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INFORMATIONAL EFFICIENCY OF FINANCE STOCKS IN MALAYSIA: A TWO-REGIME NONLINEAR THRESHOLD AUTOREGRESSIVE APPROACH

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ABSTRACT

This paper examines the weak-form efficiency of finance stocks in Malaysia. New methodology is used in exploring the weak-form efficiency of finance stocks which can better capture the unique properties and vulnerability of this kind of stock. Extra inferences on whether the stock is fully or partly complying with the random walk properties and weak-form efficiency can be achieved with this nonlinear threshold autoregressive model. A two-regime nonlinear threshold autoregressive approach is used to evaluating the random walk properties in two separate regimes. About 80% of the finance stocks show partial unit root where 13 series are stationary in regime one only while nine series are stationary in regime two only. The balance 20% are characterized by nonstationary unit root process. There is no evidence of full stationary and cannot infer inefficiencies in any case of the selected finance stocks. The findings of this study have implications on informational efficiency and investment strategy particularly for finance stocks in Malaysia. The evidence of changing efficiency state due to the presence of threshold effect is consistent with the prediction by threshold model of investor psychology.

Keywords: Informational efficiency; Nonlinear dynamic; Threshold effect; Finance sector.

1. INTRODUCTION

Weak-form efficient market hypothesis (EMH) refers to a situation where security prices fully reflect the information contained in the history of past trading. Semi-strong form EMH happens if all publicly available information is reflected in security prices. In the case of strong-form EMH, security prices reflect all price-forming related information (Fama, 1970, 1991). Among the three forms of EMH, the weak-form attracts most interest of researchers as logically it is achieved before the higher level of efficiency. The implication of EMH for investment is in terms of security price prediction. Under weak-form efficiency, predicting prices based on past trading information and using technical analysis are both ineffective. Semi-strong form efficiency neglects the usefulness of fundamental analysis in price prediction. If strong-form efficiency is achieved, price prediction is totally impossible even though using insider information.

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Market efficiency can affect finance sector resilience such that if the market is efficient, information is impounded into stock prices quickly thus the prices are often close to fundamental. In addition, efficient stock prices could indicate the arrival of financial crisis. Miller and Luangaram (1998, p.10) state that, "Asset prices can play a key role in signaling concern ex ante and in exacerbating problems when the crisis occurs". As mentioned in several studies (Munir et al., 2012; Lean et al., 2015), if stock prices follow a random walk or stochastic process, the impacts of external shocks on stock prices are permanent as a new equilibrium will be reached following a shock. Conversely, if stock prices are stationary, the impacts of shocks on stock prices are only temporary. Stock price has tendency to revert back to the long-run mean which allows prediction using historical price data. Efficient stock prices that are characterized by a random walk could indicate the arrival of financial crisis. A crisis shock can be captured using appropriate econometric model. A nonlinear threshold autoregressive (TAR) model will allow to capturing any changing behavior of stock prices following a regime shift, which may due to financial crisis.

Nonlinearity can be the result of structural change, unreliable information, information asymmetry, and noise traders (Oskooe, 2011). This issue is an important methodological consideration particularly when the testing of weak-form efficient market hypothesis (EMH) is concerned. Modelling nonlinearity is required in determining if a stock price series contains nonlinear deterministic element which can be a violation to the EMH (Shively, 2003). In addition, if threshold effect is detected, this means that stock prices behave differently when passing the threshold. Munir *et al*. (2012) and Shively (2003) lean strong support for the presence of threshold effect in stock indices.

There are strong reasons to believe that the issue regarding nonlinearity and threshold effect is pertinent to the emerging markets, like Malaysia. Emerging markets are undergoing rapid development but facing the obstacles of thin trading and low level of liquidity, thus information asymmetric is possible. Lack of symmetric behavior in emerging markets has been highlighted in Oskooe (2011) and Harrison and Moore (2012). Downward rigidity is a key feature of macroeconomic variables because downturns in business cycle are sharper than the recoveries in these variables (Enders, 2015). Similarly, finance stock prices may exhibit nonlinear behaviour that showing drastic declines during financial crisis.

Fluctuations in stock market may not unveil the true picture of vulnerable sectors. According to Hunt (2001), the puzzling aspect of stock price is not why it has fallen but why at first it got so high. Finance sector is vulnerable to systematic default risk, bank run, and shocks emanating from financial system. Finance stock vulnerability can be plausibly explained to elucidate the foregoing issue. According to Fiordelisi and Marqués-Ibañez (2013), the default risk of bank is systematic hence cannot be managed by using diversification. Narayan *et al.* (2015) point out that banks are more vulnerable as compared to other firms, because banks face the problem of inherent maturity mismatch on balance sheet and thus are exposed to the risk of bank run.[i] The contagion of banking sector is perceived to be more strong and rapid than in other sectors. In addition, banks interact most with the real economy which exposes them to shocks emanating from financial system. Nonetheless, other financial firms such as insurance companies and capital market intermediaries may also receive impact of shocks from the financial system due to their involvement in credit supply and financial investment. Regime shifts may occur due to global economic and financial crises, such as the 1974 oil price shock, the 1987 stock market crash, and the financial crisis in 1997 (Ismail and Isa, 2008).

