MATEMATIKA, MJIM, Volume 38, Number 2, 141–155

Efficient Market Hypothesis for Malaysian Extreme Stock Return: Peaks over a Threshold Method

[1]Muhammad Fadhil Marsani*, [2]Ani Shabri, [3]Basri Badyalina, [2]Nur Amalina Mat Jan and [1]Mohd Shareduwan Mohd Kasihmuddin

[1]School of Mathematical Sciences, Universiti Sains Malaysia
11800 Minden, Penang, Malaysia

[2]Department of Mathematical Sciences, Faculty of Science
Universiti Teknologi Malaysia, 81310, Johor, Malaysia

[3]Faculty of Computer and Mathematical Sciences, Universiti Teknologi Mara, Cawangan Johor
Kampus Segamat, 85000, Johor, Malaysia

*Corresponding author: fadhilmarsani@usm.my

Article history
Received: 5 January 2022
Received in revised form: 1 August 2022
Accepted: 7 August 2022
Published online: 31 August 2022

Abstract This paper presents investigation on the efficient market hypothesis of extreme stock return based on peaks over threshold method, by application of 10% Value at risk (VaR) quantile threshold level. The efficient market hypothesis (EMH) in the stock market index is validated by utilising autocorrelation, Kwiatkowski Phillips Schmidt Shin (KPSS), and variance ratio tests. The tests constituted of daily, extreme maximum and minimum, and three sub-periods data reflecting different economic condition in the market. Results indicated the strong influences of the financial crisis in the series movement. Mixed evidences were acquired; nonetheless, the overall results show that the Malaysia extreme stock return does not follow a random walk, only the series during the crisis and recovery period are in weak-form market efficiency.

Keywords Random walks; Extreme stock returns; Non-stationary; Peaks-Over Threshold.

Mathematics Subject Classification 05C81, 60G50, 62-07, 62G32

1 Introduction

A random walk is a condition when a series is entirely unpredictable, given the fact that the share price promptly responds to pertinent news. The concept of the efficient market hypothesis (EMH) in market behaviour outlined by [1] and [2] generally states that share prices respond to all available information. In other words, share prices have random movement during efficient price market, and the movement is not associated to any historical movement. In this respect, the past share price information may not be valid to envisage the excess returns throughout an efficient market. According to [2], the EMH can be sorted into three categories, such as strong, semi-strong, and weak. Strong EMH suggests that the movement of the prices is directly reflected by hidden information. Semi-strong EMH claims that the movement of the prices is reflected by the public news. Meanwhile, weak EMH says that the prices respond to all historical accessible public news. Investors, governing authorities, and academicians seek to comprehend the behavior of EMH in the stock return because it has essential repercussions in investment and financial theories. For example, investors always ask for inefficient market to have a gaining return because the share movement is predictable, while for governing authorities, they are responsible for stable economy by ensuring efficient price allocation.

Previous studies on the movement of share price demonstrated mixed finding in rejecting the EMH. Among researchers who found that share prices do not follow a random walk are [3]–[8]. By contrast, researchers who found that historical stock price movements are unpredictable include [9]–[15]. The evidence reviewed here seems to suggest a pertinent role for data environments in rejecting the EMH. In this investigation, the aim was to assess the share price behavior by focusing on Malaysian Economic conditions.

Economic conditions may be defined as a systematic process concerned with the present state of the economy in a country or region. These conditions change over time along with the economic and business cycles as an economy goes through periods of expansion and contraction. In this respect, the GDP rate is used as the economic indicator to assess these economic conditions. The economic conditions are generally classified into three types, namely i) growth, ii) crisis, and iii) recovery period, see [16] and [17]. Economic growth can be measured in several ways, but one of the most prominent is following gross domestic product (GDP). The GDP rate provides a basis for the monetary value of all finished goods and services made within a country during a specific period. The volatility of stock returns has been a major topic in finance literature. Previous research has established that economic fundamentals have explanatory power for stock return volatility [18]. However, there has been no detailed investigation of stock behavior in the context of extreme returns. Hence, indicators of economic effects provide important insights in the analysis to understand the behavior of extreme stock return.

Most studies in the field of share price only focused on the behaviour of regular daily return. To the our best of our knowledge, no known empirical research has focused on exploring the movement of extreme stock return considering the economic condition, except by [19] who focused on investigating extreme asset behaviour according to block maxima approach.

Table 1: Selected Studies on Malaysian Stock Market Efficiency

Authors (Year)	Interval (time)	Methodology	RWH null hypothesis
Mun & Kee [20]	Daily and Weekly (1982 – 1991)	Variance ratio test (Lo-MacKinlay) and Spectral shape test	Rejected
Kawakatsu & Morey [21]	Monthly (1976 – 1997)	Variance ratio test (Lo-MacKinlay & Chow Denning)	Not Rejected
Nassir *et al.* [22]	Monthly (1975 – 1989)	Serial correlation and Box-Pierce	Not Rejected
Hoque *et al.* [23]	Weekly (1990 - 2004)	Variance ratio test (Lo-MacKinlay & Chow Denning) and Wright ' s sign test	Rejected
Kim & Shamsuddin [24]	Daily and Weekly (1990 - 2005)	Variances ratio tests (Chow-Denning test, Joint sign test, Small sample, Wild bootstrap test)	Rejected

RWH stands for the random walk hypothesis

Hence, this study offers a fresh perspective on the behaviour of extreme stock return, by using peak over threshold (POT) approach, which is much less notable with regards to studying the movement of daily return according to economic condition and the management of extreme return in the financial markets. This research also covered the adeptness of EMH and random walk behaviour in KLSE extreme stock return by examining the market efficiency through the unit root, stationarity, and variance ratio tests.

