al.*, 2001).

The Wald test can be used for testing the null hypothesis of no cointegration relationship among variables. In this study, the null hypothesis based on Equation (3) is $H_0 : b_7 = b_8 = b_9 = b_{10} = b_{11} = b_{12} = 0$ (There is no cointegration relation). The alternative hypothesis is $H_A : b_7 \neq b_8 \neq b_9 \neq b_{10} \neq b_{11} \neq b_{12} \neq 0$ (There exists a cointegration relation) (Pesaran *et al.*, 2001; Morley, 2007). The asymptotic distribution of the F-statistic of the Wald test is non-standard under the null hypothesis of no cointegration among the examined variables, irrespective of whether the explanatory variables are purely *I*(0) or *I*(1)[11]. If the computed F-statistic exceeds the upper bound critical value, the null hypothesis of no cointegration can be rejected. Thus, it can be concluded that there is a long-run relationship among the exchange rate and its determinants. If the computed F-statistic falls below the lower bound, the null hypothesis of no cointegration cannot be rejected. Hence, no cointegration among variables can be concluded. However, if the F-statistic falls between the upper and lower bounds, a conclusive decision cannot be made.

Usually, previous researchers employed standard monetary framework to investigate the long-run relationship between exchange rate and its fundamentals. However, this study deviates from previous studies by examining the long-run relationship between exchange rate and with extended set of variables. To ascertain that the differentials of stock prices and current accounts are important to exchange rate movements, the exclusion test will be employed. The sum of the lags of first different terms for the differentials of stock price and current account are jointly tested by the Wald test of restriction for significance. If the F statistic of the Wald test has *p*-value that is larger than the critical value, then the null hypothesis of stock price and current account does not enter into cointegrating relationship cannot be rejected. This means that these two variables are not important determinants to exchange rate behaviour. On the other hand, if the F-test has *p*-value is smaller than the critical value, and then the null hypothesis can be rejected, which implies that these two variables do enter into testing cointegration. As such,stock price and current account differentials are important fundamentals to determine the nominal exchange rate movements.

[11] For simulated critical values, please refer to Pesaran and Pesaran, (1997) and Pesaran *et al.* (2001).

5. Empirical Results

Although ARDL approach can be applied to variables with mixed order of integration, it is not applicable for variables that are integrated of order 2 or higher. To ascertain that the variables considered are either I(0) or I(1), this study adopts three standard unit root tests, i.e., ADF, PP and KPSS (Dickey-Fuller, 1981; Phillips-Perron, 1988; and Kwiatkowski *et al.*, 1992) tests to ascertain the integration order exchange rate and its determinants for all countries in the level and the first difference. This study follows Lardic and Mignon (2006) in using confirmatory analysis for the integration order test result. According to these authors, if the integration order tests of the ADF and PP tests have contradictory results, they suggested that the KPSS test have to be employed to make confirmation, in which the KPSS test result will be followed. Table 1 summarizes the results of integration order test. According to the results shown in Table 1, it can be concluded that the variables are integrated of mixed order, $I(0)$ or $I(1)$. However, none of the variables is integrated of higher order, $I(2)$. These results support the appropriateness of using ARDL model to test for long-run relationship between exchange rate and its determinants for all the ASEAN-5 countries.

However, the result of ARDL procedures is sensitive to the lag length included in the estimation. Therefore the lag length is carefully selected. This study employs the Hendry's general-to-specific method in order to achieve at a parsimonious lag specification (Hendry and Ericsson, 1991 and Pattichis, 1999). On top of that, reliable results are ensured through diagnostic checking[12]. The estimated ARDL model for exchange rates and their determinants for each country based on Equation (3) are reported in Table 2. Overall, the F-statistics of the bound test suggest that there exists cointegration between exchange rate and its determinants at 10% significant level, with the exception of Malaysia and Thailand [13]. Previously, several empirical studies have been conducted to examine the linkage between exchange rate and their fundamentals in selected Asian countries (Husted and MacDonald, 1999; Chinn, 2000; Baharumshah *et al.*, 2002; Baharumshah and Masih, 2005; Lee *et al.*, 2007 and Long and Samreth, 2008). Husted and MacDonald (1999), for instance, have found evidence that there is a

[12] To check whether the estimated ARDL model is valid or not, this study will adopt a battery of diagnostic tests. Particularly, Jarque-Bera statistics is used to check if the residuals are normally distributed, Ramsey-RESET test is adopted to ensure the model is correctly specified, LM statistic tests for serial correlation in residual, ARCH statistic is used to test for conditional homoscedasticity and CUSUM and CUSUMQ test proposed by Brown *et al.* (1975) are adopted to estimate the parameters for stability (see for instance, Pattichis, 1999; Atkins and Coe., 2002; Akinlo, 2006).