Finance stocks in emerging markets are likely to be fragile in the face of financial crisis. Malaysia experienced dramatic declines of finance stock prices during Asian financial crisis. For examples, the share price of MAYBANK, a commercial bank, which stood at RM9.021 on 28 January 1997, had plunged to RM2.012 on 28 January 1998. The share price of MAA, an insurance company, dropped to RM0.623 on 28 August 1998 from the previous RM5.588 on 28 May 1997. Even in the developed countries, finance stocks can be vulnerable during financial crisis. The collapse of Lehman Brothers has appeared as the largest insolvency in the history of United States (U.S.) and is still mentioned in the popular press and noticed in the fragile money and capital markets (Johnson and Manun, 2012). It was officially filed for bankruptcy on 15 September 2008 causing its share price to fall from USD10.50 to USD 0.23. Consequently, New York Stock Exchange (NYSE) Composite Index fell more than 500 basis points (5 percent) from 8091.84 to 7680.15. On 17 September 2008, the aforesaid index further down to 7440.39. Moreover, the crisis shock was transmitted to the stock markets outside the U.S. with eye-catching impact on finance sector. For instance, Bursa Malaysia's Finance Index plunged shortly after Lehman Brother's bankruptcy and bottomed out at 8002.27 on 18 September 2008.

As finance stocks are considerable more vulnerable to crisis shock than others, it may be possible that finance stock prices in Malaysia reach at a certain level then behave differently in the other regime. Finance stock efficiency is important, yet little is known about it in the context of Malaysia. Hence, this paper aims to examine the weak-form efficiency of Malaysian finance stocks. By using a two-regime nonlinear threshold autoregressive (TAR) approach of Caner and Hansen (2001), it can account for possible nonlinearity and threshold effect in stock prices. The TAR model allows for evaluating the random walk properties in two separate regimes and thus to differentiate unit root, stationarity, and partial unit root in a series. The presence of threshold means that data series has more than one regime, implicitly showing the efficiency state may change when the process of data switches to a different regime.

This paper extends from Kok and Munir (2015) by examining the weak-form efficiency of Malaysian finance stocks using a two-regime nonlinear TAR approach. This approach can provide more information on stocks prices in two regimes. This study differs from previous work on the weak-form efficiency of banking and finance stocks in terms of the methodology used. The application of TAR model on this subject area is new. Therefore, this present study contributes to inferences regarding nonlinearities and threshold effects in the prices of finance stocks in Malaysia, and thus to infer whether these stocks are fully or partly complying with the random walk properties and weak-form efficiency. The implications of findings are related to informational efficiency and investment strategy particularly for finance stocks in Malaysia. Further, the evidence of changing efficiency state due to the presence of threshold effect is consistent with the prediction by threshold model of investor psychology as proposed by Cross *et al*. (2005)[1].

The remaining of this paper is organized as follows: Section 2 briefly reviews about the financial system in Malaysia; Section 3 is literature review; Section 4 discusses data and methodology; Section 5 presents the empirical results; and last section concludes.

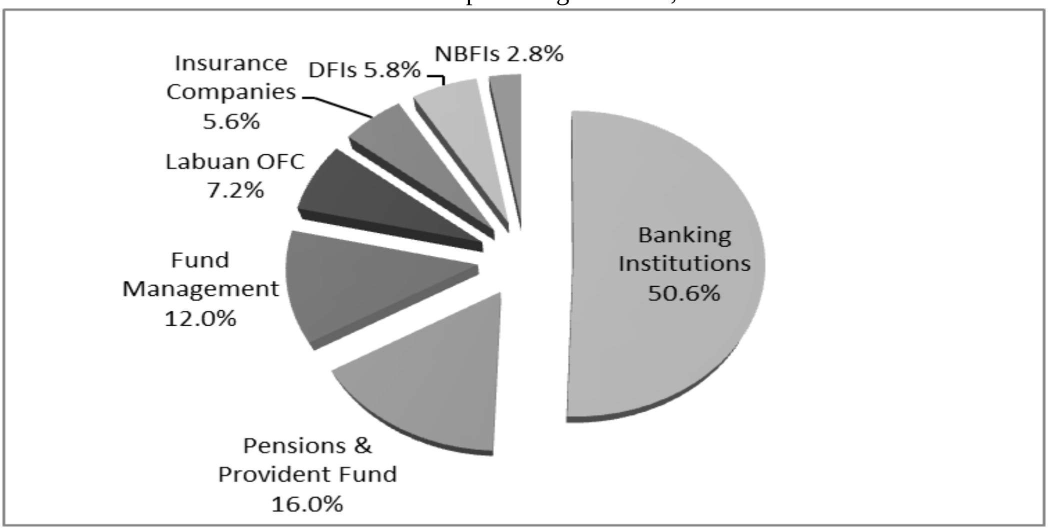
[1] Cross et al. (2005) develop a threshold model of investor psychology. The model predicts that investors are prone to psychological tension in facing a change of market sentiment. Individual investor reacts whenever the tension threshold is reached. The model specifies two types of tension thresholds, namely, cowardice threshold and inaction threshold. Investors in the minority group are likely to herd on the information reflected by market sentiment.

2. MALAYSIA'S FINANCIAL SYSTEM

In Malaysia, the classification for financial firms is given by Financial Services Act 2013, Insurance Act 1996, and Capital Markets and Services Act 2007. The current Act has stipulated the interpretations for commercial banking business, investment banking business, financial intermediation activities, factoring business, leasing business and financial advisory business under subsection 2(1). Insurance companies are licensed under the Insurance Act 1996, and capital market intermediaries are licensed under the Capital Markets and Services Act 2007. The Capital Markets and Services Act 2007 provides a single licensing for capital market intermediaries, where these institutions could be dealing with advising on corporate finance, derivatives, financial planning, fund management, investment advice, private retirement scheme, and securities.

