Chapter 4
Empirical results[26]

4.1 Introduction

The study investigates the sensitivity of commercial bank index return (hereafter called Index) to unexpected changes in interest rate, which is the inter-bank rate (hereafter called IB), for the period covering from September 1993 to March 2010 for three developing countries in the Southeast Asia region. These countries are Indonesia, Malaysia, and Thailand. As also previously mentioned in Chapter 2 (see Section 2.6), two hypotheses will be tested under different market conditions. This chapter presents the results of diagnostic tests and the estimation results from the Markov switching model (hereafter called the MS model).

The remaining parts of this chapter are organised as follows. Section 4.2 presents the descriptive analysis. The results of unit root test (the ADF test) and the MS model are shown in Sections 4.3 and 4.4. Comparison results among developing countries and the chapter summary are presented in Sections 4.5 and 4.6.

4.2 Descriptive analysis

Table 4.1 provides summary descriptive statistics for all variables during the sample period. Indonesia has the highest return on Index of 0.2202%, while Thailand has the lowest Index return of -0.1736%. In the case of IB, Indonesia also has the highest rate of 15.1029% followed by the Thai IB of 5.0458%. No variables follow a normal distribution; for example, all variables have a peak distribution relative to a normal distribution, as indicated by a positive kurtosis statistic. Table 4.2 further shows that all variables are significantly correlated, except for the correlation between Index and IB in Malaysia. As expected, Index and GF have a positively and significantly correlation. Index, however, has a negative relationship with IB for all developing countries: Indonesia, Malaysia, and Thailand.

Table 4.1: Descriptive statistics

This table summarises the sampling properties of three variables (the commercial bank stock index return: Index, the inter-bank rate: IB, and the global factor: GF) from three developing countries in the Southeast Asia region. These countries are Indonesia, Malaysia, and Thailand. The sampling period is from September 1993 to March 2010 and the total number of observations is 199 per variable.

Countries	Variables	Mean	Skewness	Kurtosis
Global	GF	-0.0267	-0.4058**	3.4679***
		(1.4794)	(0.1723)	(0.3430)

[26] Some findings of this chapter have also been written as a research paper entitled "Money market interst rate and bank return in the Southeast Asia region: A comparison study", which has been presented at and published in the refereed conference proceedings in the 4th National Conference on Business and Economy, on 22 January 2011 in Khon Kaen, Thailand.

Table 4.1: Descriptive statistics (cont'd)

Countries	Variables	Mean	Skewness	Kurtosis
Indonesia	Index	0.2202	-0.9588***	11.9606***
		(1.1124)	(0.1723)	(0.3430)
	IB	15.1029	2.9366***	8.9153***
		(1.0586)	(0.1723)	(0.3430)
Malaysia	Index	-0.1011	-0.3671**	4.2868***
		(1.0238)	(0.1723)	(0.3430)
	IB	3.9977***	1.2802***	0.7618**
		(0.1336)	(0.1723)	(0.3430)
Thailand	Index	-0.1736	-0.0715	2.4057***
		(0.9998)	(0.1723)	(0.3430)
	IB	5.0458***	1.8149***	2.7544***
		(0.3602)	(0.1723)	(0.3430)

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.
Standard errors are given in parentheses.

Table 4.2: Correlation matrix of all variables

This table shows the correlation between three variables (the commercial bank stock index return: Index, the inter-bank rate: IB, and the global factor: GF) from three developing countries in the Southeast Asia region. These countries are Indonesia, Malaysia, and Thailand. The sampling period is from September 1993 to March 2010 and the total number of observations is 199 per variable.

Indonesia	Index	IB	GF
Index	1.0000	-0.2618***	0.8497***
IB		1.0000	-0.2686***
GF			1.0000

Malaysia	Index	IB	GF
Index	1.0000	-0.0638	0.7815***
IB		1.0000	-0.1487**
GF			1.0000

Thailand	Index	IB	GF
Index	1.0000	-0.2578***	0.8142***
IB		1.0000	-0.3275***
GF			1.0000

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.

