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Financial crises, Asian stock indices, and current accounts: An Asian-U.S. comparative study

David Y. Chen a,*, Tongze Li b

a School of Business & Economics, North Carolina A&T State University, Greensboro, NC, USA
b School of Economic Sciences, Washington State University, Pullman, WA, USA

A R T I C L E   I N F O

Article history:
Received 21 March 2013
Received in revised form 26 May 2014
Accepted 19 June 2014
Available online 9 July 2014

JEL classification:
F41
F44
E44
Keywords:
Financial crises
Stock indices
Current account balances

A B S T R A C T

This paper investigates the effects of financial crises-based exchange rate, real interest rate, and personal consumption expenditure on stock market indices and balances of current account in four Asian countries/areas, and the U.S. from 1997 to 2010. Results obtained from Sims’s first-order DSGE representation suggest that two policy variables – changes in the exchange rate and changes in the real interest rate lagged by one quarter – act as stabilizers for contemporaneous changes in stock indices for Thailand, Malaysia, and the U.S., but as destabilizers for Taiwan and Hong Kong. However, changes in personal consumption expenditure lagged by one quarter only play a destabilizing role in Hong Kong. For contemporaneous changes in the current account balance, all three policy variables become destabilizers for all five countries except the one-quarter lagged change in real interest rate, which acts as a stabilizer in Malaysia.

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1. Introduction

The 1997 Asian financial crisis (AFC) and the 2008 global financial crisis (GFC) have attracted substantial attention in at least three areas: causes (Eichengreen, 2008; Mishkin, 2000; Reinhart & Rogoff, 2008), effects (Chirathivat & Malikamas, 2010; Click & Plummer, 2005), and remedies (Brunnermeier & Oehmke, 2012; Krugman, 2009). The second area has been investigated from national and regional perspectives (Baig & Goldfajn, 1999; Glick & Spiegel, 2010; Hasan, 2002; Ho, 2011). Table 1 reports quarterly variations in the stock market indices and current account balances of four Southeast/Asia countries/areas (henceforth countries) and the U.S. during financial crises. These include Thailand, Malaysia, the Republic of China (Taiwan for short), Hong Kong, Special Administrative Region (Hong Kong for short), and the U.S. which are included in the study for different reasons. Thailand was the first nation to feel the effects of the AFC (Chokesirikuchai, Ngamkroeckjoti, & Chuanrommanee, 2013; Hoontrakul, 2008; Jiranyakul, 2009); Malaysia was the second country affected during the crisis but adopted a different strategy to combat the AFC crisis (Hussin, Muhammad, Abu, & Awang, 2012; Md-Yusuf & Abd Rahman, 2013; Rahman, Sidek, & Tafri, 2009); Taiwan (Chou, Lin, & Wu, 1999; Kung & Wong, 2009; Tsai & Dean, 2009) and Hong Kong (Jao, 2001; Yu & Tam, 2007) escaped heavy losses; and the U.S. was the originator of the GFC (Roubini & Mihm, 2010). Changes in macroeconomic variables during the AFC and GFC are significant. They form the basis of this study.

The authors are grateful to the reviewers and the editor for their comments. All remaining errors are authors’ responsibility.

* Corresponding author at: Department of Economics, North Carolina A&T State University, Greensboro, NC 27411, USA. Tel.: +1 10 336 285 3326; fax: +1 10 336 256 2055.

E-mail address: chend@ncat.edu (D.Y. Chen).
Table 1
Variations in stock index and current account balance during two crises.

| Index name          | Thailand (SET) | Malaysia (KLCI) | Taiwan (TSEC) | Hong Kong (HS) | U.S. (DJIA) |
|---------------------|----------------|-----------------|---------------|----------------|-------------|
| Stock index         |                |                 |               |                |             |
| 1997 Asian crisis   | 707            | 1203            | 9111          | 14,991         | 7672        |
| 1998 Q3 trough 211 373 | 6832          | 7062            | 7842          |                |             |
| Percent change      | –70%           | –69%            | –25%          | –53%           | +2%         |
| 2007Q4              | 831            | 1445            | 8506          | 28,658         | 13,264      |
| 2009Q1 trough       | 416            | 873             | 5210          | 12,317         | 7608        |
| Percent change      | –50%           | –40%            | –39%          | –53%           | –43%        |
| Balance of current account (in US$ billions) | | | | | |
| 1997 Asian crisis   | –2.4           | –0.94           | 2.02          | –3.18          | –43.13      |
| 1998 Q3 trough       | 3.87           | 2.37            | 1.99          | –0.07          | –58.89      |
| Percent change      | +261%          | +352%           | –1%           | –97%           | 36%         |
| 2007Q4              | 6.67           | 8.64            | 12.8          | 6.12           | –156.05     |
| 2008Q4 trough       | –1.29          | 8.34            | 11.74         | 11.1           | –151.03     |
| Percent change      | –119%          | –3%             | –8%           | +81%           | –3%         |

Source: Authors’ calculations. Stock exchange indices are taken from the Stock Exchange of Thailand, the Malaysian Stock Exchange, the Taiwan Stock Exchange Corporation, the Hong Kong Monetary Authority, and online address www.finance.yahoo.com for DJIA. The current account data are obtained from various national statistical agencies.
* Q1 for Thailand, Q3 for Taiwan, and Q2 for other countries.

Table 1 indicates the severity of the losses in stock market indices in Asian countries. In Thailand alone, the loss in the Stock Exchange of Thailand index (SET) reached 70 percent from 1997Q1 to 1998Q3, whereas the U.S. Dow Jones Industrial Average index (DJIA) experienced a 2 percent gain. During the same period, the Thai current account balance increased by 261 percent and the U.S. figure by 36 percent.

However, the 2008 GFC had different effects on these countries. All five countries reported substantial declines in stock indices in the range of 40–50 percent.

Through what channels do financial crises affect financial markets and international trade? One channel is inadequate risk management (Dwyer & Tkac, 2009; Hellwig, 2008), and another is business cycle movement (Barro & Ursúa, 2009). The third channel highlights the wealth effect in monetary policy (Ludvigson, Steinel, & Lettau, 2002; Mishkin, 2013). In theory, a high level of wealth should lead to a higher level of consumption and ultimately promote higher levels of aggregate income (Fair, 1971; Starr-McCluer, 1998). The effects of changes in wealth have been studied, i.e., a change in wealth holdings leads to a change in consumption, thereby generating a change in income (Stevans, 2004). Would personal consumption expenditure actively affect a stock index and the current account in a general equilibrium-framework in the presence of financial crises? This issue has yet to be examined in depth. During unexpected financial crises, what are the relationships between three macroeconomic policy variables, namely, personal consumption expenditure, the exchange rate, and the interest rate, and two state variables, namely, a stock market index and the nation’s current account balance? The purpose of this study is to explore these relationships to shed some light on this area.