Figure 1 depicts Malaysia's finance sector composition proxies by total assets as percentage of GDP, based on the data of 2011. Banking institutions had the largest portion of finance sector's total assets as percentage of GDP, about 50.6 percent, followed by pensions and provident fund 16 percent, and fund management 12 percent. Clearly, the contribution from banking institutions to the finance sector's total assets is still dominating.

Figure 1: Malaysia's finance sector composition proxies by total assets as percentage of GDP, 2011



Source**:** Information is adapted from Appendix 1, IMF (2014)

3. LITERATURE REVIEW

This literature review concentrates on the past studies on banking stocks' weak-form efficiency and the application of TAR model. The existing literature on finance stocks is very limited. Only a few studies on bank stocks can be noticed. Stengos and Panas (1992) examine the weak- and semi-strong form EMH for the four largest banks listed on Athens Stock Exchange. By employing the test developed by Brock, Dechert & Scheinkman (1987), the results are showing there is neither linear nor nonlinear dependency in the stock price series. Thus, the weak-form EMH is valid. In addition, there is no evidence of cointegration and thus no Granger causality between these stocks. This provides support for the semi-strong form EMH.

Bashir *et al*. (2011) find the evidence of market inefficiency for 11 high trading volume bank stocks listed on Karachi Stock Exchange over the period June 1997-April 2009. The ADF and PP tests for stationary check, while the co-integration and VAR tests for testing the weak-form EMH. Narayan *et al*. (2015) examine the weak-form EMH for 34 banking-related stocks from NYSE. They propose the hypothesis that EMH is day-of-the-week dependent. The ADF (1979) test and Bai & Perron (1998) procedure indicate that market efficiency is day-of-the-week dependent. The unit root tests applied to each of the five trading days indicate that the null hypothesis of a unit root is rejected for all five trading days, for 21 firms. Based on the overall findings of the study, the weak-form EMH has not gained a strong support.

Distinctively, Chriş (2012) explores on the weak-form efficiency using a sample of eight ING unit-linked funds. The martingale difference hypothesis (MDH) is rejected for majority of the unit-linked fund markets except for ING Poland Bonds Sub-Fund and ING Poland Balanced Sub-Fund. This implies that most of these markets are yet to achieve the weak-form efficiency.

Lim *et al.* (2007) study the random walk behavior of four bank stocks in Malaysia. The results of the windowed-test procedure of Hinich and Patterson (1995) show the presence of linear and nonlinear dependencies in the series, but the observed patterns are non-persistent. Kok and Munir (2015) examine the weak-form EMH using a sample of 28 financial firms listed on the Main Board of Malaysia's stock exchange. The study employs panel nonlinear unit root test that accounts for heterogeneity and panel stationarity test allowing for the presence of cross-sectional dependence (CSD) and structural breaks. The main findings include the evidence of strong CSD among the finance stock price series, and all series are found to be following a random walk process implying market efficiency.

Next, attention is shifted to the past studies that employ TAR approach of Caner and Hansen (2001). Narayan (2006) studies the behavior of NYSE Common Stock for the period spanning from June 1964 until April 2003. The TAR model indicates that the series is a nonlinear unit root process. The findings are in favor of the weak-form efficiency. Qian *et al*. (2008) employ a TAR model to analyze both nonlinearity and unit root properties for Shanghai Stock Exchange Composite Index. The results of Wald test also indicate that the Shanghai stock market is efficient as the index series has a unit root in the whole series, as well as in each regime one and two. Munir and Mansur (2009) find the stock market of Malaysia is characterized by a nonlinear unit root process, consistent with the weak-form EMH.

Some past studies provide mixed-results. Chen (2011) examines a random walk model in Taiwan. The analysis based on TAR model confirms that the null hypothesis of a unit root cannot be rejected for most sectors including Cement, Food, Chemicals and Biotechnology and Medical Care, Electronics, Shipping and Transportation, Tourism, and Financials. This finding suggests that the series can be characterized by nonlinear unit root process. Meanwhile, the market index and the rest of sector indices are obviously departing from the random walk process. Munir *et al.* (2012)

also provide evidence that the EMH is only valid in Malaysia and Thailand but not in Indonesia, Philippines, and Singapore.

4. DATA AND METHODOLOGY

All tables and figures must be centred and title should be on top. Number all tables and figures with Arabic numerals in the order in which the tables are first mentioned in text. Use font size 9 pt for contents in tables and figures and 8pt for notes and source. All illustrations (charts, figures and graphs) in the text will be printed in black and white coloured.

4.1. Dataset

There are 34 stocks listed under the finance sector in Malaysia's stock market, Bursa Malaysia. This paper employs a balanced dataset that consists of 82% or 28 finance stocks in Malaysia for the period from January 1, 1997 to December 31, 2014. Five stocks are excluded due to data unavailability during the beginning of the study period.