4.3 *Unit root test*

The ADF test proposed by Dickey and Fuller (1979) is employed to test each variable for evidence of unit root behaviour. In each variable, the number of lags is chosen in such a way that no residual auto-correlation is evident in the auxiliary regressions.[27] The null hypothesis of this test is that data is non-stationary.

Table 4.3 shows the results of unit root test for each variable. It demonstrates that the null hypothesis of unit root test is able to reject at the conventional level of significance if all variables are in the level form, except for the IB of Malaysia and Thailand. For example, the t-statistic for the Indonesian Index is -7.6448, which is significant at the 1% level. This implies that the Indonesian Index in the level form is a stationary variable. In addition, if the Thai IB is in the level form, it is not possible to reject the null hypothesis of unit root test at the 5% level of significance. For instance, the t-statistic for the Thai IB is -2.2776, which is not significant at the conventional level. This implies that the Thai IB in the level form is not stationary; however, the first difference form of Thai IB (ΔIB) is a stationary variable, as the t-statistic is significant.

Table 4.3: Unit roots test

This table shows the result of unit root test (the ADF test) for three variables (the commercial bank stock index return: Index, the inter-bank rate: IB, and the global factor: GF) in both level and first different forms from three developing countries in the Southeast Asian region. These countries are Indonesia, Malaysia, and Thailand. The sampling period is from September 1993 to March 2010 and the total number of observations is 199 per variable. The test also includes only the intercept term. The null hypothesis of this test is the data has unit root behaviour (H_0: $\alpha = 0$) and the test is constructed as:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t ,$$

where y_t is the observed variable at time t; for $t = 1, 2, \ldots, T$,
T is the total number of observations,
x_t contains either an intercept term or an intercept term and time trend,
α, β, and δ are parameters to be estimated, and
u_t is the disturbance at time t and assumed to be white noise.

		Level form		First difference form	
Countries	**Variables**	Lags	Statistics	Lags	Statistics
Global	GF	0	-10.4564***	N/A	N/A
Indonesia	Index	1	-7.6448***	N/A	N/A
	IB	9	-3.5896***	N/A	N/A
Malaysia	Index	0	-11.9428***	N/A	N/A
	IB	1	-2.0772	0	-20.5867***
Thailand	Index	0	-12.1001***	N/A	N/A
	IB	3	-2.2776	5	-7.4907***

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.
N/A denotes Not Applicable.
The lag length selection is based on Schwarz (1978) information criterion and a maximum lag length is 14.

[27] The lag length selection is based on Schwarz (1978) information criterion.

4.4 *Markov switch model*

The first step for the MS model estimation is to simultaneously determine the numbers of regimes and lags on both IB and GF based on Schwarz (1978) information criterion (hereafter called SIC) as discussed in Chapter 3 (see Section 3.3). All results are generated by Ox metrics (see Doornik 2002) and the MSVAR package (Krolzig 1998). This study also uses the SIC to determine the MS model that is suitable for the data. The SIC value for all competing MS models with two to three regimes and up to two lags on both IB and GF are calculated, as shown in Table 4.4. For Malaysia and Thailand, the SIC value suggests that the best model is the MS model with all parameters (including intercept terms, parameters, and variances) varying with two regimes (or the MSIAH(2) model) and without any lag on both ΔIB and GF, as its value is smaller than other competing models. In the case of Indonesia, the suitable model is the MSIAH(2) model with one lag on both IB and GF.

Table 4.4: Model selection

This table summarises Schwarz (1978) information criterion (hereafter called SIC) for all competing Markov switching models with two to three regimes and one to two lags. The calculation of the SIC is defined as:

$$SIC = -2L + 2k \log(T),$$

where L, T, and k is the maximised log likelihood value, the total number of observations, and the number of estimated parameters, including the intercept term, respectively.

The sample contains monthly inter-bank rate, commercial bank stock index return, and the global factor from September 1993 to March 2010 for three developing countries, which are Indonesia, Malaysia, and Thailand, in the Southeast Asia region. The total number of observations is 199 per variable.