This study is based on a dynamic stochastic general equilibrium (DSGE) approach (Hansen & Sargent, 1980; Kydland & Prescott, 1982; Sims, 2001), which has been noted for its internal model consistency under rational expectations. This study contributes to the literature by adopting an alternative but relevant method to examine the effects of financial crises-based macroeconomic factors on financial markets and international trade. It is possible to compare this study’s results with those of other studies using OLS, the VAR, and the GMM. Quarterly data from 1997 to 2010 constitute the study period.

This paper is organized as follows: a brief literature review is provided in Section 2, the methodology and data will be discussed in Section 3, and the empirical results are presented in Section 4, followed by an analysis in Section 5. Section 6 reports on an application of the results, and Section 7 concludes with policy implications.

2. Literature review

A brief discussion of studies of financial crises, stock market indices, and current accounts is presented below. Mishkin (2000) identifies three causes of the 1997 AFC: speculative funds, an unsophisticated market structure, and a weak regulatory environment. Click and Plummer (2005) in addressing the equity market integration issue in the ASEAN-5 nations following the 1997 AFC, conclude that co-integration exists. Regarding the 2008 GFC, Eichengreen (2008) considers the reasons for crises in numerous countries, excluding the U.S., to be the time required to effectively respond, a lack of government actions, and a limited policy choice set. Reinhart and Rogoff (2008) compare 18 historical financial crises in industrialized nations and claim that such crises are related to international capital flows and the country’s current account balance.
Concerning the relationship between the current account and financial crises, Danninger and Jaumotte (2008), and Obstfeld (2012) observe differences in current account behaviors among emerging Asian and European countries. After comparing current accounts surpluses in Southeast Asian economies from 1997 to 1998, Moreno (2008) suggests that the explanation of these surpluses appears to be the large capital outflows from these countries. Medina, Prat, and Bauer (2010) examine the equilibrium current accounts in 33 emerging market countries, Thailand and Malaysia included, and suggest that their central governments need to maintain fiscal balance.

Hoontrakul (2008) evaluates the impact of the 2008 GFC on the Thai economy excluding the stock market, with respect to risks from a banker’s perspective. Jiranyakul (2009), using the Johansen test, claims that co-integration exists among the stock index, real GDP, money supply, nominal effective exchange rate, and price level in Thailand. He also claims that the 1997 AFC had no influence on stock prices. Chirathivat and Malikamas (2010) state that Thailand has been affected by the U.S. sub-prime crisis. Baharumshah and Ismail (2012) report the close correlation between changes in the current account and the present value of future net output based on a VAR model. Examining the SET index, Chokesirikuchai et al. (2013) confirm the sensitivities of the interactions between the stock index and exchange rate and between the interest rate and inflation rate. However, the authors do not include financial crises in their OLS model and the study period does not include the 1997 AFC. Chen and Huang (2012), using the Markov approach, suggest that financial crises have negative effects on the SET index.

For Malaysia, Hasan (2002) argues that the 1997 AFC did not do substantial harm to the Malaysian economy because the country already exhibited weak economic fundamentals and massive capital outflows. Using a VAR approach, Rahman et al. (2009) demonstrate the existence of co-integration among changes in the stock market index and changes in the following variables: the money supply, interest rate, exchange rate, reserves, and industrial production index. Hussin et al. (2012) in discussing the Malaysian Islamic stock market from 1999 to 2007, exclude both the beginning of the AFC and the entirety of the GFC from their study. Md-Yusuf and Abd Rahman (2013) suggest that there has been a two-way interaction between the equity market and exchange rate volatility, but do not include financial crises in their Granger causality analysis.

In studying the Taiwanese stock market, Chou et al. (1999) observe that the U.S. stock market has a volatile spillover effect without explicitly addressing financial crises based on a multivariate generalized ARCH model. Kung and Wong (2009) examine the efficiency of the Taiwanese stock market and find that 1997 is a relevant break-point when two trading rules were adopted between 1983 and 2005. Mehtalchi, Chang, and Garza-Gomez (2012) fail to consider macroeconomic factors in their study of the trading rules and strategies of the Taiwanese stock market. Tsai and Dean (2009), by examining the sales of dubious U.S. financial derivatives suggest that not only the banking industry but also Taiwanese investors were affected by the 2008 GFC.

For Hong Kong, Jao (2001) describes the speculative attacks on the Hong Kong currency and government responses to the 1997 AFC. Yu and Tam (2007) contend that the Hong Kong risk appetite index is a valuable indicator of stock market performance from 1996 to 2006. Garefalakis, Dimitras, Koemtzopoulos, and Spinthiropoulos (2011), using the Glosten–Jahannathan–Runkle GARCH model, suggest that the Hang Seng index is influenced by the U.S. Standard & Poor’s 500 index and oil prices. Reinhart and Rogoff (2008), using long-run U.S. historical data, observe parallels across a number of financial crises. Barro and Ursúa (2009), after examining long-term data from 30 countries, discover correlations between negative stock returns and business cycle contractions in the U.S., Japan, and Indonesia. Roubini and Mihm (2010) believe that indicators of a major financial crisis had existed in the U.S. long before 2008. Brunnermeier and Oehmke (2012) suggest that short-term debt financing would eventually result in a financial crisis.

In summary, the aforementioned studies are in scope with respect to financial market performance and current account balances. There is a need for a broad-based study on financial crises and fundamental financial and macroeconomic factors.

3. Methodology and data

The DSGE approach is selected due to its advantages over other methods. First, it employs the consumer Euler equation from an inter–temporal overlapping-generations perspective which is not possible when using the traditional OLS technique (Dejong & Dave, 2011). Second, it covers all sectors of the economy, in contrast to the narrower base considered in the VAR technique (Sims, 2001). Third, it is able to produce solution choices according to economic theory, which the GMM approach is not (Dotsey, 2013). For empirical applications of this approach, see www.dsgem.net.

