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Does asymmetric information play a role in explaining the Asian crisis? Application to Indonesian and Malaysian cases using a two-state Markov Switching model

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Abstract

This paper aims at establishing a relationship between disparity of information and the probability of speculative attack in explaining the Asian crisis. We apply the general framework of Markov-Switching models to the differential of interest rates (DIR), subsequently in Indonesia and Malaysia. We allow dependency of the transition probabilities over the asymmetric information indicators. The Maximum Likelihood estimators results (MLE) are twofold: (1) an increase of information dispersion among speculators leads to a higher probability of a currency crisis (2) there is a significant asymmetric impact of information disparity as measured by the difference between fund price and Net Asset Value (NAV) on the transition probability in the case of Indonesia, while the hypothesis is rejected for Malaysia's case.

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1 Introduction

Whether asymmetric information plays a role in currency crisis is an issue that has important implications for both the theoretical and empirical literature in international finance. The matter is critical. If for example, asymmetric information increases the probability of a speculative attack, the exchange rate regimes will be more vulnerable in periods of higher disparity of information and policymakers should adjust their policies accordingly, as underlined by Prati and Sbracia (2002, p.1)

The Asian crisis has caused severe economic turbulence in the economies of South East Asia since July 1997, and has spread beyond the region to reach Russia and Brazil. The explanation of the Asian crisis has been the subject of much argument. There is no easy consensus to be reached on what lay behind it. According to first generation models (Krugman (1979), Flood and Garber (1984)), currency crises are caused by insufficient foreign exchange reserves due to a persistent deficit in balance of payment and bad fundamentals. However, the second generation characterizes currency crises as self-fulfilling speculative attacks which result in multiple equilibria. Ratti and Seo (2003) provide some evidence of Korea being in the zone of multiple equilibria and having self-fulfilling speculation at times during 1997 and 1999 using a non linear model. A new generation of currency crisis emphasizes financial sector weakness and investor behaviour. These models are called inter-generation models because they combine sequences of first and second generations. Krugman (1998) and Corsetti et al. (1998) explain the Asian crisis using a moral hazard model. As a response to the Asian crisis, international policy makers suggest that increased transparency could help to avoid speculative crashes. To date, there has been little empirical work on the role of asymmetric information in explaining currency crises, with the notable exception of three papers, namely Prati and Sbracia (2002), Metz (2003) and Tillmann (2004). While the two first papers study the impact of uncertainty about fundamentals on currency crises, the third one uses a different approach. It analyses the impact of uncertainty that originates from private information among foreign exchange investors. Tillmann (2004) finds that information disparity raised the probability of speculative attack for the French Franc and Italian Lira in the European Monetary System (EMS) crisis of 1992.

We focus particularly on the cases of Indonesia and Malaysia, and try to separate the contributions of economic fundamentals from asymmetric information in explaining the speculative events. Such contribution builds on the pioneering work of Morris and Shin (1998) and Heinemann and Illing (2002). These latter developed a reduced game to model currency attack under noisy private information. They report that changes in information structure of speculators can explain the sudden movements in the probability of devaluation. However, linking global games framework to empirical finance seems not to be an easy task. That’s why adopting a methodology analogous to that of Tillmann, appears to be the most suitable approach for our purpose.

The remainder of this paper is organized as follows; section 2 motivates the use of country fund premia as an indicator of asymmetric information. Section 3 derives the testable implications of the latter inspired from Tillmann’s technical methodology and discusses the results of our estimates. Section 4 concludes.

2 Country fund premia and asymmetric information

Frankel and Schmukler (1996, 2000) were the first to introduce asymmetric information into the discussion about country fund premia/discounts. Country funds premia describe the reaction of international investors versus local investors. Lack of perfect arbitrage[1] enables us to compare the reaction of prices and NAV during the time of crises.

The basic argument is that differing investors sentiments and/or the existence of asymmetric market information induces divergent expectations across local and US investors during periods of market turbulence. This divergence might be illustrated as follows; "local holders of underlying assets are assumed to have relatively superior access to their own markets and economies, and are better in evaluating variations of fund NAVs. However, since the funds are traded on US stock exchange, US investors have better information for identifying factors that influence the fund price movements. This asymmetric information generates different expectations, which, in turn, lead to different speeds of processing market information and reacting to unexpected news or events." (Tsai (2010, p2))

3 Econometric modelling

Market participants' strategic behaviour has the potential to fuel and magnify market turmoil and even to trigger financial crises. To capture and understand such pathologies, we propose an empirical framework in the spirit of Tillmann (2004), applied to the Asian crisis context. Our specific empirical focus is on Indonesia and Malaysia.