Countries	Models	Regimes	Zero lag	One lag	Two lags
Indonesia	MSIA	Two	9.6715	9.7045	9.7109
		Three	9.1122	9.1415	9.2611
	MSIAH	Two	8.8294	8.7637	8.8192
		Three	8.9552	8.9258	9.0526
Malaysia	MSIA	Two	8.8838	8.9075	8.9505
		Three	8.6583	8.7123	8.7871
	MSIAH	Two	8.4444	8.4710	8.5323
		Three	8.5637	8.5997	8.5498
Thailand	MSIA	Two	8.8876	8.9245	9.0241
		Three	8.9075	8.6842	9.1108
	MSIAH	Two	8.4017	8.4209	8.5189
		Three	8.4985	8.5682	8.7015

Note: MSIA is the Markov switching model that allows for intercept terms and autoregressive parameters are switching.

MSIAH is the Markov switching model that allows for all parameters (including intercept terms, autoregressive parameters, and variance) varying.

4.4.1 Indonesia

The rationale of using the MS model rather than a single linear model is the ability of capturing different responses of Index to changes in IB during different market conditions. To assess the validity of the MS model, it should focus on the model's ability to distinguish periods of normal and volatile market conditions. The transition probabilities, which are shown in Table 4.5, illustrate how normal and volatile market conditions switch between each other. The probabilities in the first row represent the probabilities of regime 1 switching into regimes 1 and 2. In the case where regime 1 switches into regime 1, it would mean the probability of staying in its own regime. For example, the probability of staying in regimes 1 and 2 are 97.96% and 96.43%. Moreover, the transition probability from regime 1 to regime 2 is quite low (2.04%) and the estimated duration for regime 1 is 49.03 months. This suggests that regime 1 is more stable. The estimated duration for regime 2 is also 28.02 months. These results suggest that there are volatile market conditions in regime 2. As a result, regimes 1 and 2 are labelled as normal and volatile market conditions.

Table 4.5: Transition probabilities and estimated duration for Indonesia
This table shows the regime transition probabilities among two regimes and the persistence of each regime. These two regimes are labeled as normal and volatile market conditions.

	Regime 1 (Normal)	Regime 2 (Volatile)	Duration (Months)
Regime 1 (Normal market conditions)	0.9796	0.0204	49.03
Regime 2 (Volatile market conditions)	0.0357	0.9643	28.02

The estimated parameters of MSIAH(2) model with one lag on both IB and GF are presented in Table 4.6, which provides information on the sensitivity of Index to changes in IB corresponding to each market condition. It clearly shows similar responses of Index to changes in IB. Changes in IB, for example, has a negative effect on the Index in the regimes 1 and 2 (or normal and volatile market conditions), as indicated by the sign of coefficients. These effects, however, are zero since the coefficients on IB are not significant during both market conditions. This result is also consistent with the literature. Awirothananon and Cheung (2008b), for example, find that the Hong Kong Index responds negatively to changes in money market interest rate.

In relation to Hypotheses 1 and 2 (see Chapter 2: Section 2.6), that are reproduced below, the results from Table 4.6 do not support both hypothesis. Changes in IB, for example, have a negative effect on the Index during both normal and volatile market conditions. The study, therefore, has rejected Hypothesis 1. Hypothesis 2 is also rejected because the coefficients on IB during both normal and volatile market conditions are not significant. This implies that the impacts of changes in IB on the Index during both market conditions are the same, which is zero.

Hypothesis 1: *The response of commercial bank stock index return to changes in inter-bank rate in volatile market conditions is different from that in normal market conditions.*

Hypothesis 2: The magnitude of response of commercial bank stock index return is smaller in volatile market conditions than in normal market conditions.

Table 4.6: Markov switching regime model for Indonesia

This table presents the estimated parameters of Markov switching model that allows for all parameters (including, intercept terms, autoregressive parameters, and variance) switching with two regimes (or the MSIAH(2) model) and one lag on both inter-bank rate: IB and the global factor: GF:

$$\text{Index} = v(s_t) + \sum_{i=0}^{p} A_i(s_t)x_{t-i} + u_t ,$$

where x_t = [IB, GF]′ and Index is the commercial bank stock index return,
$v(s_t)$ and $A_i(s_t)$ are defined as a parameter conditional upon the regime s_t; $s_t = \{1, 2\}$, and
u_t is assumed to be a Gaussian innovation process conditional on the regime s_t: $u_t \sim NID(0, \Sigma(s_t))$.