These finance stocks are Affin Holdings Berhad (AFFIN), Alliance Financial Group Bhd (AFG), AMMB Holdings Berhad (AMMB), CIMB Group Holdings Berhad (CIMB), Hong Leong Financial Group Bhd (HLFG), and RHB Capital Bhd (RHBCAP), BIMB Holdings Bhd (BIMB), Hong Leong Bank Berhad (HLBANK), Malayan Banking Berhad (MAYBANK), and Public Bank Berhad (PBBANK), Hong Leong Capital Berhad (HLCAP), Hwang Capital (Malaysia) Berhad (HWANG), Kaf-Seagroatt & Campbell Bhd (KAF), and K & N Kenanga Holdings Berhad (KENANGA), LPI Capital Bhd (LPI), MAA Group Berhad (MAA), Manulife Holdings Berhad (MANULFE), MNRB Holdings Berhad (MNRB), Pacific & Orient Berhad (P & O), Syarikat Takaful Malaysia Berhad (TAKAFUL), Apex Equity Holdings Berhad (APEX), ECM Libra Financial Grp Bhd (ECM), OSK Holdings Berhad (OSK), and TA Enterprise Berhad (TA), Insas Berhad (INSAS), Johan Holdings Berhad (JOHAN), Malaysia Building Society Berhad (MBSB), and RCE Capital Bhd (RCECAP).

Daily close prices of each finance stock are sourced from Thomson Reuters Datastream. For the purpose of estimation, the data are transformed into natural logarithm.

4.2. Methodology

Equation (1) shows a two-regime nonlinear model developed by Caner and Hansen (2001):

$$\Delta y_t = \theta_1' x_{t-1} I_{\{Z_{t-1<\lambda}\}} + \theta_2' x_{t-1} I_{\{Z_{t-1\geq\lambda}\}} + e_t \tag{1}$$

where y denotes the logarithm of individual finance stock prices for $t = 1, \dots, T$; $x_{t-1} = (y_{t-1}, r_t', \Delta y_{t-1}, \dots, \Delta y_{t-k})'$; $I_{\{\cdot\}}$ is the indicator function; e_t is an independent and identically distributed error term; $Z_t = y_t - y_{t-m}$ for m represents the delay order and $1 \leq m \leq k$; r_t is a vector of deterministic components including an intercept and a linear time trend. Further, m represents an unknown threshold value. It takes the values in the compact interval $\lambda \in \Lambda = [\lambda_1, \lambda_2]$, where λ_1 and λ_2 are picked based on $P(Z_t \leq \lambda_1) = \pi_1 > 0$ and $P(Z_t \leq \lambda_2) = \pi_2 < 1$. Below show the components of θ_1 and θ_2:

$$\theta_1 = \begin{pmatrix} \rho_1 \\ \beta_1 \\ \alpha_1 \end{pmatrix}; \theta_2 = \begin{pmatrix} \rho_2 \\ \beta_2 \\ \alpha_1 \end{pmatrix}$$

where ρ_1 and ρ_2 represents slope coefficients on y_{t-1}, β_1 and β_2 are scalar intercepts, and α_1 and α_2 are $K \times 1$ vectors that contain the slope coefficients on dynamic regressors $(\Delta y_{t-1}, \dots, \Delta y_{t-k})$ in the regimes. In order to calibrate Equation (1), the concentrated least squares approach is utilized. For each $\lambda \in \Lambda$,

$$\Delta y_t = \hat{\theta}_1(\lambda)^{\prime x_{t-1} I_{\{z_{t-1}<\lambda\}}} + \hat{\theta}_2(\lambda)^{\prime x_{t-1} I_{\{z_{t-1}\geq\lambda\}}} + \hat{e}_t$$

where $\hat{\sigma}^2(\lambda) = T^{-1}\sum_1^T \hat{e}_t(\lambda)^2$ is the OLS estimate of σ^2 for fixed λ. The LS estimate of threshold parameter (λ) is found by minimizing the residual variance, $\sigma^2(\lambda)$:

$$\hat{\lambda} = \arg\min_{\lambda\in\Lambda} \hat{\sigma}^2(\lambda)$$

The nonlinear threshold effect can be assessed by testing the null hypothesis of no threshold effect: $H_0: \theta_1 = \theta_2$ that implies the process is linear, against the alternative hypothesis of threshold effect: $H_1: \theta_1 \neq \theta_2$ that implies the process is nonlinear. For this purpose, Caner and Hansen (2001) propose to use the standard Wald test statistics $W_T = W_T(\hat{\lambda}) = \sup_{\lambda\in\Lambda} W_T(\lambda)$. If the vectors of coefficients for both regimes are similar $\theta_1 = \theta_2$, this would indicate that there is no threshold effect and the null hypothesis cannot be rejected. The null hypothesis is rejected if $\theta_1 \neq \theta_2$. Caner and Hansen (2001) also propose to compute asymptotic critical values and p-values by using the bootstrap method, after discovering that W_T has a non-standard asymptotic null distribution with critical values that cannot be tabulated.

A unit root series means that stock prices follow a random walk process consistent with the weak-form EMH. Investors cannot predict future price movements based on the information of historical price data. Thus, a buy-and-hold strategy is advisable. Stationarity is a violation to efficiency. If a series is found to be stationary, the need for policy actions to improve efficiency is clear. In the case of partial unit root, which means that a series has one stationary regime and one nonstationary regime, investors still can predict stock prices in the stationary regime. Stationarity is assessed by testing the null hypothesis of unit root $H_0: \rho_1 = \rho_2 = 0$, against the alternative hypothesis of level stationarity $H_1: \rho_1 < 0$ and $\rho_2 < 0$. The stationarity of process y_t relies on the two parameters ρ_1 and ρ_2. For each regime one and two, the null hypothesis can be rejected in favor of the alternative hypothesis if each ρ_1 and $\rho_2$is significantly different from zero. If the null hypothesis holds, the process y_t has a unit root. In other words, the model (1) can be expressed in terms of the stationary difference Δy_t. The obvious alternative to the null hypothesis is when the process y_t is stationary in both regime one and two. However, a case of partial unit root is also possible, where the process y_t has a unit root in one regime and is stationary in other regime reflecting mean reversion.