3.1 Data, model description and preliminary analysis

In models of regime change, the regression parameters depend on an unobservable discrete variable whose realization is a Markov chain of first order. Iterative algorithms based on Bayesian procedures are used to estimate the model's parameters. The Markov-Switching models are very useful for modelling changes in the economic linkages and their interaction with economic fundamentals. They are particularly useful for identifying episodes of crisis and non crisis. Jeanne (1996, 2000) demonstrated through this class of models that the French Franc crisis of 1992-93 had strong self fulfilling characteristics and was caused by a phenomenon of "sunspots".

The DIR of a country displays different behaviour during periods of "pressure" and "stable" periods. In order to capture such asymmetry, we apply a two-state Markov-Switching model with time varying transition probabilities. Hamilton (1989, 1990) considered a simple version of Markov-Switching with transition probabilities that are fixed (PTF). Later, Diebold et al. (1994) developed a Markov-Switching with time-varying transition probabilities (PTV) in order to capture the systematic changes in the transition probabilities. Apart from yielding more accurate estimates of the process, the main advantage of Markov-Switching model, often advocated in the literature, is its ability to take into account features such as non linearity and the persistence of extreme observations. The regime switching model combines two or more sets of model parameters into one system. According to Moore and Wang (2009, p. 3), "it is argued that a discrete measure of crisis in probit models, which are frequently employed for the analysis of currency crises, leads to a loss of information on the scale of speculative pressure." So, we don't refer to those models in explaining the role of asymmetric

[1] The efficient market hypothesis states that the price of closed-end funds should converge to the NAV. The scope for arbitrage is limited due to capital account restrictions and transaction costs. This reflects the fact that investors in the local (NAV) and foreign markets (fund prices) differ.

information. In our case, there are two possible states of nature: "tranquil" (s_t=0) versus "crisis" (s_t=1) regime. The density function of the DIR_t, depending on s_t, is given by:

$$f\left(DIR_t / s_t\right) = \frac{1}{2\sqrt{\pi}\sigma}\exp\left(-\frac{(DIR_t - m_{s_t} - \sum_{i=1}^{3}\theta_i F_{it})^2}{2\sigma^2}\right) \quad (1)$$

Where F_{it} is the fundamental i at time t, i=1, 2, 3.

In equation (2), the interest rate differential between Indonesia or Malaysia, respectively, and United States is regressed on three macroeconomic fundamentals (see Table1 for details) whose effects are represented by the coefficients θ_1, θ_2 , and θ_3:

$$\begin{aligned} DIR_t^{ind} &= m_{s_t} + \theta_1 cagdp_t + \theta_2 rgdpg_t + \theta_3 treer_t + \varepsilon_t \\ &\text{with} \quad \varepsilon_t \to iid\left(0,\sigma^2\right) \\ DIR_t^{mal} &= m_{s_t} + \theta_1 dcrg_t + \theta_2 rgdpg_t + \theta_3 treer_t + \varepsilon_t \\ &\text{with} \quad \varepsilon_t \to iid\left(0,\sigma^2\right) \end{aligned} \quad (2)$$

Where m_{s_t} is a regime-specific intercept. Conceptually, the switching parameters need not to be restricted to the intercept of the model. We pursue this parsimonious model because of the relatively small size of the sample. The discrete variable s_t can shift between two realizations:

$$s_t = j, \quad j = 0,1 \quad (3)$$

$$prob(s_t = j / s_{t-1} = i) = p_{ij} \quad (4)$$

All the transition variables are collected in the (2x2) transition matrix:

$$\mathrm{P} = \begin{bmatrix} p_{00} & p_{10} = 1 - p_{11} \\ p_{01} = 1 - p_{00} & p_{11} \end{bmatrix} \quad (5)$$

The transition probabilities are assumed to be time-varying by considering a logistical function:

$$\begin{aligned} p_{oo} &= \frac{\exp\left(q_0 + q_1\omega_{t-1}^i\right)}{1 + \exp\left(q_0 + q_1\omega_{t-1}^i\right)} \\ p_{11} &= \frac{\exp\left(p_0 + p_1\omega_{t-1}^i\right)}{1 + \exp\left(p_0 + p_1\omega_{t-1}^i\right)} \end{aligned} \quad (6)$$