3.1. General structure of the model

This study assumes an open economy with an intertemporal consumer/producer sector with infinite horizons and a market producing a product z at a price of $p_z$ (Eggertsson & Krugman, 2012; Obstfeld & Rogoff, 1996). In this discrete time model the isoelastic utility function is

$$U_t = \sum \beta^{t-s} \left( \frac{\sigma}{\sigma-1} \right) c_t^{\sigma-1}/\sigma.$$  (1)
where $\beta$ is the time preference factor, $\sigma$ is the elasticity of inter-temporal substitution, and $s$ and $t$ are separable time periods. Each individual is assumed to maximize long-run utility subject to a resource constraint that includes income, and the only financial asset is a government bond. The Dixit–Stiglitz aggregator is used to determine aggregate consumption; thus we derive the first-order Euler equation (5). Total production is obtained from the aggregate production function. Government-issued are the only publicly available bond. There are counterparts in the foreign country.

In this paper a first-order nonlinear DSGE model is constructed in the following form (DeJong & Dave, 2011):

$$ Y(C, FE, r, FCDMY, M, GDP, SEI, BCA, w_1, w_2, w_3) = 0 $$

(2)

Each variable is specified below. The last three terms are rational expectations components.

This system is mapped into a first-order log-linear Sims’ canonical representation (Sims, 2001):

$$ G_0 Y_t = G_1 Y_{t-1} + Q + FZ_t + A T_t $$

(3)

where $Z$ is a vector of structural shocks and $T$ is a vector of expectations shocks stemming from $Z$. $G_0$, $G_1$, $F$, and $A$ are matrices. The solutions are expressed as:

$$ Y_t = T_1 Y_{t-1} + T_\epsilon + T_0 Z_t $$

(4)

where $T_0$ and $T_1$ are matrices and $T_\epsilon$ is a vector.

3.2. Model specification

The following equations for this economic system are:

(1) The Euler equation for consumer/producer sector

$$ E_t(\ln C)_{t+1} = \beta_1(\ln C)_t + \ln(1 + r_t) $$

(5)

where $E_t(\ln C)_{t+1}$ is an expectations component, $\ln C$ is $C$ in log form.

(2) The exchange rate

$$ (FE)_t = \alpha_0 + \alpha_1(\ln C)_{t-1} + \alpha_2(FCDMY)_{t-1} + \alpha_3 E_t(\ln C)_{t-1} + \epsilon_t $$

(6)

where $FE$ is the foreign exchange rate, $FCDMY$ is financial crisis dummy variable.

(3) The real interest rate.

$$ (r)_t = \rho_0 + \rho_1(r)_{t-1} + \rho_2(FCDMY)_{t-1} + \rho_3 E_t(r)_{t-1} + \epsilon_2 $$

(7)

$r$ is the real interest rate.

(4) The financial crisis dummy variable.

$$ (FCDMY)_{t} = \gamma_0 + \gamma_1(FCDMY)_{t-1} + \epsilon_3 $$

(8)

See data section for explanation.

(5) The money supply.

$$ (M)_t = \delta_0 + \delta_1(\ln M)_{t-1} + \epsilon_{4t} $$

(9)

where $M$ is the money supply.

(6) The gross domestic product.

$$ (GDP)_t = \theta_0 + \theta_1(\ln GDP)_{t-1} + \epsilon_{5t} $$

(10)

where $GDP$ is the gross domestic product.

(7) The stock exchange index equation.

$$ (SEI)_t = \lambda_1(\ln SEI)_{t-1} + \lambda_2(\ln FE)_{t-1} + \lambda_3 E_t(\ln FE)_{t-1} + \lambda_4 E_t(r)_{t-1} + \lambda_5 E_t(\ln M)_{t-1} + \lambda_6(\ln GDP)_{t-1} + \lambda_7(\ln GDP)_{t-1} + \lambda_8 E_t(\ln GDP)_{t-1} + \epsilon_{6t} $$

(11)

where $SEI$ is the stock exchange index.

(8) The current account balance equation.

$$ (BCA)_t = \xi_1(\ln BCA)_{t-1} + \xi_2(\ln FE)_{t-1} + \xi_3 E_t(\ln FE)_{t-1} + \xi_4 E_t(r)_{t-1} + \xi_5 E_t(\ln M)_{t-1} + \xi_6(\ln GDP)_{t-1} + \xi_7 E_t(\ln GDP)_{t-1} + \epsilon_{7t} $$

(12)

where, $BCA$ stands for the current account balance.

(9) The first rational expectations component.

$$ W_{1t} = E_t(\ln C)_{t+1}, W_{1t-1} = (\ln C)_t - \eta_{1t} $$

(13)

$\eta$ is expectations shock related to personal consumption.
The second rational expectations component
\[ W_{2t} = E_t(\text{FE})_{t+1} \]  
(14)

The third rational expectations component
\[ W_{3t} = E_t(\text{r})_{t+1} \]  
(15)

These equations can be summarized into the Sims’ (2001) canonical representation in (3). Detailed information for matrices \( G_0, G_1, F, A, T_0, T_1 \), and vectors \( Q, Z, \Pi, T_c \) is available from the author to the reader upon request.

In this state-space model FE, r, and C are considered as policy variables, and SEI and BCA are state variables.

3.3. Data

The financial crises dummy variable is constructed as follows: it takes value 1 when a financial crisis occurs in the quarter of the year considered, including the 1997Q3 AFC, 2001Q3 9/11 in the U.S. and the 2008Q1 GFC, and value 0 otherwise. All countries use the same FCDMY.

Thailand: Quarterly information for the Stock Exchange of Thailand (SET) index, aggregate money supply (M2), and the Bangkok interbank offered rate (BIBOR) are taken from the Bank of Thailand’s website. Quarterly real GDP in constant 1988 prices in billions of baht, consumption expenditure, and the current account balance in billions of baht are obtained from publications of the Thailand National Economic and Social Development Board. The Thai nominal exchange rate is taken from the website of the US Federal Reserve Bank of St. Louis (www.stlouisfed.gov). The real effective exchange rate (REER) is obtained from the Bank of Thailand.

Malaysia: The Malaysian Stock Exchange index (Kuala Lumpur Composite Index-KLCI) is based on the beginning of the month at market closing. Quarterly real GDP in constant 2000 prices is taken from the Bank Negara Malaysia (the Central Bank). Aggregate money supply (M2) in billions of ringgit and the Malaysia interbank overnight loan rate at the beginning of the month, the exchange rate measured in the number of ringgit per U.S. dollar are also quoted from the Bank Negara Malaysia. The current account balance and consumption expenditure are obtained from the website of the Malaysian Department of Statistics.