Table 1 lists some studies on Malaysian stock market efficiency. Note that, rejection of random walk hypothesis (RWH) suggests predictability of share prices. In general, the previous findings gave mixed results, and the reasons might be due to lack of deliberation on the effect of the economic circumstance. These studies highlight the need for further analysis to investigate the behavior of stock return in different economic conditions. In addition, several lines of evidence suggest that the importance of extreme stock return while modeling the stock returns. Some prior studies that have noted the importance to understand the extreme stock return behaviour are such as by [25]–[30]. Most studies in the field of share price only focused on the behaviour of regular daily return.

The contributions of this research were as follows: (1) To represent the possible random walk behaviour of extreme stock market returns data set in POT representation. (2) To compare the adeptness of EMH and random walk behaviour in different economic condition of KLSE extreme stock return by examining the market efficiency through the unit root, stationarity, and variance ratio tests. The remainder of this paper is organized as follows: research methodology is reviewed in Section 2, which specifically elaborates how data sample is obtained, and how extreme values are defined according to POT. Various tests employed to investigate asset behaviour are also explained. Section 3 presents the empirical results, and finally Section 4 concludes the implications of the findings for the Malaysian stock market.

2 Methodology

This section elaborates the technique used, beginning with introduction of the data and how the extreme minimum and maximum data series are obtained, followed by description of a bunch of random test analysis.

2.1 Data Description

The financial crisis in Malaysia started in mid-May 1997, attributed to Thailand's currency (baht) falling due to the tremendous pressure of speculative attacks. This attack also affected the Malaysian ringgit, which caused intense selling pressure. The initial impact of the crisis led to declining imports of luxury goods as domestic demand slowed due to the ringgit depreciation. In addition, the adverse effects of the crisis include the slowdown in construction and services sectors, the declining trend of foreign direct investment (FDI) levels, and a decrease in both government expenditure and investment [31].

In this study, daily-adjusted closing price of the KLSE index, which is a Malaysian capitalisation-weighted share market index, was in for assessment. This stock reveals the evolution of the prices of the 30 largest companies listed in Bursa Malaysia. The stock price data was obtained from Yahoo Finance from 03 January 1994 to 30 June 2008. The investigation was conducted by considering the overall sample (Jan 1994 - June 2008) and three sub-periods, which represent typical economic conditions, namely growth (Jan 1994 - June 1997), crisis (July 1997 - Dec 2001), and recovery (Jan

2002 - June 2008) period. These partitions were set according to Malaysian quarterly gross domestic product (GDP) growth report.

2.2 Peak-Over-Threshold (POT)

The POT method is implemented to obtain the maximum and minimum of the extreme return. By expression, when F signifies the distribution function of loss X, the equation for conditional distribution F_u is defined as:

$$F_u(x) = P(X - u \leq x \mid X > u), \; x \geq 0,$$

where u denotes the threshold level. When threshold u is large, the conditional threshold excess distribution F_u will be well approximated by the Generalized Pareto Distribution (GPD). Let $Y = X - u$ for $X > u$ and for n observed variables $X_1, X_2, \ldots, X_n$. The general GPD distribution limit is given by:

$$G_{\xi,\sigma}(y) = \begin{cases} 1 - \left(1 + \frac{\xi}{\sigma} y\right)^{-\frac{1}{\xi}} & \text{if } \xi \neq 0 \\ 1 - \exp(-y/\sigma) & \text{if } \xi = 0 \end{cases},$$

where ξ and σ are the shape and scale parameters. If $0 \leq y \leq (x_F - u)$, then it corresponds to GPD. In this study, the selection of the threshold level was arranged using the dispersion index. This method functions to seek the most suitable threshold value in representing the VaR quantiles using the asymptotic approximation. Refer to [32] and [33] for a clear view on this method.

2.3 Serial Correlation

Serial correlation among the series was observed to detect existence of random walk. A random walk is presumed when the returns are uncorrelated at all lags with no serial correlation in the series. The serial correlation coefficient (ρ) of stock returns at lag k can be written as:

$$\rho(k) = \frac{\sum_{t=k+1}^{N} \left(x_t - x_\mu\right)\left(x_{t-k} - x_\mu\right)}{\sum_{t=1}^{N} \left(x_t - x_\mu\right)^2},$$

where x_t is the stock return for time $t = 1, 2, \ldots, N$, x_{t-k} signifies lagged returns values over the period, and x_μ is the mean return. Correlation coefficient ρ_k may give negative or positive values, indicated as negative or positive serial correlation, while zero correlation denotes random movement of the series. An autocorrelation function (ACF) is a graphical representation of serial correlation coefficient, which displays correlation structure by different values of lag. In this study, Ljung and Pierce box test had also been employed to assess the combination of all serial coefficients hypothesis.