Where p_{ii} : is the probability of remaining in regime i at time t, p_{ij} is the probability of switching from regime i to j. The coefficient q_1 (p_1) represents the impact of the proxy on the probability of jumping from regime 0 (1) to regime 1 (0). We expect q_1 to be negative, which means that a speculative attack is more likely if the information is more disparate. Finally, ω^i, is a proxy of information disparity among the investors. Following Tillmann (2004), we consider the same three measures of asymmetric information, based on the definition of country fund premia:

$$
\begin{aligned}
\omega_t^1 &= (\,fund\ \ price - NAV\,)_t \\
\omega_t^2 &= \left| fund\ \ price - NAV \right|_t \\
\omega_t^3 &= \left(fund\ \ price - NAV \right)^2{}_t
\end{aligned}
\qquad (7)
$$

Where ω^1 measures the difference (in US dollars) between the fund prices and their underlying net asset values. This indicator reflects the informational advantage of foreign investors over local investors. ω^2 and ω^3 are two measures of information disparity, irrespective to which party is better informed than the other. When the fund price exceeds the NAV, this difference is called premium, and discount in the opposite case. Table 2 presents the statistics for both Southeast Asian countries. Both countries have sold at average premium of 2.88% in Indonesia and 4.49% in Malaysia. In general, the window corresponding to the currency crisis is not well defined. In order to have a uniform basis for comparison across the two funds, we use 117[2]-month window starting from mid-July. The non-event window used for comparison is the 117-day period preceding the Asian crisis. Statistical significance of changes in premia is evaluated using t-statistics from regressions of the premia on a constant and a dummy variable equals to one during the 117-day crisis and 0, otherwise. A significantly positive coefficient on the dummy variable implies that the premia during the crisis are significantly higher than premia before the crisis. A visual inspection of figures 1 and 2 shows that premia rose for both funds starting in mid-1997. The jump in premia in the case of Indonesia was quite sudden, while the Malaysia's premia increased slightly, despite the country's economic recovery. In fact, we see discounts shrinking before the free floating and turning into premia afterwards. These observations generally coincide with Frankel and Schmukler's findings, namely that foreign investors tend to be more optimistic than local investors during the crisis period. This preliminary analysis urges us to use country fund premia as an indicator of information disparity and investigate its impact on the probability of speculative attack in a Markov-Switching framework.

Finally, the estimator of maximum likelihood is given by the expression:

$$
\begin{aligned}
\widehat{\phi}_{ML} &= \arg\max_{\phi} \ln L(\phi) = \sum_{t=2}^{T} f\left(DIR_t / \Omega_{t-1}\right) \\
f\left(DIR_t / \Omega_{t-1}\right) &= \sum_{j=0,1}\sum_{i=0,1} f\left(DIR_t, s_t = j, s_{t-1} = i / \Omega_{t-1}\right) \qquad (8)\\
&= \sum_{j=0,1}\sum_{i=0,1} f\left(DIR_t / s_t = j, s_{t-1} = i, \Omega_{t-1}\right) prob\left(s_t = j / s_{t-1} = i : \omega_{t-1}\right) prob\left(s_{t-1} = i / \Omega_{t-1}\right)
\end{aligned}
$$

3.2 Estimation results and discussion

This study uses monthly[3] data for Indonesia and Malaysia over the period 1990: 3 through 2001: 3 and 1987: 5 through 2001: 6, respectively. The choice of the period is restricted by

[2] Data range from 14/7/1997 to 31/12/1997. We chose to work with a daily basis in order to have a large dataset.
[3] We used monthly data because the Asian fundamentals provided are available on a monthly basis.

the Dataset on fundamentals provided and the availability of fund price and the NAV data. These latter were gathered from http://www.etfconnect.com/[4] web site.
The EM-algorithm was performed using R2.6.0 software[5]. In this subsection, we discuss the estimation results of the Markov-Switching model with both fixed and time varying transition probabilities.

Markov-Switching with fixed transition probabilities

From these results, we can draw the following observations:
First, in order to identify which regime is more persistent, we need to interpret the probability estimates. The estimates of transition probabilities p_{oo} and p_{11} are both highly significant in the two South East Asian countries. The probabilities of staying in regime 0 (the values are about 0.98) are bigger than the probabilities of staying in regime 1 (the values are about 0.94 and 0.97, respectively).