Taiwan: The financial and macroeconomic information is obtained from the Directorate General of Budget, Accounting and Statistics, Ministry of Economic Affairs. The Taiwan Stock Exchange Corporation provides stock index information (TSEC). The interbank overnight interest rate is taken from the Central Bank of Taiwan.

Hong Kong: The macroeconomic and financial data for Hong Kong, including the Hang Seng index, are obtained from HK Monetary Authority (HKMA) publications. The interest rate is the Hong Kong interbank offered overnight rate in percent per annum from HKMA’s quarterly bulletins.

U.S.: The U.S. data on quarterly real GDP, consumption expenditure, current account balance, aggregate money supply (M2), and the overnight federal funds rates are obtained from the FRED databank of the U.S. Federal Reserve Bank of St. Louis’ website. Information on the Dow Jones Industrial Average index (DJIA) is available online at www.finance.yahoo.com.

4. Results

The purpose of this study is to generate an optimal set of parameter estimates for each country through simulations. Each simulation generates a set of parameter estimates. The minimum mean standard error (MSE) is used as the selection criterion to determine which set of parameter estimates is optimal for that country. A comparison of the optimal sets is then possible, and impulse responses can be determined for prediction purposes. This process involves the methodology described below.

4.1. The unit-root test

Each time series of these countries is tested for stationarity in the form of a constant mean, variance, and autocovariance structure over time. Four unit-root tests are used: the Augmented Dickey–Fuller, Generalized Least Squares–Dickey–Fuller, Phillips Perron, and Kwiatkowski–Phillips–Schmidt–Shin test. The results indicate that nearly all of series in their original form are non-stationary. For transformation, the first-difference (henceforth, change in variable) is employed instead of the central trend process for simplicity. Table 2 presents selected information on the series due to space limitations.

The first five variables are related to stock market indexes, the next five to the current account balances and the last five to the personal consumption expenditure series. Those series passing at least three of the four unit-root tests are selected for this study.

4.2. Co-integration test

Table 3 contains the results of the Johansen co-integration test on eight transformed series (consumption expenditure, FE, interest rate, FCDMY, M, GDP, SEI, and BCA) to determine the validity of grouping these series. This study finds that the
co-integration is present in all eight series in Thailand, Taiwan, and the U.S. but for only five series in Malaysia and Hong Kong. This result confirms Jiranyakul’s contention (2009) for Thailand. The pegged exchange rate followed in Malaysia from 1998Q4 to 2005Q2 resulted in missing data when the first difference was taken. Therefore, we are unable to confirm or refute the result obtained by Rahman et al. (2009). The same problem exists for Hong Kong from 2000Q3 to 2003Q2.

4.3. Calibration

To generate simulation values, a set of one is selected for the benchmark parameter values in the stock market index and balance of current account equations. Then, the new initial values are used in further simulations; the ranges of parameters values are reported in Table 4.

This study conducted 150 simulations. The following criterion is adopted to select the optimal set of parameter estimates for further analysis.

4.4. Selection of the optimal simulation

The minimum mean standard error (MSE) criterion was chosen to obtain the optimal set of parameter estimates from all simulations (Ball, 1999):

\[
\text{Objective function} = \min \{ \text{Var(SEI)} + \mu \text{Var(BCA)} \} \tag{16}
\]

where \( \mu = 1 \). Using this criterion, it is possible to minimize the total variances of the two state variables in Table 5. The unusually high variance of the stock market index in Hong Kong reflects the effects of three events in Hong Kong: the 1997 AFC, the 2003 SARS (severe acute respiratory syndrome) epidemic, and the 2008 GFC. A detailed discussion of these results will be provided in the Section 5.

Presented in the upper half of Table 5, the variances for Thailand (presented in thousands) are 7.71 for the SET index, 0.8 for the current account balance, and 7.79 for the total. The lower half of Table 5 contains the maximum set obtained from the simulations as a comparison. For instance, in Taiwan the sum of variances is 7536.7, which is approximately eight times greater than in the minimum set.

Table 3
Cointegration test.

| Country   | Thailand | Malaysia | Taiwan | Hong Kong | U.S. |
|-----------|----------|----------|--------|-----------|------|
| Equations | 8        | 5        | 8      | 5         | 8    |
| Trace/maximum eigenvalue stat. | 5.994 | 5.799 | 5.108 | 4.526 | 6.409 |
| Probability | 0.014 | 0.016 | 0.024 | 0.033 | 0.011 |

Source: Authors’ calculations.
The critical value for eight equations is 3.841.
Table 4
Calibration values.

| Equation | Parameter | Variable | Initial value | Range     |
|----------|-----------|----------|---------------|-----------|
| SEI      | $\lambda_2$ | FE       | 1             | $-15.0 \sim 10.26$ |
|          | $\lambda_4$ | $r$      | 1             | $-3.0 \sim 52.0$ |
|          | $\lambda_6$ | ln(C)    | 1             | 0.98 – 36.0 |
| BCA      | $\xi_2$    | FE       | 1             | $-0.2 \sim 3.99$ |
|          | $\xi_4$    | $r$      | 1             | $-1.3 \sim 3.67$ |
|          | $\xi_6$    | ln(C)    | 1             | $-3.12 \sim 5.0$ |

Source: Authors’ calculations of parameter value assigned in simulations.

Table 5
Selection of the optimal simulation by sum of variances.

|          | Thailand | Malaysia | Taiwan | Hong Kong | U.S. |
|----------|----------|----------|--------|-----------|------|
| Minimum set | Var (SEI) | 7.71     | 14.2   | 878.9     | 4449.8 | 647.4 |
|          | Var (BCA)| .08      | .04    | .3        | .04   | .5    |
|          | Sum      | 7.79     | 14.24  | 879.2     | 4449.84 | 647.9 |
| Maximum set | Var (SEI) | 40.06    | 202.3  | 7211.3    | 16,452.6 | 8379.7 |
|          | Var (BCA)| 35.73    | 8.6    | 325.4     | .1     | 3.0   |
|          | Sum      | 75.79    | 210.9  | 7536.7    | 16,452.7 | 8382.7 |

Source: Authors’ calculations from model used. All numbers are in thousands.