2.4 Ljung and Pierce Box Test

The Ljung-Box (LB) and Box-Pierce (BP) test are conducted to examine the autocorrelations for a group whose time series is non-zero. A major advantage of both tests is that they can calculate the randomness of the series for an overall and specific number of lags. Thus, the test statistic for the LB test is given by:

$$Q_{LB} = N(N+2) \sum_{k=1}^{h} \frac{\hat{\rho}_k^2}{N-k},$$

where N denotes the sample size, $\hat{\rho}_k$ denotes the correlation coefficient at lag k and $h$denotes the number of tested lags. For the Box-Pierce (BP) test, the test statistic is given by:

$$Q_{BP} = N \sum_{k=1}^{h} \hat{\rho}_k^2.$$

Hence, the hypotheses for these tests are expressed as:

H_0: The data are independently distributed (randomness in the series).

H_1: The data are not independently distributed (serial correlation present).

There is an existence of randomness in the time series if the test fails to reject H_0.

2.5 Breusch-Pagan

The Breusch Pagan test is employed to assess the heteroscedasticity of errors in a linear regression model by testing the relation between the dependent and independent variables [33]. Suppose the linear regression can be defined as:

$$y_t = x_t\beta + u_t,$$

where x_t represent the dates and y_t is stock returns for time t = $1, 2, \ldots,$ N, β is the $(k \times 1)$ vector of coefficient parameters and u_t is the residuals term. The idea is to looks for the linear relationship between the squared residuals and the predictors. Hence, the estimated squared residuals $\hat{u}_t^2$ can be expressed as:

$$\hat{u}_t^2 = z_t\alpha + \upsilon_t,$$

where z_t is the known constants and α is the $(p\times1)$ vector of error variance parameters. The hypotheses for this test can be written as:

H_0: The error variances are all equal ($\alpha_1 = \alpha_2 = ... = \alpha_p = 0$) vs

H_1 : The error variances are not equal

For the Breusch Pagan test statistic, the equation can be written as:

$$N \times R^2$$

where N is the sample size, R^2 is the regression of squared residuals and the test statistic is approximately distributed as the chi-square distribution $\chi^2{}_{(p-1)}$ with p degrees of freedom.

2.6 KPSS Test

To examine if the apparent sample is a non-stationary or deterministic trend, Kwiatkowski Phillips Schmidt Shin (KPSS) test is applied. The KPSS can be defined as:

$$x_t = r_t + d_t + \varepsilon_t,$$

where x_t is the stock return at time t, r_t represent the random walk component, d_t denotes the deterministic trend and ε_t is the stationary error. The random walk term can be defined as, $r_t = r_{t-1} + u_t$ where the error u_t is distributed as IID $N(0, \sigma_u^2)$. The deterministic trend can be expressed as,

$d_t = \sum_{i=0}^{p} \beta_i t^i$, for $p = 0, 1$ where β_i is the constant trend coefficient, and the stationary error ε_t is distributed as IID $N(0, \sigma_\varepsilon^2)$. Hence, the test statistic is given by:

$$LM = \sum_{t=1}^{N} \frac{\widehat{s_t}^2}{\widehat{\sigma_\varepsilon^2}},$$

where $\widehat{s_t}$ is the estimated residual of a regression y_t defined as, $\widehat{s_t} = \sum_{j=1}^{t} \widehat{u_j}$ and $\widehat{\sigma_\varepsilon^2}$ is a consistent estimate of the long-run variance obtained from $\widehat{u_t}$. The hypotheses for KPSS test are expressed as:

H_0 : the series is stationary or trend-stationary ($\sigma_u^2 = 0$)

H_1 : the series has a unit root and non-stationary ($\sigma_u^2 > 0$)

Note that if the test fails to reject H_0, there is absence of randomness in the sample series.

2.7 Lo-MacKilay and Chow-Denning Test

The purpose of Lo-MacKilay test is to explore whether or not the sample behaves like a random walk. Test statistic $M_1(k)$ is given by [34]:

$$M_1(k) = \frac{VR(x_t; k) - 1}{\phi(k)^{0.5}},$$

where x_t denote an asset return at time t = $1, 2, \ldots$ N, k is the holding lags periods and $VR(x; k)$ is asymptotic distribution by assuming that k is fixed when $N \to \infty$. The asymptotic variance, $\phi(k)$, is given by:

$$\phi(k) = \frac{2(2k-1)(k-1)}{3kN}$$

Note that, the null hypothesis in Lo-MacKinlay test only verifies an individual value of k, therefore it has some disadvantages as it ignores the RWH joint testing. For that, in this study, Chow-Denning test was utilized to relate the entire individual variance ratio tests. Individual variance ratio tests have to be computed while taking control of the test size. In this test, the null hypothesis was taken from the maximum absolute value of individual variance ratio statistics. The test statistic for the Chow-Denning joint null hypothesis can be written as:

$$CD = \sqrt{N} \max_{1 \le j \le m} \left| M_2\left(k_j\right) \right|.$$

The conditional heteroscedasticity in x_t is adapted by employing robust statistic for heteroscedasticity $M_2(k)$, which can be expressed as:

$$M_2(k) = \frac{VR(x_t; k) - 1}{\phi^*(k)^{0.5}}.$$

$M_2(k)$ follows the standard normal distribution asymptotically under the null hypothesis that $VR(k) =$ 1 and the asymptotic variance, $\phi * (k)$, is given by:

$$\phi * (k) = \frac{\sum_{j=1}^{k-1} \left[\frac{2(k-j)}{k}\right]^2 \left(\sum_{t=j+1}^{N} (x_t - \hat{\mu})^2 \left(x_{t-j} - \hat{\mu}\right)^2\right)}{\left(\sum_{t=1}^{N} (x_t - \hat{\mu})^2\right)^2}.$$

The hypotheses for both Lo-MacKilay and Chow-Denning tests are described as:

H_0 : the series follow the random walk

H_1 : the series does not follow the random walk

The time series is noted to behave as the random walk if the test fails to reject H_0.