Markov-Switching with time varying transition probabilities

Results from estimating the non-linear maximum likelihood model are given in Tables 3.1 and 4.1. We can see that the coefficients of the three macroeconomic fundamentals are statistically significant for the case of Indonesia, and a little bit for Malaysia. They have also the expected signs. The regime-switching intercepts are highly significant. It is clear that the linear approach is strongly rejected in both cases against the Markov-Switching model as shown in table 3.2 and table 4.2 which report the results of Wald specifications tests for equality for the regime dependent coefficients. The null hypothesis of equal intercept terms across regimes is rejected at high levels of significance for both countries, mirrored by the value of likelihood ratio (LR[6]). In most cases, the impact of ω^i is negative as measured by the coefficient q_1 which means that disparate information raises the probability of a currency crisis[7]. However, only the first disparity of information measure seems to have a significant asymmetric impact on the transition probability (Indonesia). The same test fails to detect any significant asymmetric impact for the other measures. In the same vein, the results from Table 4.2 suggest that the expectations of local and foreign investors were not sufficiently divergent in Malaysia although there is a statistical significant impact of the measure ω^2 .

Other empirical works that studied PTV models using the exchange market pressure, include Cerra and Saxena (2002) who tried to test the contagion effect on the Indonesia's currency crisis from the neighbouring countries (Thailand, Korea). Similarly, Abiad (2003) used PTV models to study the Asian crisis, but he hardly found any significant impact of fundamentals on the exchange market pressure. All these papers analysed the impact of fundamentals/contagion on the exchange market pressure. In our knowledge, this paper is the first to study the combined effect of fundamentals and asymmetric information on the differential of interest rates, but applied to the context of Asian crisis.

[4] Data can precisely be obtained from this page: http://www.cefconnect.com/Pricing/DailyPricing.aspx

[5] The Markov-Switching program is available on the webpage of Atsushi Matsumoto http://www.geocities.jp/atsmatsumoto/index.html. Some modifications were done in order to fit our model's specification.

[6] LR=-2(L_c-L_{nc}) where L_c and L_{nc} are Max L. for constraint and non constraint models, respectively.

[7] If $\omega^i \uparrow \rightarrow\ p_{01} = 1 - p_{00} = \dfrac{1}{1+\exp(q_0 + q_1\omega^i_{t-1})}\uparrow$

4 Concluding Remarks

In this paper, we have investigated the role of information disparities in the case of Asian crisis. We particularly focused on two South East Asian countries, namely, Indonesia and Malaysia. Our framework is based on Tillmann's model with a slight difference. Country funds premia are used to approximate the dispersion of information among investors. We find that disparate information raises the probability of a currency crisis, with a significant asymmetric impact on the probability of transition, hardly depicted only for the case of Indonesia. This paper relates to the role that transparency plays in currency crisis models. It will be more interesting to investigate the impact of disparate information on the probability of speculative attack in other East Asian countries (i.e. Thailand, Singapore, Korea, Hong Kong, Taiwan, Philippines). On step in this direction might be modelling DIR as a Markov Switching process for panel data. This will depend upon availability of data on country funds premia. There may be also scope for an empirical verification of multiple factors crisis (See Cerra and Saxena, 2002). Future research may be, then, seeing which of the following factors, namely, fundamentals, contagion or asymmetric information that the most determines the Asian currency crisis.