4.5. Optimal equations for each country

Table 6 compiles the parameter estimates from the optimal equations for five countries. The upper half reports results from the stock exchange index equation, and the lower half those from the current account balance equation. The missing parameter estimates are related to rational expectations. The next section provides an interpretation of these estimates.

5. Analysis

The discussion of the optimal parameter estimates for the stock market indices is divided by policy variable and country, as are those for the current account balances.

5.1. Stock market parameter estimates – exchange rate

In the upper half of Table 6, the exchange rate parameter estimate for Thailand of $-0.265$ suggests that a one-unit increase in the one-quarter lagged first difference exchange rate reduces the contemporaneous change in the SET index by .265 points. This implies that an increase in the change in the foreign exchange rate can mildly attenuate the change in the SET index. The exchange rate acts as a stabilizer for the stock index. Prior to June 1997, the Thai currency traded at 24.534 baht per US dollar. When the 1997 AFC struck Thailand, the Thai exchange rate was 35.256 in 1997Q3. The central bank’s intervention failed, as the rate increased to 44.309 in the fourth quarter. Moreover, the SET decreased by 14 percent from the

Table 6
Optimal equation and selected parameter estimates by country.

| Parameter/variable | Thailand | Malaysia | Taiwan | Hong Kong | U.S. |
|--------------------|----------|----------|--------|-----------|------|
| Stock exchange index equation |          |          |        |           |      |
| $\lambda_1$ (lag SEI)  | $-0.005$ | $-0.002$ | $0.178$ | $0.326$   | $0.119$ |
| $\lambda_2$ (lag FE)  | $-0.265$ | $-0.103$ | $1.555$ | $2.296$   | $0.698$ |
| $\lambda_4$ (lag r)   | $-0.382$ | $-2.11$  | $1.042$ | $2.249$   | $0.595$ |
| $\lambda_6$ (lag M)   | $0.026$  | $-0.145$ | $1.065$ | $3.353$   | $0.574$ |
| $\lambda_7$ (lag GDP) | $-0.009$ | $-0.006$ | $0.822$ | $0.931$   | $0.333$ |
| $\lambda_9$ (lag C)   | $-0.411$ | $-1.528$ | $-1.954$| $2.514$   | $0.632$ |
| Balance of current account equation |        |        |        |           |      |
| $\xi_1$ (lag BCA)     | $1.102$  | $1.079$  | $1.122$ | $1.1$     | $1.467$ |
| $\xi_2$ (lag FE)      | $1.664$  | $0.16$   | $.555$  | $5.186$   | $2.069$ |
| $\xi_4$ (lag r)       | $1.399$  | $-2.399$ | $.764$  | $5.649$   | $1.276$ |
| $\xi_6$ (lag M)       | $.366$   | $.144$   | $.19$   | $3.343$   | $-0.227$ |
| $\xi_7$ (lag GDP)     | $.264$   | $.008$   | $.135$  | $1.531$   | $.108$ |
| $\xi_9$ (lag C)       | $1.481$  | $2.86$   | $1.319$ | $7.514$   | $2.487$ |

Source: Authors’ calculations using the mean standard error criterion.
second to the third quarter of 1997 and declined by 22 percent from the third to the fourth quarter, as the central bank decided to abandon its policy of intervening in the foreign exchange market. The effect of the December 2004 Tsunami in West Indonesia and Thailand on the Thai tourist industry is reflected in both the exchange rate and the unemployment rate. The exchange rate stood at 39.1835 per U.S. dollar in 2004Q4 but had reached 39.5935 by 2005Q1. The national unemployment rate was 1.46 percent but had increased to 2.36 percent over the same period. During the 2008 GFC the exchange rate increased from 31.404 in 2008Q1 to 35.737 one year later, and fell to 33.204 in 2009Q4. Our result disagrees with that obtained by Jiranyakul (2009), that the 1997 AFC had no influence on SET stock prices, but agrees with the findings of Chirathivat and Malikamas (2010), Chokesirikuchai et al. (2013), and Chen and Huang (2012).

For Malaysia, the parameter estimate for a change in the exchange rate is —1.03, approximately half the size of the estimate for Thailand. It serves as a very limited stabilizer as in the case of Thailand. These two countries adopted different exchange rate policies during the 1997 AFC. Malaysia employed a capital control policy while Thailand used a pegged exchange rate in compliance with IMF restrictions. Regarding the 2008 GFC, the Malaysian exchange rate was 3.2 ringgitus per US dollar in 2008Q1 and then climbed to 3.72 per dollar one year later. The observation that a change in the exchange rate serves as a stabilizer disagrees with the finding presented by Hasan (2002), but confirms those of Md-Yusuf and Abd Rahman (2013) and Chen and Huang (2012).

The data from Taiwan yield a positive estimate for the exchange rate, which entails substantial fluctuations resulting from a contemporaneous change in the stock market index. During the 1997 AFC, Taiwan’s exchange rate climbed from 27.4084 per U.S. dollar in 1997Q1 to 32.3375 in 1998Q4. The average quarterly change over three years was 0.679. During the 2008 GFC, Taiwan experienced an average appreciation of 0.0066 per quarter, much milder than that observed in Thailand or Malaysia. The Taiwanese stock index increased from 8166 in March 1997 to 9890 in August 1997 and then fell to 7731 in November, a fluctuation of 22 percent. The Central Bank of Taiwan prevented substantial fluctuations in the exchange rate. The focus of this study differs from those of Chou et al. (1999), Kung and Wong (2009), Metghalchi et al. (2012), and Tsai and Dean (2009); therefore, the results are not directly comparable.

Hong Kong has the largest positive parameter estimate, 2.296. During the 1997 AFC, the change in the Hong Kong exchange rate averaged 0.0014 per quarter. The HKMA actively intervened in the exchange rate market to maintain stability. Hong Kong foreign currency reserves declined from US$96.96 billion in 1998Q1 to US$88.23 billion in 1998Q3 but were replenished to US$96.29 by 1999Q4. The Hang Seng index increased from 13,507 in 1997Q1 to 14,991 before the speculative attack but had decreased to 7062 by 1998Q3, a loss of 50 percent. During the 2008 GFC, there was almost no change in Hong Kong’s exchange rate. It was HK$7,782 per U.S. dollar in 2008Q1 and 7,762 per dollar in 2010Q1. The stability of the exchange rate during these two financial crises reflects that changes in the exchange rate were not the primary reason for stock index variations. Our results are not directly comparable to the findings of Jao (2001), Yu and Tam (2007) or Garefalakis et al. (2011) because the emphases of the papers differ.