3 Result and Discussion

Figure 1 shows the economic conditions breakdown according to the Malaysian quarterly gross domestic product (GDP) growth report. As shown in Figure 1, the GDP rate during the crisis period was significantly lower than in the other two periods. The average GDP rate during the growth, crisis, and recovery period was 9.09%, 2.03%, and 5.71%, respectively.

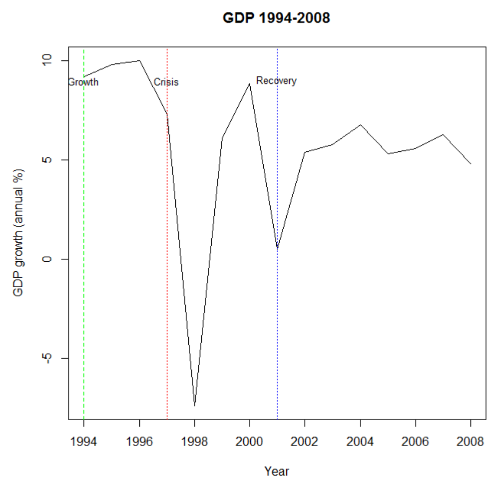

Figure 1: Malaysia GDP Growth

Figure 2(a) presents KLSE stock price from year 1994 until 2008 while Figure 2(b) displays KLSE stock price return computed using $r_t = \ln(p_t/p_{t-1})$, where r_t is return index at t time, p_t is share price index in terms of t, while p_{t-1} is share price index at time $t-1$. As shown in Figure 2(a), there was a steady movement reaching peak of 1400 in the number of KLSE share price during the growth period. In the crisis period, the index demonstrated a mixed trend, initially with a sharp drop from 1000 to approximately 200, and then fluctuated with growing uptrend reaching back to 1000 before declining again touching 600. In the recovery period, the market recovered by a gradual increase in term of number of prices starting from 600 reaching the top at 1600. With regard to price return in Figure 2(b), there was apparently higher volatility during the crisis period compared to other periods. The most maximum and minimum return values also occurred during this period.

An important observation that emerged from the data observations are every economic circumstance displayed distinctive trend. According to [31], there are several reasons why the Malaysian price movement has high volatility during the crisis. These are the property market slump and general contraction in domestic demand due to the net contractionary impact of the ringgit depreciation. Secondly, the economic slowdown in domestic-oriented industries, such as the construction and services sectors. Lastly, the contracted private investment is due to the uncertainties arising from the decline in local and external demand, excess capacity, and tight liquidity. Hence, the distinctive trend of stock prices can be expanded by studying the presence of random walks in each sample period for overall and extreme returns. In this study, the daily adjusted share price was used to calculate extreme stock return by using peaks over a threshold approach based on 10% VaR quantile threshold level, including the three economic sub-periods, namely growth, crisis, and recovery period.

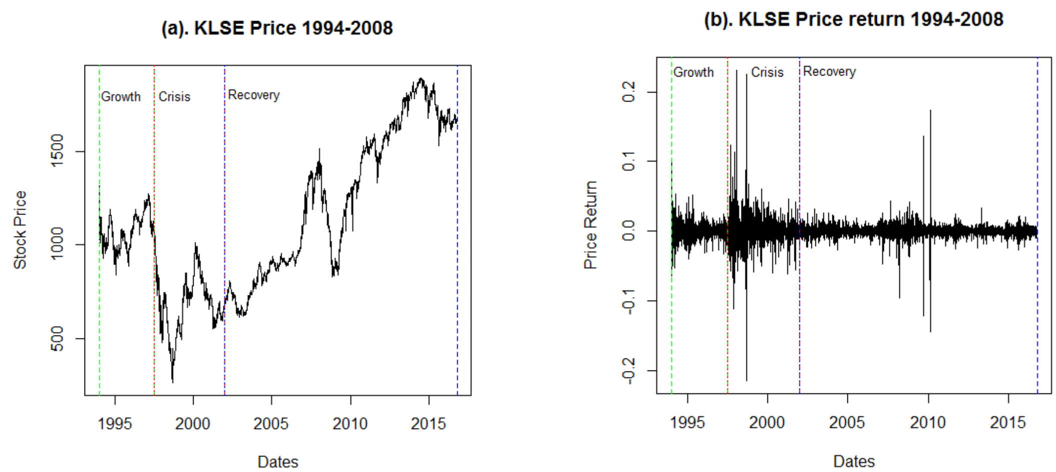

Figure 2: KLSE Share Price Movement

Figure 3 shows the dispersion index for overall sample returns. The asymptotic approximation calculation suggests that 10% of threshold level should be the best selection value to represent the VaR quantile sample, as the threshold dispersion stability emerged from the value. The result found is consistent with those found by [35] who points out that the risk measures can be more reliable by selecting 10 percent or more to cover precisely 99 percent of the outcomes. Hence, for this study, 10% VaR was set as the quantile threshold level for all studied periods to provide reliable estimates.