[13] In the case of Malaysia, statistic is slightly below the upper bound critical value, however. So, the null of no cointegration can be rejected marginally. For Thailand, since the statistic is smaller than the lower bound critical value, it means there is no cointegration relationship between exchange rate and the independent variables under examined.

cointegration relationship between exchange rate and its economic fundamentals, namely money supply, income and interest rate for Asian countries including Indonesia against Japan based on Panel test proposed by Hansen (1996). However, this study adds additional variables – differentials of stock prices and current accounts – to the monetary framework. Note that this finding is consistent with Smith (1992), Abdalla and Murinde (1997), Baharumshah *et al.* (2002) and Hatemi-J and Roca (2005), which find that stock price differential is an essential determinant to exchange rate movements. Besides, the current findings are in line with Cushman *et al.* (1996), Jhy-Liu (1999), Edison and Melick (1999) and Baharumshah and Masih (2005) which have demonstrated the importance of current account differential in estimating cointegration relationship among variables. Since the integration order of the variables exhibit $I(0)$ and $I(1)$, the ARDL approach is appropriate to further the test for cointegration.

From the middle panel of Table 2, it is observed that all the estimated models have passed through the diagnostic tests. Based on the diagnostic tests, the residuals are normality distributed, serially uncorrelated and there was no evidence of conditional heteroscedasticity. Moreover, these parsimonious models are correctly specified based on Ramsey-RESET test. Thus, the validity of the findings from the bounds tests of cointegration is established.

Table 1: Result of Integration Order Test

VARIABLE	LEVEL			FIRST DIFFERENCE			Conclusion
	ADF	PP	KPSS	ADF	PP	KPSS	
Indonesia							
s	-1.377[1]^{a}	-1.276[2]^{a}		-5.982[0]^{***a}	-5.982[1]^{***a}		*I(1)*
*m-m**	-2.915[0]^{**a}	-2.742[1]^{*a}					*I(0)*
*y-y**	-2.371[2]^{b}	-1.961[2]^{b}		-4.828[2]^{***a}	-9.501[1]^{***a}		*I(1)*
*i-i**	-3.300[2]^{**a}	-2.414[4]^{a}	0.129[6]^{**b}		-6.616[3]^{***a}		*I(0)*
*sp-sp**	-1.940[0]^{a}	-1.941[2]^{a}		-7.953[0]^{***b}	-7.953[1]^{***b}		*I(1)*
*ca-ca**	-1.972[10]^{b}	-2.985[3]^{b}	1.016[6]^{a}	-2.585[9]^{a}	-18.547[58]^{***a}	0.211[31]^{*a}	*I(1)*
Philippines							
s	-3.235[2]^{**a}	-2.627[4]^{*a}					*I(0)*
*m-m**	-1.958[4]^{b}	-5.321[9]^{***b}	0.140[9]^{**b}	-5.497[3]^{***a}			*I(0)*
*y-y**	-1.848[8]^{b}	-8.368[9]^{***b}	0.212[9]^{***b}	-3.621[7]^{***a}			*I(0)*
*i-i**	-3.873[1]^{**b}	-3.536[4]^{**b}					*I(0)*
*sp-sp**	-0.956[0]^{b}	-1.077[2]^{b}		-9.279[0]^{***a}	-9.276[1]^{***a}		*I(1)*
*ca-ca**	-3.616[4]^{**b}	-3.932[8]^{**b}					*I(0)*
Singapore							
s	-4.135[1]^{***a}	-3.126[3]^{b}	0.203[6]^{***b}		-6.492[2]^{***a}		*I(0)*
*m-m**	-3.031[0]^{b}	-3.218[2]^{*b}	0.186[5]^{***b}	-8.610[0]^{***a}			*I(0)*
*y-y**	-0.965[8]^{a}	-5.523[6]^{***b}	0.224[5]^{b}	-2.778[7]^{*a}		0.101[16]^{*a}	*I(1)*
*i-i**	-2.746[1]^{*a}	-2.019[0]^{a}	0.439[6]^{**a}		-7.240[5]^{***a}		*I(0)*
*sp-sp**	-3.052[0]^{b}	-3.004[2]^{b}		-10.357[0]^{***a}	-10.460[3]^{***a}		*I(1)*
*ca-ca**	-3.427[4]^{*b}	-2.329[7]^{a}	0.834[6]^{a}		-14.994[0]^{***a}	.170[30]^{*a}	*I(1)*
Thailand							
s	-1.379[0]^{a}	-1.549[4]^{a}		-7.540[0]^{***a}	-7.550[3]^{***a}		*I(1)*
*m-m**	-2.586[0]^{b}	-2.617[5]^{b}		-8.303[0]^{***a}	-8.430[9]^{***a}		*I(1)*
*y-y**	-3.225[0]^{*b}	-3.162[4]^{b}	0.215[6]^{***b}		-10.826[1]^{***a}		*I(0)*
*i-i**	-1.653[1]^{a}	-1.468[4]^{a}		-4.525[0]^{***a}	-4.563[1]^{***a}		*I(1)*
*sp-sp**	-3.079[0]^{b}	-2.969[1]^{b}		-10.062[0]^{***a}	-10.396[4]^{***a}		*I(1)*
*ca-ca**	-1.682[4]^{b}	-2.110[6]^{a}		-5.561[2]^{***a}	-13.579[1]^{***a}		*I(1)*
Malaysia							
s	-1.917[0]^{a}	-2.005[1]^{a}		-6.408[0]^{***a}	-6.320[3]^{***a}		*I(1)*
*m-m**	-1.766[0]^{b}	-1.922[2]^{b}		-7.123[0]^{***a}	-7.102[6]^{***a}		*I(1)*
*y-y**	-1.999[5]^{b}	-0.426[24]^{a}		-5.009[4]^{***a}	-8.719[22]^{***a}		*I(1)*
*i-i**	-2.320[0]^{a}	-2.549[4]^{a}		-8.253[0]^{***a}	-8.282[4]^{***a}		*I(1)*
*sp-sp**	-2.711[0]^{*a}	-2.740[1]^{*a}					*I(0)*
*ca-ca**	-2.372[0]^{b}	-2.408[3]^{b}		-9.657[0]^{***a}	-9.632[1]^{***a}		*I(1)*