The parameter estimate for the U.S. exchange rate of —0.698 is the largest negative value obtained for the five countries considered. It implies that a one-unit change in the U.S. exchange rate tends to reduce the change in the DJIA index by .698 percent. The DJIA index increased in 1996, 1997 and 1998, the only exception being in 1998Q3 (7842) and it recovered in the next quarter (to 9181). During the 2008 GFC, the DJIA index declined from 12,262 in 2008Q1 to 7608 one year later and then increased to 10,857 in 2010Q1. The U.S. nominal major currencies dollar index exhibited instability from 2007 to 2010, varying from 70.336 in 2008Q1 to 84.007 in 2009Q1. The cause of the financial crisis was sub-prime mortgage loans in the U.S. This result is consistent with the finding of Roubini and Mihm (2010).

5.2. Stock market parameter estimate – interest rate

The effect of the real interest rate parameter estimate on stock index values is similar to that of the exchange rate. Only Thailand, Malaysia, and the U.S. have negative estimates as stabilizers. In the second half of 1997, the interest rate in Thailand rose as capital outflows accelerated. The BIBOR increased 1.28-fold from 9.0 percent in 1997Q1 to 20.5 percent three quarters later. These decisions were part of the effort to retain foreign capital in the country, while the SET index decreased by 45 percent during the same period. In 2008, the BIBOR increased from 3.273 percent in the first quarter to 3.865 by the end of the year, and the growth in percentage terms was only 18 percent. The SET index fell 54 percent over the same period. Fluctuations in the Thai interest rate tend to attenuate changes in the stock market index. The estimate for Malaysia of —2.11 is substantially higher than those for the other countries. Malaysia’s interbank offered rate (IBOR) increased from 6.16 percent in 1997Q1 to 10.39 percent in 1998Q2.

The Malaysia stock market index reached a peak 1077.3 in 1997Q2 and then declined to 373.52 in 1998Q3, a 65 percent loss. The direction of the change is consistent with estimates obtained in this study. When government credit controls were implemented in September 1998, the IBOR decreased to 5.68 in 1998Q4, a 45 percent decline. There was a 14 percent decrease in the stock index from 586.13 in 1998Q4 to 502.82 in 1999Q1. During the 2008 GFC, the interest rate fell from 3.49 in 2008Q1 to 2.0 percentage point in 2010Q1, a 43 percent decline. From 2008Q2 to 2010Q2, the stock index increased by 14 percent; therefore, reducing the interest rate would increase the stock index. A one-quarter lagged change in the IBOR during two financial crises attenuates changes in the stock market index.

In Taiwan the IBOR performed very differently during major crises. It peaked at 7.555 percent in 1997Q3 and reached a trough of 4.954 at the end of 1998. The monetary authority implemented a carefully designed tight interest rate policy to combat the inflow of speculative funds, and the rate then entered a downward trend, falling below 2 percent by 2007Q1.
Between 2007 and 2008, the interest rate hovered at approximately 2 percent and then fell to 0.492 percent in 2008Q4, when the U.S. federal funds rate decreased to 0.16.

In Hong Kong, the IBOR stood at 7.13 percent in 1997Q3, but fell to 4.38 percent six months later. The HKMA implemented policies targeting currency reserves to maintain capital inflows. Another peak is evident in 2000Q4, when the value reached 7.13 percent but it declined to 0.07 percent in 2003Q4, reflecting the impact of the SARS epidemic. The IBOR peaked at 4.75 in 2007Q3, had declined to 0.23 percent by 2008Q4, and then declined further to 0.13 in 2009Q2. This low rate was comparable to those observed in other nations.

The U.S. Federal Reserve System was able to limit fluctuations in the effective federal funds to between 5.56 in 1997Q2 and 4.68 in 1998Q4. However, during the 2008 GFC, the federal funds rate fell from 5.26 percentage points in 2007Q1 to 0.12 in 2009Q4, reflecting the U.S. recession. A low interest rate was implemented to promote business activity and revive the economy. The DJIA index decreased from 13,408.62 in 2007Q2 to 10,856.63 in 2010Q1, a 19 percent decline. The gradual change in the interest rate contributes to a mild change in the DJIA index.

5.3. Stock market parameter estimate – money stock

The estimate for the one-quarter lagged first difference of the money supply of .026 in Thailand is a positive but of minor significance. The money supply in Thailand decreased 7.5 percent in 1997Q2 and by a further 2.2 percent in 1997Q3. The Bank of Thailand began to increase the money stock in 1998, ranging from 1.2 percent in 1998Q2 to 3.9 percent in 1998Q3, to meet credit demand. However, the largest increase in the money supply was the 9.6 percent figure observed in 2008Q1, and the SET index decreased by 4 percent in 2008Q2. This result is consistent with the parameter estimates. To preserve space, we will omit the other three countries and turn to the U.S. estimates.

During the 1997 AFC, the Federal Reserve System maintained its ongoing expansionary policy. The rate of growth in the money supply ranged from 0.7 percent in 1997Q2 ($3896 billion) to 3.4 percent in 1998Q4 ($4396 billion). However, during the 2008 GFC, the money growth rate in 2007Q4 was 2 percent ($7521 billion), registered a meager 1.2 percent increase in 2008Q3 and declined by –0.66 percent in 2009Q3 ($8399 billion). The Fed's quantitative easing (QE) strategy targeted purchases of Treasury bonds and the retirement of bad debts from commercial banks and selected corporations, not the stock market.

5.4. Stock market parameter estimate – personal consumption expenditure

In Thailand, the estimate of the one-quarter lagged change in personal consumption expenditure of –.411 implies that a one-unit increase in this variable tends to reduce a contemporaneous change in the SET index by .411 point. This variable acts as a stabilizing factor. In 1997Q2 aggregate consumption decreased from 438 to 358 billion baht in 1998Q3, a reduction of 18 percent over 15 months. Aggregate consumption required four years, until 2002Q1, to rebound to 433 billion. Aggregate consumption expenditure in Thailand reached baht 586 billion in 2009Q4 from 566 billion in 2008Q1, with minor fluctuations between the two periods.