The plots of price return and ACF for daily overall, growth, crisis and recovery return periods are presented in Figure 4. The flat red line in price return representing mean return shows that there was no significant trend in price return. Meanwhile, The ACF plot shows that autocorrelation was cut off after the second lag in all plots suggesting no significant autocorrelation in the daily interval and the series was random. Moreover, the randomness was slightly heavier during crisis period when the ACF became significant during the second lags.

Figure 5 displays the plots for extreme price return case and the ACF for overall, growth, crisis, and recovery return periods. For all extreme intervals, the ACFs quickly decayed towards zero, denoting there was no associated capacity to deduce current value for relation to the next value. However, as shown, the flat red line in price return indicates a significant trend in extreme price return. For that, further investigation needed to be conducted in subsequent analysis.

The descriptive statistics for the daily and extreme returns of the KLSE stock index are given in Table 2 respectively. For the daily data sample in Table 2, diverse mean average returns of the four intervals, specifically overall, growth, crisis and recovery periods, reflect different visual standards in the particular periods. Interestingly, the highest and lowest average returns were gained from the crisis period, and the highest standard deviation (0.0242) portraying significant volatility also came from the crisis period. The returns in all intervals, except for recovery period, were positively skewed, implying that the returns were flatter to the right, relative to normal distribution. The level of kurtosis measuring tail distribution was high during the overall period, while judging between economic intervals, the highest kurtosis came from the crisis period, suggesting that the return distribution was heavy-tailed. The Jarque-Bera method was employed to examine the normality of the data dispersions, whose result confirmed that all the intervals did not follow normal distribution and was leptokurtic. The Ljung-Box and Pierce-Box at lag $k = 10$ verified the evidence for serial correlation in overall and sub-period intervals. Breusch-Pagan test was employed to inspect for heteroscedasticity, which was significant at all intervals. The KPSS test displayed significant values at all intervals, signalling the presence of random walk in daily return due to a contradiction in the result obtained.