The null hypothesis is tested against the unrestricted alternative $\rho_1 \neq 0$ or $\rho_1 \neq 0$ using the Wald statistics expressed as $R_{2T} = t_1^2 + t_2^2$, where t_1 and t_2 represent the ratios for $\hat{\rho}_1$ and $\hat{\rho}_2$, respectively, from the OLS estimate. As noted by Caner and Hansen (2001), the one-sided version of this test may have more power than the two-sided version. Hence, they propose to use the one-sided Wald statistics as follows:

$$R_{1T} = t_1^2 I_{\{\hat{\rho}1<0\}} + t_2^2 I_{\{\hat{\rho}2<0\}}$$

This allows to test the null hypothesis against the one-sided alternative $\rho_1 < 0$ or $\rho_2 < 0$. A statistical significant R_{1T} will justify rejecting unit root in favour of stationarity but does not show whether it is the stationary case H_1 or the partial unit root case H_2. In order to provide an answer to this question, further examining the individual t-statistics t_1 and t_2 is required. Only one of $-t_1$ or $-t_2$ being significant would be consistent with the partial unit root case.

5. RESULTS AND DISCUSSION

This procedure begins with standard Wald statistic to detect the presence of threshold effects and hence nonlinearity in the daily stock prices. Table 1 reports the Wald statistics, the bootstrap critical values at 1 percent conventional level, the bootstrap *p*-values (using 100 replications) for threshold variables of the form $Z_t = y_t - y_{t-m}$.

As the data is on daily basis and by considering the usual trading days in a month, the maximum lag is set to be equal to 22. According to Caner and Hansen (2001), *m* is endogenous where it is through selecting the *m* value that minimizes the residual variance of the least squares estimate, on the other hand maximizes the W_T. The results based on W_T provide strong evidence for threshold effects and hence nonlinearity at the 1 percent level of significance for all series and KENANGA at the 5 percent level of significance.

Table 1 also records the threshold parameters for each series at the corresponding optimal delay parameters, and the number of observations in each regime. In the case of P & O, W_T is maximized, the optimal delay parameter is *m* = 17 and the threshold parameter is -0.086. This reflects that, in regime one the prices of P & O have either been constant or decreased by less than 8.6 percent within 17 days. When the price of P & O falls more than 8.6 percent in 17 days, its price behaves differently as switching to regime two. There are 480 observations or about 10.3 percent of the whole sample belong to regime one. Regime two is outside the band of -0.086, which reflects that the prices of P & O have been decreased by more than or equal to 8.6 percent within 17 days. Approximately 89.7 percent of the sample or a total of 4190 observations belong to regime two. In the case of JOHAN, the optimal delay parameter is *m* = 18 and the threshold parameter is 0.146. This means that in regime one, the prices of JOHAN have either been constant or increased by less than 14.6 percent within 18 days. The market for JOHAN switches to regime two when the price of JOHAN rises by more than 14.6 percent in 18 days. For this series, there are 4220 observations or about 90.2 percent of the sample belong to regime one. In regime two, the prices of JOHAN have been increased by more than or equal to 14.6 percent within 18 days. In regime two, there are 456 observations or about 9.76 percent of the sample.

Regime one is dominant for 21 series: AFFIN, AFG, AMMB, CIMB, RHBCAP, BIMB, MAYBANK, HWANG, KAF, KENANGA, MAA, MNRB, TAKAFUL, APEX, ECM, OSK, TA, INSAS, JOHAN, MBSB, and RCECAP. The share of regime one or ‘inside the band’ regime fluctuates between 7.53 percent and 92.8 percent of the overall observations for the series. While, regime two is dominant for seven series, HLFG, HLBANK, PBBANK, HLCAP, LPI, MANULFE, and P & O. The share of regime two or ‘outside the band’ regime is in the range 7.17 percent to 92.5 percent. This finding lends strong support for the presence of threshold effects in all series, thus the use of a two-regime TAR approach is appropriate.