Notes: ^{a}Estimation with constant. ^{b}Estimation with constant and a trends. *, ** and *** denote significant at 10, 5 and 1 percents level, respectively. The numbers in square brackets are optimal lag selected automatically by Eviews using Schwartz Bayesian Information Criterion (SBC) (ADF test) and Newey-West Bandwidth (PP and KPSS test). For constant, the critical values of ADF test are -3.535 (1%), -2.907 (5%) and -2.591 (10%). For constant and with a trends, the critical values of ADF test are -4.106 (1%), -3.480 (5%) and -3.168 (10%). For constant, the critical values of PP test are -3.535 (1%), -2.907 (5%) and -2.591 (10%). For constant and with a trends, the critical values of PP test are -4.106 (1%), -3.480 (5%) and -3.168 (10%). The critical value of KPSS test are 0.739 (1%), 0.463 (5%) and 0.347 (10%) for estimation with constant and 0.216 (1%), 0.146 (5%) and 0.119 (10%) for estimation with constant and a trends.

Table 2: ARDL Bound Testing for Cointegration Results

	Indonesia	Philippines	Malaysia	Singapore	Thailand
Optimal Lags	(3,4,3,4,4,1)	(1,2,4,2,4,1)	(4,3,4,3,4,1)	(3,3,2,0,0,1)	(3,2,1,4,3,1)
Sample Size	67	107	67	91	67
F-statistic[a]	6.497*	3.601*	3.302	3.881*	1.889
Diagnostic Tests[b]					
Jarque-Bera Test	0.742	1.606	0.950	0.252	3.657
	[0.690]	[0.448]	[0.622]	[0.881]	[0.161]
Ramsey-RESET Test	2.077	0.459	0.210	0.408	2.599
	[0.159]	[0.500]	[0.650]	[0.526]	[0.115]
LM Autocorrelation Test (4)	1.002	0.371	1.933	1.793	1.996
	[0.421]	[0.829]	[0.133]	[0.142]	[0.117]
ARCH Test (4)	1.359	1.167	0.235	0.823	0.917
	[0.261]	[0.330]	[0.918]	[0.515]	[0.461]
CUSUM Test	Stable	Stable	Stable	Stable	Stable
CUSUMsq Test	Stable	Stable	Stable	Stable	Stable
Test of Exclusion					
(*sp-sp**) and (*ca-ca**)	1.952*	3.013**	8.005***	2.646**	-
	[0.095]	[0.054]	[0.000]	[0.022]	