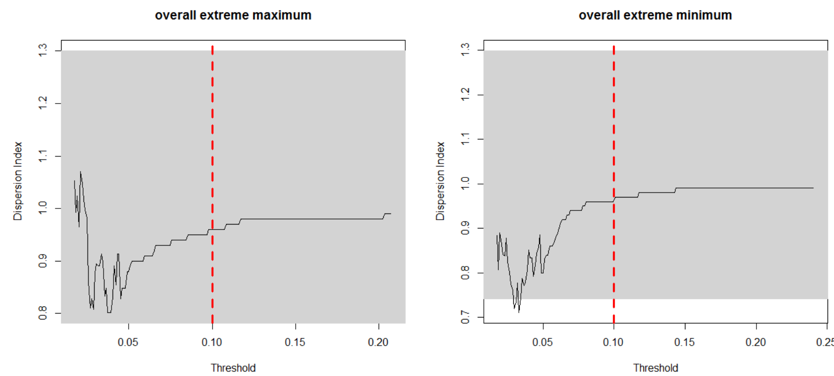

Figure 3: Dispersion Index Plot

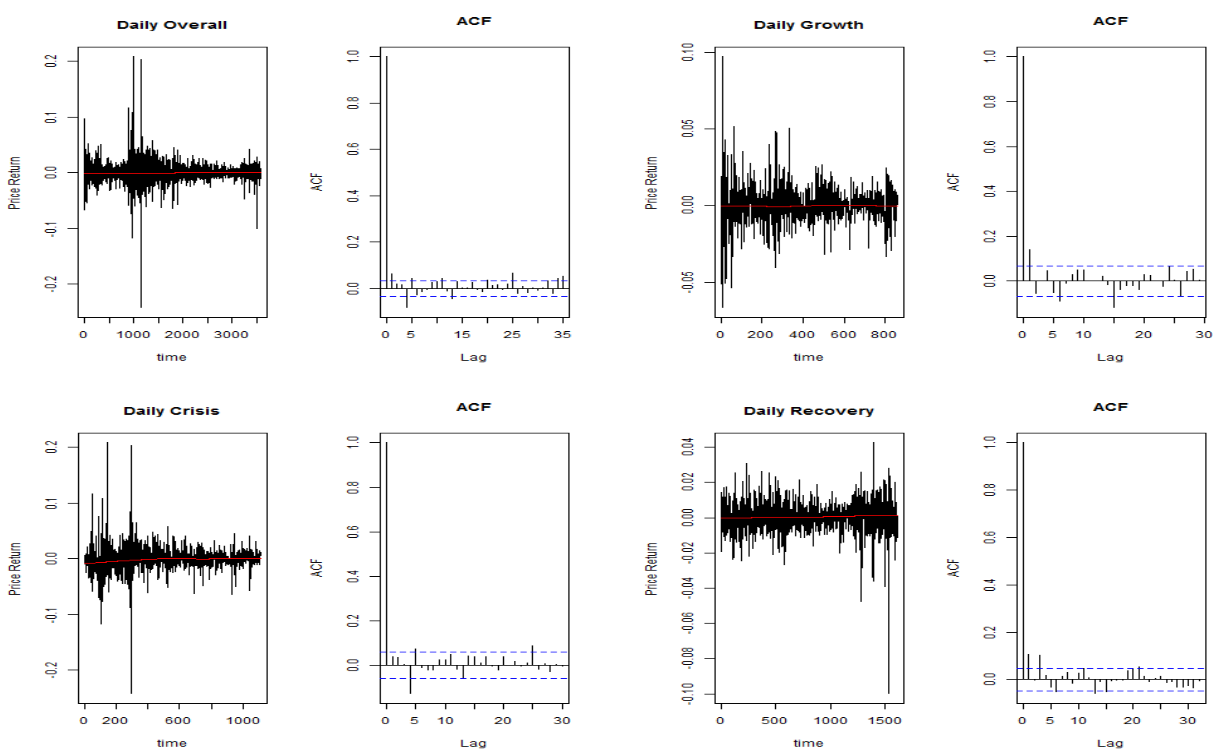

Figure 4: Daily Price Return and Autocorrelation Function (ACF) Plot

Table 2: Descriptive Statistics for Daily Return

	Daily			
	Overall	Growth	Crisis	Recovery
Start Period	Jan-94	Jan-94	Jul-97	Jan-02
End Period	Jun-08	Jun-97	Dec-01	Jun-08
N	3577	859	1,110	1,608
mean(%)	0.00	−0.02	−0.04	0.03
max(%)	20.82	9.71	20.82	4.26
min(%)	−24.15	−6.65	−24.15	−9.98
std.deviation(%)	1.58	1.26	2.42	0.82
Skewness	0.45	0.21	0.50	−1.40
Kurtosis	44.03	10.26	25.04	19.06
JB.test	250989.40(0.000)***	1894.42(0.000)***	22521.91(0.000)***	17799.00(0.000)***
Ljung(10)	56.25(0.000)***	34.93(0.000)***	29.39(0.000)***	45.97(0.000)***
Pierce(10)	56.16(0.000)***	34.70(0.000)***	29.22(0.000)***	45.83(0.000)***
Breusch-Pagan	22.27(0.000)***	42.49(0.000)***	23.63(0.000)***	9.48(0.000)***
KPSS.test	0.21(0.100)*	0.15(0.100)*	0.22(0.100)*	0.08(0.100)*

$*$, $**$ and $***$ denote significant level of the p-values at 10%, 5% and 1%, respectively.
Ljung-Box and Box-Pierce Q statistics were up to 10th order autocorrelation

Turning now to the experimental evidence on extreme data sample in Table 3, all the extreme returns gave evidence of significant excessive skewness compared to daily returns, indicating that the samples were non-normally distributed. Comparatively, as referred to LB and BP tests, the four intervals showed that the stock returns were not significantly serially correlated by growth minimum, growth maximum, crisis minimum, and recovery maximum, revealing that there was no serial correlation for extreme return.

Test for heteroscedasticity using the Breusch-Pagan test was significant only on overall minimum, growth maximum, and growth minimum extreme returns. The KPSS test showed that the series had a unit root and the series was non-stationary only for growth maximum, crisis minimum and recovery minimum. Other intervals gave contradictory result, indicating a random walk. For that, statistical interpretation for randomness was further studied using variance ratio tests to confirm the random walk behaviour.

Table 4 lists the results of the variance ratios tests for KLSE stock return prices. For Lo-MacKilay test, the holding lags periods $k = 2, 5$ & 10 were adopted. Focusing on the daily interval, both Lo-MacKilay and Chow-Denning tests showed that the RWH was rejected only during the recovery period for each horizon k, indicating that the movement during this period did not behave like a random walk. This finding is supported by the results of observation on KLSE share price plot when the movement was highly structured compared with the other periods. Also, RWH was rejected during the growth period when using Chow-Denning test, but only at $k = 2$ using Lo-MacKilay test, suggesting that the stock return was only foreseeable across the short-horizon during the growth period.

In the crisis period, the RWH utterly could not be rejected at all lags k, signifying that the movement of stock return was random and the return was highly unpredictable due to an economic crisis. With regard to the extreme return, Lo-MacKilay test showed that that RWH could not be rejected during the brief lag period ($k = 2$) for overall and growth intervals, signifying that extreme return could merely be projected for long-horizon compared to short horizon. Chow-Denning test again confirmed that the RWH was rejected during these periods, indicating that extreme return was predictable due to weak form or inefficiency of an extreme return during overall and growth