Table 1: Results of Wald Tests

Series	W_T	Bootstrap Critical Value (1%)	Bootstrap p-Value	m	Threshold Parameter	Number of Observations	
						Regime 1	Regime 2
AFFIN	179	91.400	0.000	7	0.054	4080 (87.3%)	592 (12.7%)
AFG	134	71.600	0.000	15	0.080	3960 (84.7%)	716 (15.3%)
AMMB	130	71.500	0.000	6	0.040	3860 (82.5%)	818 (17.5%)
CIMB	214	67.800	0.000	12	0.063	3970 (84.9%)	706 (15.1%)
HLFG	162	64.800	0.000	3	-0.028	605 (12.9%)	4070 (87.1%)
RHBCAP	276	66.100	0.000	6	0.054	4080 (87.2%)	598 (12.8%)
BIMB	148	64.800	0.000	2	0.035	4260 (91.2%)	412 (8.82%)
HLBANK	200	71.900	0.000	1	-0.019	398 (8.52%)	4280 (91.5%)
MAYBANK	256	81.000	0.000	9	0.047	4120 (88.2%)	552 (11.8%)
PBBANK	189	67.400	0.000	2	-0.014	680 (14.6%)	3990 (85.4%)
HLCAP	183	60.400	0.000	1	-0.031	382 (8.17%)	4290 (91.8%)
HWANG	154	60.300	0.000	7	0.054	4070 (87.2%)	600 (12.8%)
KAF	252	71.900	0.000	3	0.045	4310 (92.2%)	364 (7.79%)
KENANGA	98.5	92.400	0.020	10	0.090	4140 (88.6%)	534 (11.4%)
LPI	161	69.600	0.000	4	-0.030	501 (10.7%)	4170 (89.3%)
MAA	160	73.800	0.000	4	0.055	4190 (89.7%)	482 (10.3%)
MANULFE	143	70.100	0.000	3	-0.033	352 (7.53%)	4320 (92.5%)
MNRB	220	85.700	0.000	8	0.049	4200 (89.9%)	472 (10.1%)
P & O	158	62.000	0.000	17	-0.086	480 (10.3%)	4190 (89.7%)
TAKAFUL	247	69.300	0.000	2	0.040	4280 (91.6%)	394 (8.43%)
APEX	120	75.100	0.000	1	0.033	4340 (92.8%)	335 (7.17%)

Series	W_T	Bootstrap Critical Value (1%)	Bootstrap p-Value	m	Threshold Parameter	Number of Observations	
ECM	139	66.800	0.000	2	0.042	4130 (88.3%)	548 (11.7%)
OSK	127	66.700	0.000	5	0.056	4150 (88.7%)	527 (11.3%)
TA	175	66.700	0.000	9	0.078	4090 (87.4%)	588 (12.6%)
INSAS	170	70.500	0.000	3	0.065	4290 (91.8%)	384 (8.22%)
JOHAN	107	68.500	0.000	18	0.146	4220 (90.2%)	456 (9.76%)
MBSB	117	64.700	0.000	6	0.071	4140 (88.6%)	535 (11.4%)
RCECAP	151	73.900	0.000	5	0.022	3420 (73.2%)	1250 (26.8%)

Note: W_T denotes the Wald statistic; and *m* is the optimal delay parameter.

5.1. Threshold Unit Root Test

Having established that all series are nonlinear processes, the next step is to examine whether the series contain a unit root. This requires for computing the threshold unit root statistics, for one-sided Wald statistic R_{1T} and two-sided Wald statistic R_{2T}. Basically, the purpose of using both one-sided and two-sided Wald tests is to test for a unit root against a two-regime stationary nonlinear mode.

For regime one, the null hypothesis of unit root can be rejected in favour of the alternative hypothesis of level stationarity if the parameter $\rho_1 \neq 0$, and similarly for regime two. The expected results can be either the series is stationary in both regimes (H_1: $\rho_1 < 0$ and $\rho_2 < 0$), or the series has a unit root in one regime and it is stationary in the other regime, known as the case of partial unit root (H_2: $\rho_1 < 0$ and $\rho_2 = 0$ or $\rho_1 = 0$ and $\rho_2 < 0$).

For the one-sided Wald statistic, $R_{1T} = t_1^2 I_{\{\hat{\rho}_1 < 0\}} + t_2^2 I_{\{\hat{\rho}_2 < 0\}}$ the null hypothesis of unit root is tested against the one-sided alternative $\rho_1 < 0$ or $\rho_2 < 0$. One-sided Wald test is more superior compared to the two-sided Wald test (Caner and Hansen, 2001). Therefore, the results obtained from the one-sided Wald test are mainly referred. Whereas, for the two-sided Wald test, the null hypothesis of unit root is tested against the unrestricted alternative $\rho_1 \neq 0$ or $\rho_2 \neq 0$ using the Wald statistic $R_{2T} = t_1^2 + t_2^2$ where t_1 and t_2 are the t-ratios for $\hat{\rho}_1$ and $\hat{\rho}_2$ respectively.

As summarized in Table 2, both one-sided and two-sided Wald statistics R_{1T} and R_{2T} are quite consistent. Specifically, the one-sided Wald statistics indicate that 10 series: BIMB, HLBANK, HWANG, P & O, TAKAFUL, APEX, ECM, INSAS, JOHAN, and RCECAP cannot be rejected or contain a unit root. The series exhibit nonlinear behavior with a unit root. The rest of the series: AFFIN, AFG, AMMB, CIMB, HLFG, RHBCAP, MAYBANK, PBBANK, HLCAP, KAF, KENANGA, LPI, MAA, MANULFE, MNRB, OSK, TA, and MBSB are stationary. This means that for 10 out of 28 series, the series follow a random walk process (nonstationary process).