Notes: [a] The 10% lower and upper critical bound's value are 2.26 and 3.35 respectively. [b] Jarque-Bera test is normality test for residual (H_0: the residuals are normally distributed; H_1: the residuals are not normally distributed). RESET is Ramsey's specification test (H_0: No misspecification error; H_1: misspecification error). LM is the lagrange multiplier test for serial correlation (H_0: no autocorrelation in residuals; H_1: error term has autocorrelation). ARCH test is the autoregressive conditional heteroskedasticity test statistic distributed (H_0: no conditional heteroskedasticity in residuals; H_1: conditional of heteroskedasticity in error term). CUSUM and CUSUMsq Tests are used to test parameter stability (H_0: the parameters are constant over time; H_1: the parameters are not constant over time). Probability value is stated in square brackets. Asterisk (*) indicates significance at the 10 percent levels.

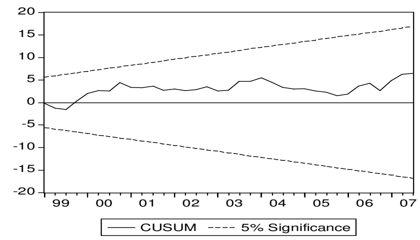
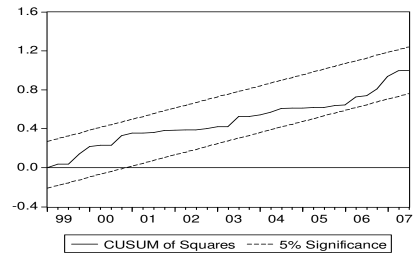
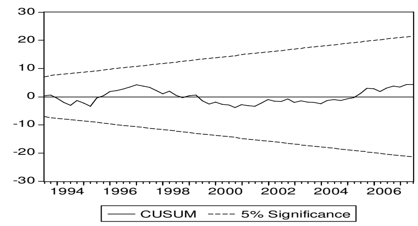
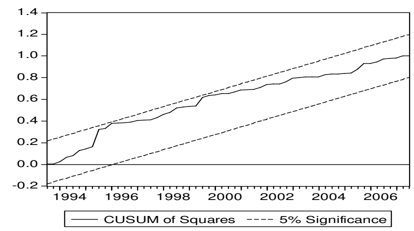
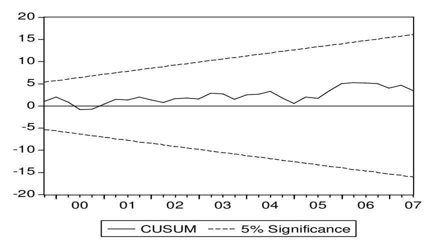
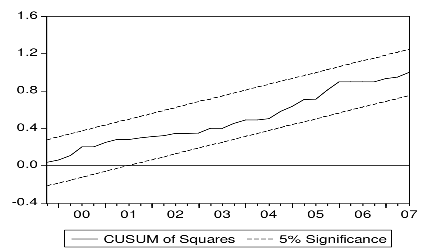
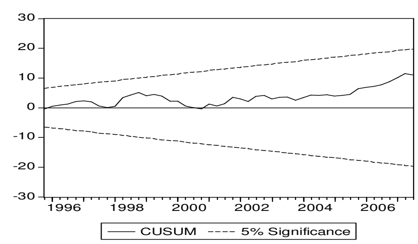
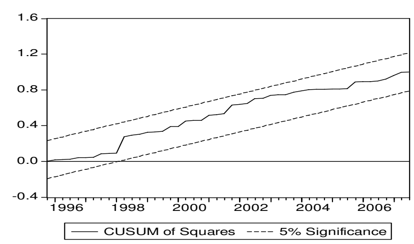
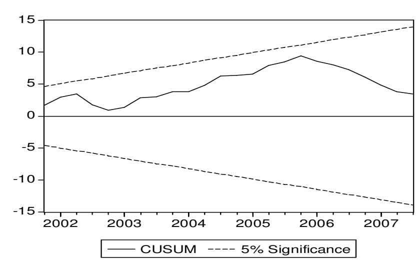
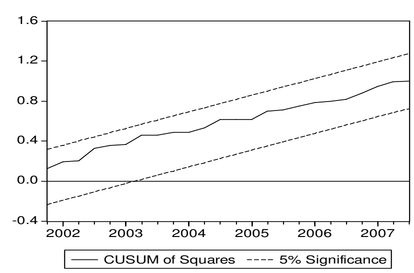
One of the contributions of this study is to extend the monetary model by adding differentials of stock prices and current accounts. To ensure that the added variables are important, the Wald test of exclusion test applied [14]. The sum of the lags of first difference terms for the differentials of stock prices and current accounts are jointly tested. Results of exclusion test are reported in the bottom panel of Table 1. In each case, stock prices and current accounts differentials are shown to be important determinants that must be entered in the cointegration relationship. For instance, for the case of Indonesia, the F-statistic of Wald test has *p*-value of 0.095, which is smaller than 0.1. It indicates that the null hypothesis of differentials of stock prices and current accounts do not enter into cointegrating can be rejected at the 10 percent level. Thus, these two variables cannot be excluded in determining the long-run relationship between exchange rate and its determinants in the case of Indonesia. Similarly, these two variables also play an important role in establishing cointegrating relationship the Philippines, Malaysia and Singapore [15]. Furthermore, the plots of CUSUM and CUSUM of squares statistics, as presented in Figure 1, show that these statistics are within the 5 percent confidence intervals band for all countries. This means that the estimated parameters are