The sample contains monthly data from September 1993 to March 2010 and the total number of observations is 199 per variable.

Coefficients on	Regime 1 (Normal market conditions)	Regime 2 (Volatile market conditions)
v	5.1968***	12.9633
	(1.1127)	(8.1988)
IB	-0.0937*	-1.1529
	(0.0490)	(0.7898)
IB_1	0.3174***	0.6915
	(0.0523)	(0.7465)
GF	-0.2369***	-0.0610
	(0.1104)	(0.4415)
GF_1	-0.0739	0.0528
	(0.1517)	(0.4513)

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.
Standard errors are given in parentheses.

4.4.2 Malaysia

The transition probabilities, which are shown in Table 4.7, illustrate how normal and volatile market conditions switch between each other. The probabilities of staying in regimes 1 and 2 are 98.55% and 95.42%. Moreover, the transition probability from regime 1 to regime 2 is quite low (1.45%) and the estimated duration for regime 1 is 68.99 months. This suggests that regime 1 is more stable. The estimated duration for regime 2 is also 21.85 months. These results suggest that there are volatile market conditions in regime 2. As a result, regimes 1 and 2 are named as normal and volatile market conditions.

The estimated parameters of MSIAH(2) model without any lag on both ΔIB and GF are presented in Table 4.8, which provides information on the sensitivity of Index to changes in ΔIB corresponding to each regime. It clearly shows very similar responses of the Index to changes in ΔIB. Changes in ΔIB, for example, have a negative impact on the Index during both normal and volatile market condition, as indicated by a negative sign on IB. These impacts during both market conditions, however, are zero since the coefficients on ΔIB are not significant. This result is also consistent with the literature. Awirothananon and Cheung (2008b), for instance, find that the Hong Kong Index responds negatively to changes in money market interest rate.

Table 4.7: Transition probabilities and estimated duration for Malaysia

This table shows the regime transition probabilities among two regimes and the persistence of each regime. These two regimes are labeled as normal and volatile market conditions.

	Regime 1 (Normal)	Regime 2 (Volatile)	Duration (Months)
Regime 1 (Normal market conditions)	0.9855	0.0145	68.99
Regime 2 (Volatile market conditions)	0.0458	0.9542	21.85

Table 4.8: Markov switching regime model for Malaysia

This table presents the estimated parameters of Markov switching model that allows for all parameters (including, intercept terms, autoregressive parameters, and variance) switching with two regimes (or the MSIAH(2) model) and no lag on both inter-bank rate in the first difference form: ΔIB and the global factor: GF:

$$\text{Index} = \nu(s_t) + \sum_{l=0}^{p} A_l(s_t)x_{t-l} + u_t ,$$

where $x_t = [\Delta IB, GF]'$ and Index is the commercial bank stock index return, $\nu(s_t)$ and $A_l(s_t)$ are defined as a parameter conditional upon the regime s_t; $s_t = \{1, 2\}$, and u_t is assumed to be a Gaussian innovation process conditional on the regime s_t: $u_t \sim NID(0, \Sigma(s_t))$.

The sample contains monthly data from September 1993 to March 2010 and the total number of observations is 199 per variable.

Coefficients on	Regime 1 (Normal market conditions)	Regime 2 (Volatile market conditions)
ν	0.8867	-5.7027
	(0.9700)	(4.5231)
ΔIB	-0.0274	-0.0633
	(0.0778)	(0.4046)
GF	-0.2610***	0.1208
	(0.1262)	(0.3151)

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.
Standard errors are given in parentheses.

In relation to Hypotheses 1 and 2 (see Chapter 2: Section 2.6), that are reproduced below, the results from Table 4.8 do not support both hypotheses. During both regimes (normal and volatile market conditions), for example, the sign of coefficients on ΔIB are the same, which is negative. The study has, therefore, rejected Hypothesis 1. In addition, Hypothesis 2 is rejected because the coefficients on ΔIB in both normal and volatile market conditions are not significant. This indicates that there is no effect of changes in ΔIB on the Index during both market conditions.

Hypothesis 1: The response of commercial bank stock index return to changes in inter-bank rate in volatile market conditions is different from that in normal market conditions.