Table 2: Results of One- and Two-Sided Unit Root Tests

Series	R_{1T} Wald Statistic	Bootstrap Critical Value (5%)	Bootstrap *p*-Value	R_{2T} Wald Statistic	Bootstrap Critical Value (5%)	Bootstrap *p*-Value
AFFIN	14.400	13.800	0.030	14.400	13.900	0.040
AFG	14.900	14.800	0.050	14.900	14.800	0.050
AMMB	38.100	16.800	0.000	38.100	16.800	0.000
CIMB	26.100	15.400	0.000	26.100	15.400	0.000
HLFG	25.900	13.800	0.000	25.900	13.800	0.000
RHBCAP	25.300	11.500	0.000	25.300	11.600	0.000
BIMB	4.870	12.700	0.630	5.830	12.700	0.490
HLBANK	10.300	13.800	0.230	10.300	13.800	0.230
MAYBANK	19.900	13.900	0.010	19.900	13.900	0.010
PBBANK	37.300	12.200	0.000	43.100	12.200	0.000
HLCAP	23.100	14.500	0.000	23.100	14.500	0.000
HWANG	7.430	13.000	0.380	7.430	13.000	0.390
KAF	17.800	15.700	0.030	17.800	15.700	0.030
KENANGA	10.900	11.000	0.070	10.900	11.200	0.080
LPI	23.600	13.200	0.010	23.600	13.200	0.010
MAA	17.500	12.000	0.000	17.500	12.300	0.000
MANULFE	18.400	12.900	0.000	18.400	12.900	0.000
MNRB	13.600	13.500	0.050	14.500	13.500	0.040
P & O	5.150	14.800	0.610	5.150	14.900	0.620
TAKAFUL	4.570	12.400	0.670	4.570	12.400	0.680
APEX	9.250	13.600	0.210	9.250	14.000	0.220
ECM	11.500	15.300	0.120	11.500	16.100	0.130
OSK	14.600	15.700	0.070	16.900	15.700	0.050
TA	13.600	14.900	0.070	13.600	14.900	0.080
INSAS	8.690	14.400	0.240	8.700	14.500	0.240
JOHAN	8.590	13.000	0.230	8.590	13.000	0.230
MBSB	16.000	12.400	0.010	16.000	12.400	0.010
RCECAP	9.320	14.200	0.180	9.320	14.200	0.180

5.2. Test Partial Unit Root Tests

Nonetheless, the results obtained so far are unable to show if there is the case of partial unit root or partial stationarity. Hence, the data are further analyzed by using the partial unit root tests which are able to discriminate between the stationarity in regime one and two. The results indicate that only six series have a unit root in both regime one and two reflecting the full unit root namely, BIMB, HWANG, P & O, TAKAFUL, APEX, and JOHAN. The remaining 22 series are consistent with partial unit root or partial stationary.

From the 22 series, 13 series including AFFIN, AFG, HLFG, MAYBANK, HLCAP, KAF, KENANGA, MNRB, ECM, OSK, TA, INSAS, and RCECAP are found to be stationary in regime one only. The results of partial unit root tests can only reject the null of unit root in regime one. However, the series contain a unit root in regime two. For these finance stocks, when the percentage of stock price changes is above the threshold value, the series switch to regime two and become nonstationary or follow a random walk process.

On the other hand, another nine series: AMMB, CIMB, RHBCAP, HLBANK, PBBANK, LPI, MAA, MANULFE, and MBSB are stationary in regime two but contain a unit root in regime one. This means that when the percentage of price changes is below or equal to the threshold value, these series are nonstationary or random walk processes. When the stock price changes by a percentage larger than the threshold value, the series switch to regime two and become stationary.

In brief, for six series: BIMB, HWANG, P & O, TAKAFUL, APEX, and JOHAN, the weak-form efficiency is strongly supported. Each of the series has a unit root in regime one and regime two. For 22 series, the market is partly efficient in the weak-form sense either in regime one or two. However, the application of a two-regime TAR approach does not suggest the full stationary because none of the series studied is completely stationary in both regimes.

Table 3: Results of Partial Unit Root Tests

Series	***T*_1 Statistic**	**Bootstrap Critical Value (5%)**	**Bootstrap *p*-Value**	***T*_2 Statistic**	**Bootstrap Critical Value (5%)**	**Bootstrap *p*-Value**
AFFIN	3.350	2.950	0.010	1.780	3.480	0.400
AFG	3.110	2.970	0.020	2.290	3.360	0.210
AMMB	2.690	3.250	0.160	5.550	3.080	0.000
CIMB	-0.098	3.370	0.890	5.110	3.340	0.000
HLFG	4.340	3.060	0.000	2.660	3.410	0.160
RHBCAP	2.700	3.000	0.110	4.240	2.950	0.000
BIMB	2.210	3.160	0.270	-0.982	3.110	0.980
HLBANK	1.990	3.250	0.300	2.510	3.120	0.080
MAYBANK	3.660	3.110	0.020	2.550	3.170	0.100
PBBANK	-2.410	3.220	1.000	6.110	3.080	0.000
HLCAP	4.780	3.560	0.000	0.428	3.540	0.800
HWANG	2.620	3.160	0.140	0.762	3.090	0.820
KAF	3.670	3.150	0.020	2.090	3.340	0.450
KENANGA	2.760	2.610	0.020	1.810	2.910	0.480
LPI	2.380	3.090	0.200	4.230	3.120	0.000
MAA	1.830	2.990	0.440	3.770	2.920	0.010
MANULFE	0.308	3.050	0.850	4.280	2.780	0.000
MNRB	3.690	3.340	0.010	-0.915	3.110	0.970
P & O	1.080	3.470	0.670	2.000	3.140	0.360
TAKAFUL	1.470	2.720	0.550	1.550	3.180	0.470