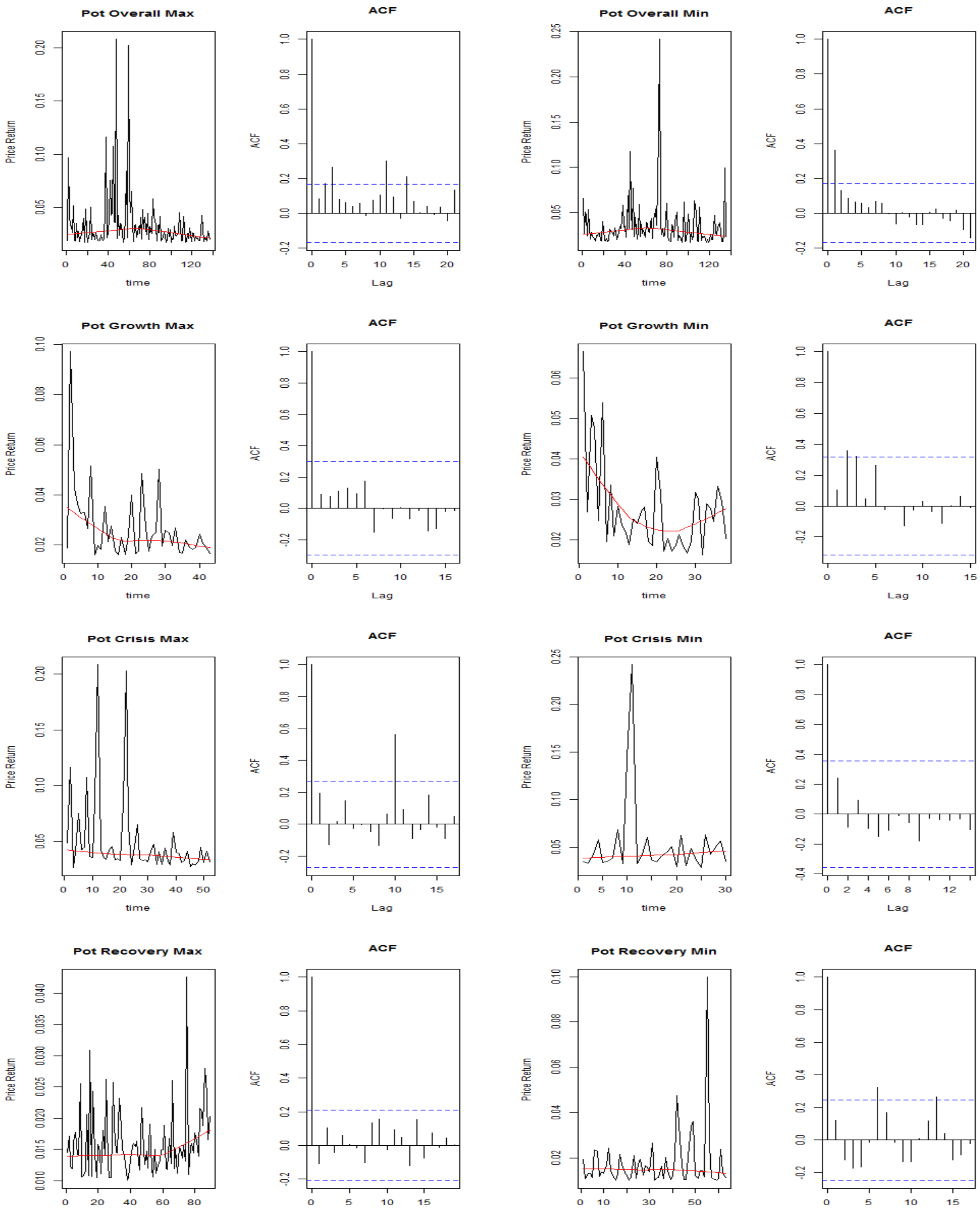

Figure 5: Extreme Price Return and Autocorrelation Function (ACF) Plot

intervals. Results obtained from recovery extreme maximum and minimum return were somewhat counterintuitive compared to the daily recovery return, since both Lo-MacKilay and Chow-Denning tests reported that the RWH could not be rejected, suggesting that the progress throughout this period was random and could not be predicted. The results for the extreme crisis period indicated that the RWH could not be rejected in both Lo-MacKilay and Chow-Denning tests.

Table 3: Descriptive Statistics for Extreme Return

	Overall		Growth		Crisis		Recovery	
	Max	Min	Max	Min	Max	Min	Max	Min
Start Period	Jan-94	Jan-94	Jan-94	Jan-94	Jul-97	Jul-97	Jan-02	Jan-02
End Period	Jun-08	Jun-08	Jun-97	Jun-97	Dec-01	Dec-01	Jun-08	Jun-08
n	137	135	43	38	52	30	89	63
mean(%)	3.34	3.56	2.67	2.74	5.01	5.31	1.59	1.76
max(%)	20.82	24.15	9.71	6.65	20.82	24.15	4.26	9.98
min(%)	1.72	1.72	1.61	1.61	2.88	2.88	1.01	1.01
std.deviation(%)	2.67	2.59	1.46	1.13	3.68	4.15	0.54	1.27
skewness	4.46	4.72	2.96	1.75	3.16	3.59	2.03	4.62
kurtosis	26.91	33.55	13.83	5.90	13.16	16.03	8.98	29.05
JB.test	3719	5751	272	32	310	276	193	2005
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Ljung(10)	20.01	24.37	5.59	14.72	27.03	5.90	8.09	18.24
	(0.29)**	(0.007)***	(0.848)	(0.142)	(0.003)***	(0.824)	(0.621)	(0.051)*
Pierce(10)	19.18	23.68	4.71	12.76	21.71	4.68	7.36	16.11
	(0.038)**	(0.009)***	(0.910)	(0.238)	(0.017)**	(0.911)	(0.691)	(0.097)*
Breusch-Pagan	1.28	0.04	4.05	6.96	2.06	0.56	0.27	2.45
	(0.258)	(0.839)	(0.044)**	(0.008)***	(0.151)	(0.454)	(0.602)	(0.117)
KPSS.test	0.60	0.17	0.61	0.75	0.53	0.13	0.31	0.25
	(0.023)**	(0.100)*	(0.021)**	(0.010)***	(0.035)**	(0.100)*	(0.100)*	(0.100)*