Hypothesis 2: The magnitude of response of commercial bank stock index return is smaller in volatile market conditions than in normal market conditions.

4.4.3 Thailand

The transition probabilities that present how normal and volatile market conditions switch between each other are shown in Table 4.9. For example, the probabilities of stay in regimes 1 and 2 are 96.97% and 91.11%. Furthermore, the transition probability of regime 1 switches to regime 2 is quite low (3.03%) and the estimated duration for regime 1 is 33.03 months. This suggests that regime 1 is more stable. The estimated duration for regime 2 is also 11.25 months. These results suggest that there are more volatile market conditions in regime 2. As a result, regimes 1 and 2 are labelled as normal and volatile market conditions.

Table 4.9: Transition probabilities and estimated duration for Thailand
This table shows the regime transition probabilities among two regimes and the persistence of regimes. These two regimes are labeled as normal and volatile market conditions.

	Regime 1 (Normal)	Regime 2 (Volatile)	Duration (Months)
Regime 1 (Normal market conditions)	0.9697	0.0303	33.03
Regime 2 (Volatile market conditions)	0.0889	0.9111	11.25

Table 4.10 presents the estimated parameters of MSIAH(2) model without any lag on both ΔIB and GF. It provides information on the sensitivity of Index to changes in ΔIB corresponding to each regime. It also clearly shows that the Index responds differently to changes in ΔIB across normal and volatile market conditions. Changes in ΔIB, for example, have a positive (negative) impact on the Index during normal (volatile) market conditions, as indicated by a positive (negative) sign. These impacts, however, are zero since the coefficients on ΔIB are not significant during both market conditions. This result is also consistent with the literature. Faff and Howard (1999), for example, report a positive and negative relationship between Australian commercial banks' stock return and money market interest rate.

In relation to Hypotheses 1 and 2 (see Chapter 2: Section 2.6), the results do support only Hypothesis 1. In normal market conditions, for example, the Index reacts to changes in ΔIB in a positive manner (as indicated by a positive sign) while a negative reaction occurs during volatile market conditions. Hypothesis 2 is, however, rejected since the coefficients on ΔIB during both normal and volatile market conditions are not significant. This implies that the responses of Index to changes in ΔIB are the same during both market conditions.

Hypothesis 1: The response of commercial bank stock index return to changes in inter-bank rate in volatile market conditions is different from that in normal market conditions.

Hypothesis 2: The magnitude of response of commercial bank stock index return is smaller in volatile market conditions than in normal market conditions.

Table 4.10: Markov switching regime model of Thailand

This table presents the estimated parameters of Markov switching model that allows for all parameters (including, intercept terms, autoregressive parameters, and variance) switching with two regimes (or the MSIAH(2) model) and no lag on both inter-bank rate in the first difference form: ΔIB and the global factor: GF:

$$\text{Index} = \nu(s_t) + \sum_{l=0}^{p} A_l(s_t)x_{t-l} + u_t \,,$$

where x_t = [ΔIB, GF]′ and Index is the commercial bank stock index return,

$\nu(s_t)$ and $A_l(s_t)$ are defined as a parameter conditional upon the regime s_t; $s_t = \{1, 2\}$, and

u_t is assumed to be a Gaussian innovation process conditional on the regime s_t: $u_t \sim NID(0, \Sigma(s_t))$.

The sample contains monthly data from September 1993 to March 2010 and the total number of observations is 199 per variable.

Coefficients on	Regime 1 (Normal market conditions)	Regime 2 (Volatile market conditions)
ν	-0.4552	-2.3580
	(0.8328)	(4.6935)
ΔIB	0.0029	-0.3942
	(0.0561)	(0.3901)
GF	-0.1412	0.1042
	(0.1021)	(0.3452)

Note: One, two, and three asterisks stand for 10%, 5%, and 1% statistical significance respectively.
Standard errors are given in parentheses.

4.5 Comparison results among developing countries

As mentioned in the objectives of this study (in Chapter 1: Section 1.2), the response of Index to changes in IB between Thailand and other developing countries, including Indonesia and Malaysia, in the Southeast Asia region will be compared under different market conditions.