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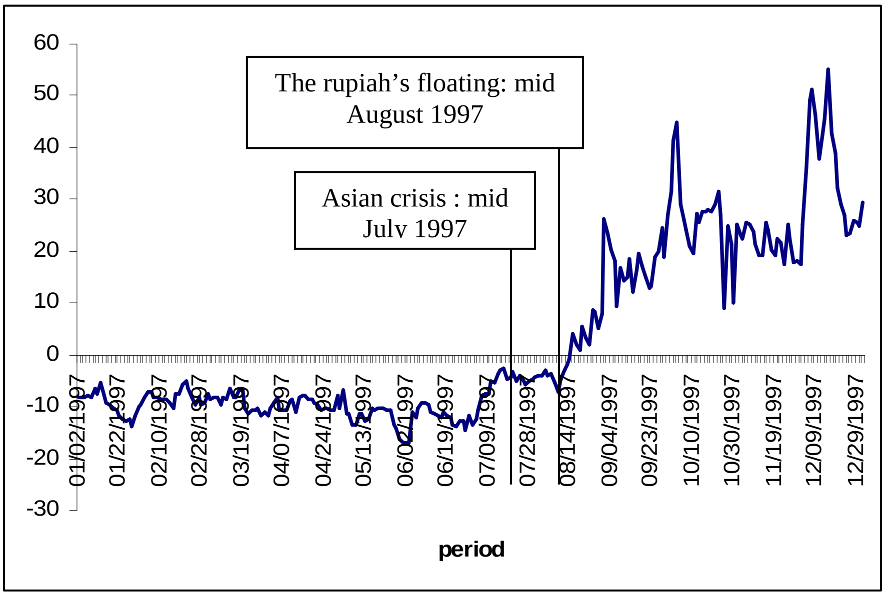
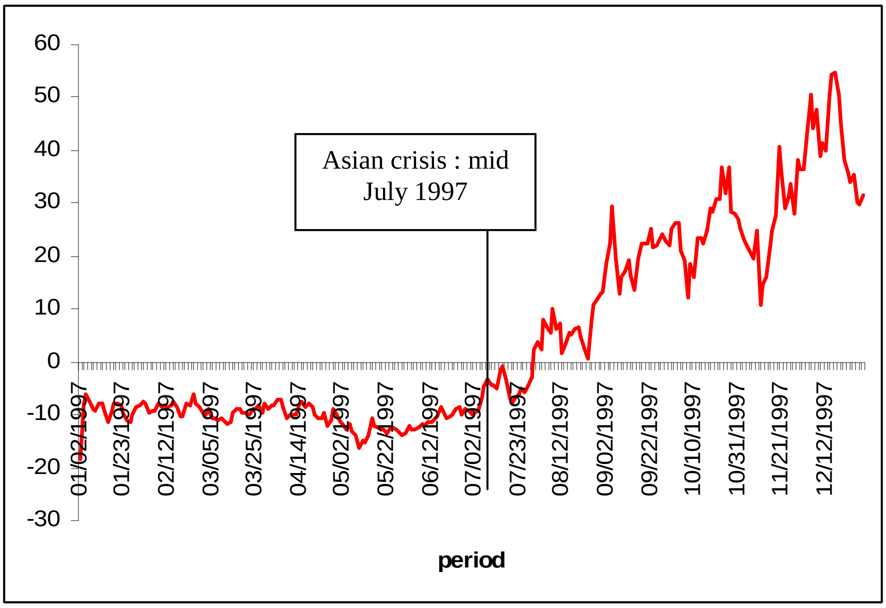
A. Figures

Figure 1- Indonesia fund premium/discount



Note: Daily country fund premia plotted under the period 2/1/1997-31/12/1997

Figure 2- Malaysia fund premium/discount



Note: Daily country fund premia plotted under the period 2/1/1997-31/12/1997

B. Tables

Table 1- Fundamentals per country and expected signs

	Notation	Indonesia	Malaysia	Expected sign
Current account as a percentage of GDP	**cagdp**	**yes**		**-**
Domestic Credit Growth	**dcrg**		**yes**	**+**
Real gross domestic product growth	**rgdpg**	**yes**	**yes**	**-**
Temporary component of real exchange rate	**treer**	**yes**	**yes**	**?**

Note: treer=actual real exchange rate-Hodrick Prescott filter

Table 2- Closed-end country fund premia: Descriptive statistics

Country fund premia: Descriptive statistics						Behaviour of country fund premia				
						Before the crisis		During the crisis		
Fund symbol	N° of obs	Mean (%)	Min (%)	Max (%)	Sd (%)	Mean (%)	Sd (%)	Mean (%)	Sd (%)	Coeff/t-statistic
IF	250	2.88	-17.02	54.98	17.15	-10.12	2.44	17.51	14.80	**27.63*** (4.44)**
MF	251	4.49	-18.42	54.6	18.51	-9.98	2.26	20.22	15.03	**30.6*** (4.54)**

Note: This table provides descriptive statistics of the daily premia for the period January 1997-December 1997, and compares the distribution of country fund premia before and during the crisis. The t-statistics in the last column are from regressions of premia on a constant and a dummy variable which is one for the 117-day subsequent to the Asian crisis, and 0 for the 117-day before the crisis. The t-statistics are corrected for serial correlation using 50 Newey-West lags. The event date (the Asian crisis)=mid-July 1997