*, ** and *** denote signicant level of the p-values at 10%, 5% and 1%, respectively.
Ljung-Box and Box-Pierce Q statistics were up to 10th order autocorrelation

Table 4: Variance Ratio Test

		Interval	Lo-MacKilay			Chow-Denning
			k=2	k=5	k=10	
Daily		Overall	0.820(0.478)	0.675(0.504)	0.336(0.704)	0.820(0.648)
		Growth	2.265(0.014)***	1.188(0.182)	0.106(0.57)	2.265(0.042)**
		Crisis	0.383(0.742)	0.294(0.774)	0.120(0.922)	0.383(0.926)
		Recovery	2.518(0.006)***	2.735(0.004)***	2.127(0.034)**	2.735(0.014)***
Extreme	Overall	Max	1.208(0.198)	2.787(0)***	3.139(0.002)***	3.139(0.002)***
		Min	1.408(0.114)	1.882(0.014)***	2.339(0.006)***	2.339(0.01)***
	Growth	Max	0.515(0.616)	−0.236(0.172)	−0.718(0.022)**	0.718(0.094)*
		Min	−0.487(0.428)	0.756(0.022)**	0.268(0.012)***	0.756(0.024)**
	Crisis	Max	1.544(0.086)*	0.819(0.366)	0.307(0.504)	1.544(0.168)
		Min	0.678(0.622)	0.513(0.634)	−0.144(0.986)	0.678(0.85)
	Recovery	Max	−1.102(0.304)	−0.624(0.8)	−0.935(0.996)	1.102(0.534)
		Min	1.242(0.232)	−0.879(0.456)	−0.575(0.806)	1.242(0.392)

*, ** and *** denote signicant level of the p-values at 10%, 5% and 1%, respectively

4 Conclusion

This study was carried out to measure the behaviour of Malaysia stock return from January 3, 1994, to Jun 30, 2008, using daily and extreme returns. The term was applied based on the Malaysian economic report for Quarterly Gross Domestic Product, with aim to scrutinise the degree of expectancy of price return by occupying different risk measures in three economic conditions, specifically growth, crisis, and recovery periods. According to [2] and [36], the random walk (RW) model in stock data can be measured by using three successively restrictive hypotheses criteria: firstly RW1, the return is serially uncorrelated but dependent; secondly RW2, returns are serially uncorrelated, independent but not identically distributed; and thirdly RW3, returns are serially uncorrelated and identically distributed. In this study, the serial dependence of the series inspected using the Ljung box and Autocorrelation Function (ACF) plot to answer RW1. At the same time, the stationarity condition was observed using Kwiatkowski Phillips Schmidt Shin (KPSS) tests to answer RW2. Lastly, distributional assumptions were checked using multiple variance ratio tests, specifically the Lo- MacKilay and Chow-Denning test, to answer RW3.

Table 5 sums up the findings for rejecting hypothesis null for each of the tests considered, namely Ljung-Box (10), Box-Pierce (10), KPSS and Chow Denning. The findings from Ljung-Box, and Pierce-Box test suggest that the daily interval series was not advantageous to the random walk supposition, while in extreme intervals, these tests presented mixed indication. The tests present various indications for extreme data series that may be due to different data characteristics in each economic situation. By specifically focusing on random walk analysis using Chow-Denning test, there was evidence that random walk was favourable during the crisis for both daily and extreme return periods, indicating no return predictability over Malaysian economic catastrophe in 1997.

Table 5: Summary of Rejection of Null Hypothesis

	Daily				extreme							
					Overall		Growth		Crisis		Recovery	
Test	Overall	Growth	Crisis	Recovery	Max	Min	Max	Min	Max	Min	Max	Min
Ljung-Box(10)	yes	yes	yes	yes	yes	yes	no	no	yes	no	no	yes
Box-Pierce(10)	yes	yes	yes	yes	yes	yes	no	no	yes	no	no	yes
KPSS	no	no	no	no	yes	no	yes	yes	yes	no	no	no
Chow.Denning	no	yes	no	yes	yes	yes	yes	yes	no	no	no	no

Despite this, during periods of growth and recovery, daily returns were predictable. Interestingly, contradictory finding between daily and extreme cases could be seen in the overall and recovery period when extreme overall series did not follow a random walk and conversely for extreme recovery series. Findings in this study scaled that the behaviour of Malaysian stock return; particularly extreme return, as having been given less consideration beforehand. Ability to comprehend the behaviour of stock return could reduce risks while being beneficial to shareholders. These discoveries also offer new information in economics by clarifying the movement accuracy of stock return in various economic periods, especially for the Malaysian stock market. A further study using different stock market with the similar procedure is therefore suggested so that the relationship between the behaviour of stock return and economic factor can be more deliberately understood.

Acknowledgment

The work was supported by a Universiti Sains Malaysia, Short-Term Grant with Project No: 304/PMATHS.6315641.

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