The estimate for Malaysia of –1.528 is the second-largest negative value, following the –1.954 obtained for Taiwan. Personal consumption expenditure in 1998Q1 was 3 percent smaller than in the same quarter one year previously. The figure for 1998Q2 reflects an 11 percent decline from the previous year because disposable income fell by 5.2 percent in 1998 (Malaysia Ministry of Finance, 2007). The consumption expenditure fell 7.8 percent from 1997 levels. Conditions were much favorable during the 2008 GFC, when consumption reached ringgit 334 billion, 9 percent higher than in 2007. Stability in consumption expenditure during the 2008 GFC reduces changes in the Malaysian stock market index.

The –1.954 estimate for Taiwan is the largest negative number, both among the variables considered and between countries. During the 1997 AFC, Taiwan exhibited a steady increase in private consumption expenditures from NT$1200 billion in 1997Q1 to 1384 billion in 1998Q4. The quarterly growth rate varies from 0.85 in 1997 to 3.3 percent in 1998. During the 2008 GFC, Taiwan entered a recession. Consumption expenditure declined from 2008Q2 to 2009Q2, deflation occurred in 2009, and the quarterly GDP growth rate fell to negative 10 percent in 2009Q1. In 2008Q4, the weighted stock market index declined by 46 percent in year-on-year terms but began to recover and reached 8188.11 in 2009Q4. The effect of a change in consumption expenditure on the change in the Taiwan stock market index was significant.

The parameter estimate for consumption expenditures in Hong Kong of 2.514 is the only positive estimate obtained for the countries under study. The 1997 level of consumption expenditures reached HK$798 billion, 10.6 percent higher than that in 1996. However, this figure decreased to 762 billion in 1998 and then further to 733 billion in 1999, an additional loss of 3.8 percent. In 2003, consumer spending suffered another 3.8 percent decline relative to 2002 because of the SARS epidemic. Consumer spending decreased from HK$1026 billion in 2008 to HK$1019 billion in 2009, a minor decrease of 0.6 percent. The volatility of consumption expenditures destabilized the Hang Seng index.

The parameter estimate for U.S. consumption expenditures of –.632 ranks in the middle of the results obtained for all countries considered. U.S. consumer spending did not decline in either 1998 or 1999. Consumer spending registered a 6.8 percent increase in 1998 relative to 1997 and was 7.7 percent higher in 1999 than 1998. This trend continued despite the 9/11 terrorists attacks in 2001. However, consumers spent $9745 billion in 2008, a 2 percent decrease in year-on-year terms, or 3.4 percent less from 2008Q3 to 2008Q4. Changes in personal consumption expenditures served as a stabilizing factor for changes in DJIA index.
5.5. Current account balance estimate – exchange rate

The parameter estimate of 1.664 for Thailand falls in the middle of the range observed for the five countries. Prior to the 1997 AFC Thailand had captured substantial capital inflows; the net trade deficit in 1996 reached baht 420.7 billion (US$4.3 billion). The factors contributing to the reversal of capital inflows during the 1997 AFC include: (1) deterioration in the exchange rate due to external speculative attacks, (2) weak financial institutions, and (3) lax government regulations (Mishkin, 2000; Whitman & Cascales, 1999). Thailand consented to adopt the stringent fiscal and monetary policies required by the International Monetary Fund. The current account balance changed from –US$5 billion in 1997Q3 to US$3.95 billion in 1998Q1. Exports suffered and the unemployment rate rose from 0.9 percent to 4.6 percent over the same periods. During the 2008 GFC, Thailand’s current account balance in 2008 (US$2.16 billion) was much smaller than one year previously ($15.7 billion) and one year later ($21.9 billion). Changes in the exchange rate exacerbated changes in the current account balance, thus serving as a destabilizing factor. The effect of this variable on current account at the country level is, in descending order, Hong Kong, the U.S., Thailand, Taiwan, and Malaysia. Discussions of the results for the remaining four countries are omitted due to a lack of space.

5.6. Current account balance estimate – interest rate

As the only negative interest rate estimate obtained for any of the countries, the –2.339 estimate for Malaysia indicates that it is a stabilizing factor. During the 1997 AFC the IBOR in Malaysia increased from 5.89 percent in 1997Q3 to 10.69 over six months. Malaysia’s annual current account balance varied from ringgit –14.2 billion in 1997, 37.4 billion in 1998, and 47.9 billion in 1999. Both capital outflows and commodity exports contributed to these increases. The estimate for Taiwan was .764 because the IBOR loan rate fell from 7.55 percent in 1997Q3 to 6.67 percent in the next quarter and reached 4.95 in 1998Q4. Taiwan’s current account balance decreased from US$7.0 billion in 1997 to US$3.4 billion in the next year, a loss of more than 50 percent. For context, the countries rank as follows on the measure, in descending order: Hong Kong, Thailand, the U.S., Taiwan, and Malaysia.

5.7. Current account balance estimate – money stock

All four Asian countries yield positive parameter estimates. In terms of magnitude, the estimate for Hong Kong is nearly ten-times higher than that for Thailand and 20-fold greater than that of Taiwan or Malaysia. By excluding Hong Kong, it is reasonable to suggest that the one-quarter lagged change in the money supply has a mild influence on a contemporaneous change in the current account balance. The U.S. money growth rate changed from being positive in all quarters in 2008 to negative in the second and third quarters of 2009, while the current account deficit improved substantially in 2009. For instance, this deficit was –US$177 billion in 2008Q1 but –98.5 billion one year later. A change in the U.S. money supply reduces the contemporaneous change in the U.S. current account balance.

5.8. Current account balance estimate – personal consumption expenditure

All five countries have positive parameter estimates for personal consumption expenditures. The ranking of the countries with respect to magnitude, in descending order is as follows: Hong Kong, Malaysia, the U.S., Thailand, and Taiwan. These figures are relatively higher than the estimates for the other variables with one exception in Thailand. We will briefly discuss the case of Hong Kong. In 1997, Hong Kong reported HK$798 billion (US$104 billion) in consumption expenditures, a current account balance of negative HK$47 billion, and HK$706 billion in foreign currency reserves. One year later, consumption expenditures decreased by 4.5 percent, the current account increased by 147 percent, and currency reserves declined by 3.4 percent. During the 2008 GFC, personal consumption expenditures fell by 0.6 percent from 2008 to 2009, the current account decreased by 39 percent, and foreign currency reserves increased by 38 percent. Reduced exports and a constant foreign exchange rate contributed to the substantial change in the current account balance. In the case of Hong Kong, a change in consumption expenditures served as a destabilizing factor with respect to a change in the current account.

