Jurnal Ekonomi Malaysia 37 (2003) 3 - 20

Testing Informational Market Efficiency on Kuala Lumpur Stock Exchange

Ozer Balkiz

ABSTRACT

The primarily objective of this study is to investigate the informational efficiency of the Kuala Lumpur Security Exchange (KLSE) in terms of the daily Composite Index for the period of 1st January 1977 – 3rd May 2002. This paper concerned with the weak form test of efficient market hypothesis. Since its discovery in 1982 by Engel, Autoregressive Conditional Heterocedastic (ARCH) modelling , which allows the conditional variance to change over time as a function of past errors keeping the unconditional variance constant, has turn out to be a growth industry, with all sorts of variations on the original model. One that has became well-known is the Generalized Autoregressive Conditional Heterocedastic (GARCH) model that is developed by Bollerslev (1986). It has been observed that such models capture much temporal behaviour like thick tail distribution and volatility clustering of many economic and financial variables. Since, in order to explore efficiency of such growing market a non-linear GARCH model is estimated. Empirical results confirm that KLSE is predictable and thus is not informationally efficient in the weak sense and volatility of return is quite persistent when daily observation of composite index is used.

Keywords: efficiency, GARCH model, volatility

INTRODUCTION

The past ten years have perceived impressive growth in both the size and virtual importance of emerging equity markets in developing countries. The development of liberalisation within these countries, high level of economic growth and tendency towards financial markets globalisation afforded the setting in which equity markets may perhaps advance. Besides, western investors and equity fund managers were magnetized to these markets by the potentially high rate of returns existing and they

desire to examine international diversification. As these markets developed, momentous consideration has been devoted to the question of whether they function in an efficient form.

There is an old joke, commonly said between economists, about an economist walking down to street with a friend when they come across a USD100 bill lying on the ground. As the friend tries to pick up the bill, economist say 'do not bother – if were a real USD100 bill somebody would have already picked it up'.

This funny example of economic sense gone perilously close to home for students of Efficient Market Hypothesis (EMH), one of the most contentious and well studied proposition in all the social science. EMH is simple to state, has far reaching results for academic searches and business practice and yet is amazingly resistant to empirical proof or denial. Even after three decades of research and literally thousands of journal articles, economists have not yet achieved a agreement about whether market – specifically financial markets – are efficient or not. This happy state of rational confusion has launched many distinguished careers, leaving in its wake a rich legacy of economic thought that still challenges us today.

What do we mean by saying market efficiency or efficient market? An efficient market is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firm's activities under the assumption that security prices at any time *fully reflect* all available information (Fama 1970). When this condition is satisfied, investors cannot earn an unusual profit by exploiting available information. The macroeconomic importance of market efficiency is derived from the role of prices as aggregators of structural information. When asset and commodity markets are efficient, economic agents who make decisions on the basis of observed prices will insure an efficient allocation of resources. Furthermore, the issue of efficiency is particularly important for emerging markets because efficiency signals an increase in liquidity, a removal of institutional restrictions and an increase in the quality of information revealed in these markets.

As with loads of the ideas of modern economics, the origin of the EMH can be traced back to Paul Samuelson (1965) whose contribution is carefully reviewed in his article of *Proof that Properly Anticipated Prices Fluctuate Randomly*. The EMH, which is at the heart of financial economics literature, relies on the efficient use of information by economic actors and is often referred to as 'informational efficiency'. Commonly, a security

market is said to be informationally efficient if the asset price 'fully reflect' available information (Fama 1970). If this is a characteristic of a security market then it should not be feasible for market participants to make unusual profits.

To realize the hypothesis empirically and to make sense of the term fully reflect, Levich (1979) and Hallwood and MacDonald (1994), discovered that a degree of equilibrium expected returns or equilibrium prices is necessary. Using equilibrium expected returns, for instance, the excess market return on asset *i* may be expressed as:

$$d_{i,t} = r_{i,t} - E\left\langle \overline{r}_{i,t} \,|\, I_{t-1} \right\rangle, \tag{1}$$

where, d denotes the excess market return, $r_{i,t}$ is the one-period percentage return, I_{t-1} is the information set and a bar denotes an equilibrium value. If the market for asset i is efficient then the sequence of $d_{i,t}$ should be orthogonal to the information set {i.e., $E(d_{i,t} / I_{t-1}) = 0$} and serially uncorrelated. In that sense, the EMH is a joint hypothesis because it assumes that agents in forming their expectations in period t–1 are rational. Rationality, in order, means that investors are risk averse and neutral in their forecasts of expected market equilibrium/returns. It also means that stock prices/returns react immediately to information. In addition, the EMH should be tested jointly using some model of equilibrium, an asset-pricing model. This joint hypothesis is a serious problem as how to measure inefficiency from the empirical point of view. Such as, if we found significant excess of returns (i.e., $E(d_{i,t} / I_{t-1}) \neq 0$), we still do not know whether due to inefficiency (because of biased forecasts, irrational agents, the existence of institutional impediments, time varying expected returns, or seasonally) or because using a misspecified model of market equilibrium. This joint hypothesis problem was behind the unpopularity of equation (1) in the empirical literature.