[14] Baharumshah *et al.* (2002) and Baharumshah and Masih (2005) have used the exclusion test to determine the variables that enter into the cointegrating relationship.

[15] For the case of Thailand exclusion test is not performed as there is no evidence of cointegration. For Malaysia, as cointegration relationship can be marginally established, the exclusion test is conducted.

stable over time, implying stable long-run relationship between exchange rate and its determinants for those countries, in which cointegration exists.

Figure 1: Stability Test Results

Country	CUSUM	CUSUM of Squares
Indonesia		
Philippines		
Malaysia		
Singapore		
Thailand		

6. Conclusion

Previous studies often provide evidence of the inadequacy of the monetary model of exchange rate. Numerous exchange rate researchers have advocated that omission of important variables may have lead to such outcome. Aiming at improving the model, stock prices or current accounts variables have been included in the model. Baharumshah *et al.* (2002) and Baharumshah and Masih (2005) among others have provided empirical evidence supportive of such inclusion. This study attempts to extend the studies of Baharumshah *et al.* (2002) and Baharumshah and Masih (2005), by incorporating current accounts and stock prices simultaneously in the standard monetary model for broader set of sample data from the ASEAN-5 countries. Following Morley (2007), the ARDL bound testing procedure for cointegration has been implemented in this study. The integration order tests are first implemented to verify that the series included are either integrated at order zero, $I(0)$ or first order, $I(1)$. This is because variables which are integrated of order two, $I(2)$ or higher order could not be included in testing the cointegration (Atkins and Coe, 2002). Based on standard unit root tests, it is found that the above requirement has been met. Thus, the ARDL testing procedure has been used to determine the long-run relationship between exchange rate and its determinants. Based on the Wald test results, evidence of cointegration for Indonesia, the Philippines, Malaysia and Singapore is found in this study. The estimated models have passed through a battery of diagnostic tests, indicating the validity of the cointegration test results. Besides, the exclusion test results suggest the significance of differentials of stock prices and current accounts in the cointegration relationship. Moreover, the estimated models are stable based on CUSUM and CUSUM of squares tests pioneered by Brown *et al.* (1975) over the sample period. It signifies stable long-run relationship between exchange rate and its determinants including the differentials of stock prices and current accounts. In other words, these ARDL models estimated for selected ASEAN countries are reliable. Thus, the standard monetary model they must be extended to include stock prices and current accounts. However, for the case of Thailand, there is no evidence of such long-run relationship. In terms of policy implications, the findings of this study suggest that besides the monetary variables, the differentials of stock prices or current accounts are also crucial variables that cannot be neglected in the monitoring of exchange rate movements.

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