Series	*T*_1 Statistic	Bootstrap Critical Value (5%)	Bootstrap *p*-Value	*T*_2 Statistic	Bootstrap Critical Value (5%)	Bootstrap *p*-Value
APEX	2.330	3.050	0.190	1.960	3.180	0.330
ECM	2.900	3.230	0.090	1.750	3.240	0.390
OSK	3.820	2.990	0.030	-1.520	3.290	1.000
TA	3.240	3.220	0.050	1.760	3.410	0.470
INSAS	2.950	2.960	0.060	-0.057	3.020	0.960
JOHAN	1.970	3.200	0.410	2.170	2.870	0.230
MBSB	2.000	3.130	0.290	3.470	3.060	0.010
RCECAP	2.920	2.810	0.050	0.883	3.260	0.810

In the findings, the observed threshold effect is consistent with the proposition of Cross *et al.* (2005) that investors are subject to psychological tensions and could react once their tolerance levels are reached. The relevance of threshold effect in stock prices has been validated in several past studies, for examples, Shively (2003), Qian *et al*. (2008), Munir and Mansur (2009), and Munir *et al*. (2012). Specifically, the evidence of full unit root for the stock market index of Malaysia, KLCI, is provided from the studies of Munir and Mansur (2009), and Munir *et al*. (2012). However, this present study find that only small number of firm level series can be characterized as full unit root process and the rest of series are showing partial unit root process.

Even though both studies examine the case of Malaysian stock market and use the TAR approach. However, the findings are not starkly different. Munir and Mansur (2009) use monthly data of Kuala Lumpur Composite Index for the period of January 1980-August 2008. The main finding is that the unit root process is supported in favour of the weak-form efficiency. The present study employs daily data of 28 individual finance stocks. The present study shows that six series strongly support the weak-form efficiency. The other 22 series has a unit root in either regime 1 or regime 2 but none of the series is completely inefficient. Therefore, the overall results are in favour of weak-form efficiency, and hence not contrasting with the findings of Munir and Mansur (2009).

If one regime is stationary or inefficient, it allows for prediction. For certain stocks, prediction is possible when price is accelerating and for other stocks, prediction is possible when price is declining. Finance sector is vulnerable to systematic default risk, bank run, and shocks emanating from financial system. Nonetheless, other financial firms such as insurance companies and capital market intermediaries may also receive impact of shocks from the financial system due to their involvement in credit supply and financial investment.

6. CONCLUSION

This study employs a two-regime nonlinear TAR approach of Caner and Hansen (2001) in assessing the stochastic properties of finance stocks prices from the Malaysia's stock market. Wald test result shows strong evidence of threshold effects and thus nonlinearities in all the series analyzed. Regime one is dominant for 21 series whereas in seven series, regime two is dominant.

It is found that only six series have a unit root in both regimes reflecting the full unit root. Meantime, 22 series are consistent with partial unit root or partial stationary. There are 13 series are found to be stationary in regime one only. In regime two, these series contain a unit root. Meanwhile, nine series are stationary in regime two but contain a unit root in regime one. There is no evidence of full stationary. This finding does not allow us to infer inefficiencies in any case of the selected finance stocks. For six series, BIMB, HWANG, P & O, TAKAFUL, APEX, and JOHAN, the weak-form EMH is strongly supported because each of the series has a unit root in both regimes. For 22 series, the market is partly efficient either in regime one (nine series) or regime two (13 series). The findings, therefore, are more in favor of weak-form efficiency. The evidence of changing efficiency state due to the presence of threshold effect is consistent with the prediction by threshold model of investor psychology as proposed by Cross *et al*. (2005). In other words, the efficiencies of finance stocks may change during times of extreme market sentiment as stocks prices reflect the effects of tension threshold.

The above findings suggest that specific investment strategy can be formulated. The six series of BIMB, HWANG, P & O, TAKAFUL, APEX, and JOHAN follow a random walk process, thus investors cannot predict prices using past values. Therefore, a buy-and-hold strategy is advisable. On the other hand, 22 series show the case of partial unit root which means that a series has one stationary regime and one nonstationary regime. Investors are still able to predict stock prices in the stationary regime. Finance stocks that are characterized as partial unit root series can be the intriguing choices of investors, because mean-reversion in the stationary regime is exploitable for excess profits. Nevertheless, investors should consider the transaction costs of frequent buy and sell.

In relation to stock price prediction, some of the partial unit root series have more number of observations in the stationary regime than the nonstationary regime. Among the nine series that are stationary in regime two, four series have more observations in this stationary regime, HLBANK, PBBANK, LPI, and MANULFE. From the total 13 series that are stationary in regime one, surprisingly 11 series have more observations in regime one, including AFFIN, AFG, MAYBANK, KAF, KENANGA, MNRB, ECM, OSK, TA, INSAS, and RCECAP.

As nonlinearity and threshold effect are detected in all finance stocks prices, there is a strong evidence of regime change. As noted by Enders (2015: 408), dynamic specifications are needed to capture nonlinear behavior of time series. This paper demonstrates that a two-regime threshold model can recognize nonlinear patterns in finance stocks prices, and can more accurately estimate stationarity in the presence of threshold effect. This insight will be useful in terms of methodological consideration in future studies.

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[i] As Cabral (2013) notes, the increased leverage of some large banks in the U.S. during the financial crisis in 2007-2008 was the consequence of high profits obtained earlier through balance sheet expansion and growing default, liquidity, and term risk mismatch between assets and liabilities.