6. Applications of the optimal set parameter estimates

There are two applications of the findings reported in Table 6: first, the contributions of policy variables and, second, the impulse responses due to the shocks.

6.1. Contribution of policy variables to state variables in 2009

The contributions are calculated using the effects of the exchange rate, interest rate, and personal consumption expenditures on both the respective stock market index and current account balance in 2009. The year 2009 is selected for two reasons: it is the second year of the global crisis, and the impact of the crisis had already been felt in many countries. In the U.S., mortgage-based derivatives collapsed when massive numbers of homeowners defaulted on their mortgage payments. In April 2007, the New Century Financial Company declared bankruptcy, the Ameriquest Mortgage Corporation
fell in August 2007, Lehman Brothers filed for Chapter 11 in September 2008, and the Federal Reserve Banks extended loans valued at 85 billion dollars to American International Group in September 2008. In February 2009, the U.S. President Barack Obama signed a fiscal stimulus package into law (Krugman, 2009; Roubini & Mihm, 2010). The effect of U.S. mortgage derivatives on Taiwanese banks and investors is exemplified by the securities issued by the Private Equity Management Group Inc. (PEMG) controlled by Danny Pang. In 2009, the U.S. Securities and Exchange Commission filed suit against PEMG (Tsai & Dean, 2009). The contributions of three policy variables to the two state variables are reported in Table 7.

All figures reported in Table 7 represent the average of all four quarters in 2009. The change in the HK Hang Seng index of 2001.32 reported in row 1 is the largest value observed in the five countries considered. This index lost 1790.54 points declining from 14,108.84 in 2008Q4 to 12,317.46 in 2009Q1, but increased by 6571.13 points during the second quarter; the overall average change across the four quarters is 2001.32. Row 2 reports the product of $\lambda_2$ and the one-period lagged change in the exchange rate shown in equation 7. For Thailand, only .04 percent of the average stock index change of 79.77 can be attributed to the one-period lagged change in the exchange rate. Malaysia fared better, with a negative .37 percent of the change in the KLCI index being attributable to the one-period lagged change in the exchange rate. The results for the countries indicate a contribution of less than one percent. For the U.S., changes in the exchange rate exhibit an inverse relationship with changes in the DJIA index number, but this change is of insignificant magnitude. This result suggests that changes in consumption expenditures contribute much less than changes in the interest or exchange rate with respect to changes in stock market indices during 2009.

The lower half of Table 7 reports the contributions of the policy variables to changes in current account balance. In row 10, reporting the shares of a one-period lagged change in the exchange rate in the countries considered, Thailand and U.S. reflect a negative effect, while Malaysia, Taiwan, and Hong Kong indicate a positive effect. The ranking of the magnitudes in descending order is Taiwan, Malaysia, Hong Kong, Thailand, and the U.S. Row 14 presents the contribution of personal consumption expenditures in each country. Notable effects are observed in four countries with the exception being Hong Kong.

6.2. Impulse responses in Thailand

The impulse responses in Thailand reflect the effects of a variance shock from either of the two policy variables, the exchange rate and the interest rate, on the two state variables, the stock index and the current account balance. These graphs, not presented here, for the five countries are available from the author upon request. For example, when a change in the exchange rate in Thailand generated a shock, the standard error of the change in the SET stock index moved in a sequence: $-0.1$ in the beginning, $-0.3$ in the third quarter, positive $0.2$ in the next two quarters, and zero in the 16th quarter. When a change in the interest rate generated a shock, the standard error of the change in Thailand’s current account balance responded by $-0.04$, increased to $0.01$, reduced to $-0.02$, and ultimately returned to 0. A change in the interest rate has a stronger effect on changes in the stock index than on changes in the current account.

A variance shock due to a change in the exchange rate tends to generate initially positive responses in Hong Kong, negative responses in Malaysia and Taiwan, and no responses in the U.S.

7. Conclusions and policy implications

This study finds that the financial crises-based one-quarter lagged changes in the exchange rate and real interest rate exert a stabilizing effect on fluctuations in contemporaneous changes in stock market indices in Thailand, Malaysia,
and the U.S. A one-quarter lagged change in personal consumption expenditures serves as a stabilizer of the same variable for four countries with the exception being Hong Kong. The magnitude of the stabilizing effect is as follows, listed in descending order: the U.S., Thailand, and Malaysia. For those countries where it has a destabilizing effect, the ranking, in descending order, is: Hong Kong and Taiwan.

As policy variables, a one-quarter lagged change in the exchange rate, and in personal consumption expenditures exert a destabilizing effect on the contemporaneous first-difference of the current account balance in the five countries considered. Regarding the exchange rate in descending order of magnitude, the countries rank as follows: Hong Kong, the U.S., Thailand, Taiwan, and Malaysia. With respect to consumption expenditures ranking of the magnitude of the country-level effects, in descending order, is Hong Kong, Malaysia, the U.S., Taiwan, and Thailand. The real interest rate only serves as a stabilizer in Malaysia, while it acts as a destabilizer in the other four countries; the ranking of the latter effect, in descending order, is Hong Kong, Thailand, the U.S., and Taiwan.

The findings of this study provide valuable and practical information for policymakers in these countries. All sectors of the economy, households, firms, the government, and external economies, are considered in the DSGE specification. Our study distinguishes stabilizing from destabilizing factors. For example, policymakers governing Thai financial markets may realize that there are three significant factors, namely, personal consumption expenditures, the short-term interest rate, and the foreign exchange rate, which act as stabilizers to reduce fluctuations in the SET stock market index. Therefore, determining how to incorporate consumer spending into the monetary or financial policy toolkit poses a challenge. Similarly, personal consumption expenditures can be regarded as a new potential policy tool for policymakers in Malaysia, Taiwan, and the U.S. However, it may not serve the same purpose for Hong Kong, as it acts as a destabilizer in the SAR.

Our findings also suggest that policymakers regulating international trade in all five countries have a new indicator to evaluate, namely, personal consumption expenditures. This indicator exerts an equal or greater destabilizing effect on a country’s international trade as the foreign exchange rate. In addition, policymakers in Malaysia may wish to give additional consideration to the real interest rate as a significant stabilizer to reduce fluctuations in its foreign trade.

Further studies are needed in two areas: the incorporation of shocks generated by key macroeconomic variables into a Bayesian estimation and the incorporation of labor/technology considerations into the production sector function to enrich the analysis.

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