Table 3.1- Linear and Markov-Switching results: Indonesia

	Linear	*Markov- Switching*			
		PTV			PTF
		ω_t^1	ω_t^2	ω_t^3	
m	20,31157*** (0,59865)				
$m(s_t=0)$		26,004*** (0,65424)	20,312*** (0,58914)	22,239*** (0,50596)	26,043*** (0,655664)
$m(s_t=1)$		17,1529*** (0,49114)	5,0106*** (350,043)	-0,822881 (2,2381)	17,083*** (0,48246)
θ_1	-81,25916*** (17,60637)	-57,326*** (12,337)	-81,2777**** (17,339)	-113,33*** (13,638)	-59,353*** (12,125)
θ_2	-150,22697*** (10,53189)	-126,61*** (7,7468)	-150,23*** (10,348)	-180,78*** (8,6133)	-124,68*** (7,8168)
θ_3	0,20654*** (0,05067)	0,19548*** (0,041097)	0,2056*** (0,055164)	0,05658 (0,048457)	0,18461*** (0,040191)
σ	5,091	3,3789*** (0,21172)	5,0137*** (0,30749)	3,8198*** (0,2374)	3,2721*** (0,21112)
p_{00}					0,981357***
p_{11}					0,9350268***
p_0		3,5714*** (0,83953)	3,1482 (77,355)	-3,4055 (3,6863)	3,9623*** (0,72759)
q_0		5,5632 (3,9388)	11,595 (35,157)	5,3357*** (1,6983)	2,6666*** (0,67565)
p_1		0,25121 (0,54468)	4,9846 (596,58)	461,25 (371,1)	
q_1		-2,0861 (2,3847)	4,9921 (582,45)	27,61 (62,098)	
Sample	1990 : 3 - 2001 : 3				
Max L	-410,7232	-362,7761	-403,14054	-374,1851	-363,55635

Note: Asterisks refer to significance level: * 10%, ** 5%, *** 1%

Table 3.2- Wald test Results: Indonesia

$H_0(\chi^2(1))$	ω_t^1	ω_t^2	ω_t^3	PTF
$m(s_t=0)=m(s_t=1)$	95,89425***	15,16532***	73,07619***	94,3337***
$p_1 = q_1$ [8]	23,95169***	-2,617626 e^{-06}	1,491540	

Note: Asterisks refer to significance level: * 10%, ** 5%, *** 1%

[8] H_0 : the impact is symmetric

Table 4.1- Linear and Markov-Switching results: Malaysia

	Linear	*Markov -Switching*			
		PTV			PTF
		ω_t^1	ω_t^2	ω_t^3	
m	-0,12012				
	(0,41517)				
$m(s_t = 0)$		-1,3572***	-1,3432***	-1,3492***	-2,7836***
		(0,25823)	(0,24897)	(0,25616)	(0,28589)
$m(s_t = 1)$		3,7318****	3,7533***	3,7227***	1,9063***
		(0,33013)	(0,31715)	(0,32941)	(0,26772)
θ_1	16,221***	13,756***	13,61***	13,579***	20,003***
	(2,32648)	(1,5001)	(1,4746)	(1,4756)	(1,5693)
θ_2	-5,41371	-5,0382*	-5,2924**	-5,2646*	2,3917
	(4,57014)	(2,7821)	(2,6566)	(2,7517)	(2,9212)
θ_3	-0,04849	0,050862*	0,054317*	0,054568*	0,052789*
	(0,04810)	(0,030734)	(0,02999)	(0,030043)	(0,031127)
σ	2,693	1,5358***	1,5286***	1,536***	1,5551***
		(0,084927)	(0,083822)	(0,08498)	(0,085734)
p_{00}					0,9827272***
p_{11}					0,967428***
p_0		3,1965***	4,4528***	2,9302***	3,39119***
		(0,84463)	(1,4316)	(0,724)	(0,63930)
q_0		4,2394***	5,1718***	4,739***	4,0412***
		(0,7316)	(1,1198)	(1,0726)	(0,74114)
p_1		-0,45105	-2,5056*	3,2268	
		(0,4739)	(1,6796)	(9,8805)	
q_1		-0,16666	-3,8572**	-8,3788	
		(0,31772)	(1,6058)	(7,509)	
Sample	1987 : 5 – 2001 : 6				
Max L	-407,62044	-326,61923	-323,54842	-326,42895	-330,48011

Note: Asterisks refer to significance level: * 10%, ** 5%, *** 1%

Table 4.2- Wald test results: Malaysia

$H_0(\chi^2(1))$	ω_t^1	ω_t^2	ω_t^3	PTF
$m(s_t = 0) = m(s_t = 1)$	162,0024***	168,1440***	162,3830***	154,2807***
$p_1 = q_1$	0,2584267	0,2059565	1,022133	

Note: Asterisks refer to significance level: * 10%, ** 5%, *** 1%