Table 4.11 presents the comparison results of the response of Index to changes in IB between Thailand and other developing countries, including Indonesia and Malaysia, under different market conditions. The results can be divided into two categories: Direction of response and magnitude of response. It shows that during normal market conditions, the direction of response of the Thai Index to changes in IB is a positive manner, which is different from those of Indonesian and Malaysian Indices. In volatile market conditions, however, the Thai Index responds negatively to changes in IB. This response is similar to other developing countries' Indices. In term of the magnitude of response, the Thai Index does not react significantly to changes in IB rate during both normal and volatile market conditions. This study, therefore, concludes that the magnitude of response for the Thai Index is the same during both market conditions. These results are similar to both Indonesian and Malaysian Indices since their responses to changes in IB are not significant in both normal and volatile market conditions as well.

Table 4.11: Summary of results
This table summarises the results of three developing countries, namely Indonesia, Malaysia, and Thailand, in the Southeast Asia region. It can be divided into two groups: direction of response and magnitude of response.

Characteristics of responses	Countries	Market conditions	
		Normal	Volatile
Direction of response	Indonesia	Negative	Negative
	Malaysia	Negative	Negative
	Thailand	Positive	Negative
Magnitude of response	Indonesia	Zero	Zero
	Malaysia	Zero	Zero
	Thailand	Zero	Zero

There are some explanations for the difference among these three developing countries. First, the economic background of these countries is different from each other. Referring to the Fitch rating (in Table 2.3), the Thai economy has developed in a positive trend while the Indonesia and Malaysia sovereign rating have been downgraded in some periods. For example, the credit rating for Indonesia in 1998 is BB- and it is downgraded to B- between 1999 and 2001. Second, Thailand operates monetary policy within an explicit inflation-targeting framework while Malaysia operates without it. These three developing countries also seek to stabilise the inflation rate, which is their objective. To achieve this objective, the central banks focus mainly on a core measure of inflation. At the same time, Indonesia and Malaysia have also pursued to stabilise the exchange rate while Thailand has not (Genberg & He 2009; Filardo & Genberg 2010). According to Ahsan, Skully and Wickramanayake's (2007, 2008) studies, they show that the Bank of Thailand has smaller degree of independence in pursuing its foreign exchange rate when compared with Indonesia and Malaysia. Pursuing the exchange rate stability, it may create a conflict with the inflation stability, if it leads to inappropriate setting the policy rate (Amato et al. 2005). This might cause the result of these three developing countries to be different from each other.

4.6 Chapter summary

This chapter discusses the results generated from unit root test, model selection, and the MS model for Thailand and other developing countries, namely Indonesia and Malaysia, in the Southeast Asia region. The results of unit root test (the ADF test) show that most data are stationary in the level form, except for the IB of Malaysia and Thailand. The SIC value supports the use of the MS model with two regimes and one lag on both IB and GF for Indonesia, while the MS model with two regime and without any lag on both ΔIB and GF is suitable for Malaysia and Thailand.

The results from the MS model suggest that the Thai Index responds positively (negatively) to changes in IB during normal (volatile) market conditions. These directions of response lead to an acceptance of Hypothesis 1, as shown in Table 4.12. In the case of Indonesia and Malaysia, changes in IB create only a negative effect on Index during both normal market conditions. Hypothesis 1 is, therefore, rejected for both Indonesia and Malaysia. In addition, the responses from all developing countries' Indices to changes in IB are not significant in both normal and volatile market conditions. This implies that changes in IB may not create any impact on Index during both market conditions. As a result, Hypothesis 2 for all developing countries is rejected.

Table 4.12: Summary of hypotheses testing

This table summarises the results of hypotheses testing for three developing countries, namely Indonesia, Malaysia, and Thailand.

Hypotheses	Countries	Results
Hypothesis 1: The response of commercial bank stock index return to changes in inter-bank rate in volatile market conditions is different from that in normal market conditions.	Indonesia	Rejected
	Malaysia	Rejected
	Thailand	Accepted
Hypothesis 2: The magnitude of response of commercial bank stock index return is smaller in volatile market conditions than in normal market conditions.	Indonesia	Rejected
	Malaysia	Rejected
	Thailand	Rejected