However, the fact that market efficiency should be tested jointly with rationality and an equilibrium-pricing model does not imply that the efficiency issue is irrelevant. Finally, the empirical studies on market efficiency are capable of changing the opinion and practices of market professionals. Tests of market efficiency also enrich our knowledge of resource allocation and the behaviour of returns across securities and through time. As a result, a more accurate and testable hypothesis of "fully reflect" is necessary.

A famous financial economist named Eugene Fama (1970) conducted the first major, comprehensive examination of the market efficiency question. He recognized that there may be three forms of EMH. First, *the weak*

form of EMH (when people talk of the EMH, they usually mean this one): The weak form of the EMH says that future asset prices can not be predicted on the basis of the past asset prices. The reason for this is that all information on past movements in prices is reflected in current prices, so current prices are the only information, which is required. Past prices constitute no additional information.

Second, *the semi-strong form of the EMH*: The semi-strong form of the EMH says that future prices con not be predicted on the basis of any published information. This is because as soon as information is published, investors take it onto account and the current price adjusts. Therefore current prices embody all published information. Third, *the strong form of the EMH*: All information, both public and private, is reflected in the price of the stock. In Fama's original research, he examined strong form market efficiency by looking at the performance of mutual funds.

Emerging stock markets have recently been of great importance to the world-wide investment community. According to the International Finance Corporation (IFC), a subsidiary of the World Bank, all markets in developing countries are treated as emerging. The World Bank defines developing countries to have per capita GNP below 7,620 U.S. dollars in 1990 prices. Under these definitions, the Kuala Lumpur Stock Exchange (KLSE) is an emerging market of a developing country namely Malaysia.

The traditional tests of efficiency have been used for examining markets, which are distinguished by a high level of liquidity, sophisticated investors with access to high quality and consistent information and little institutional barriers. Under these conditions, stock prices react relatively or linearly to information. Alternatively, emerging markets are in general typified by low liquidity, thin trading, perhaps less well-informed investors with access to inaccurate information and large volatility. Besides, throughout the early years of trading, emerging markets might be characterized by investors who do not behave rationally. Specifically, investors may not constantly show risk aversion. Investors may be loss averse, in that they are more responsive to losses than to gains (Bennartzi & Thaler 1992). Such loss aversion may cause investors behaving in a risk loving or risk neutral way. Also, investors may put too much confidence in their own forecasts that is bringing bias into their action (Dabba, Smith & Brocato 1991).

In addition, investors do not always respond immediately to information (Schatzberg & Reiber 1992). Particularly, noise (uniformed) traders may suspend their response to check how informed market participants act as they do not have the resources to effectively analyze the informa-

tion or given that the information may not be trustworthy. Likewise, emerging markets revolutionize very quickly through time. The liberalisation process triggers adjustment in the institutional and regulatory framework, which in line influence the informational efficiency of the market. It is then essential to look into the evaluation of these markets, before taking a picture of the market at a specific point in time. This will allow us to see the effect of regularity changes on the efficient functioning of the market and allows us to derive a policy conclusion concerning the appropriate regulatory framework for recently developing equity markets. Such nature of emerging markets may suggest that stock prices in those markets respond to information in a non-linear fashion.

Before the days of nonlinear dynamics, testing the efficient market hypothesis (EMH) of Fama in the perspective of security market generally entailed testing the null hypothesis that autocorrelation coefficient of different lags are statistically insignificant. For this reason runs test, Ljung-Box (1978) test of autocorrelation and regression tests used to be employed. But, since 1980's it is well appreciated that lack of linear dependence (i.e., serial correlation) does not rule out nonlinear dependence which, if present, would conflict the EMH and may aid in forecasting, especially over short time intervals. Purposely, Granger and Anderson (1978) and Sakai and Tokumaru (1980) have explained that simple nonlinear models do not present serial correlation whereas having strong nonlinear dependence. This has, in fact, led several researchers like Granger and Anderson (1978), Hinich and Patterson (1985) and Scheikman and LeBaron (1989) to look for nonlinear structures in stock returns. With mounting intensity of computers together with advances in both nonlinear dynamics and chaos, the number of research interested in the re-examination of the behaviour of security returns from the perspective of market-efficiency has increased noticeably, and most of these (see Hsieh 1991; Willey 1992; Sewell et al. 1993; Opong et al. 1999; among others) have cast doubt on the conclusion that market efficiency derived only from the lack of serial correlation in returns.

Except for complicated nonlinear dependence/dynamics, there are two well known reasons which may produce inefficiency in the market even if standard tests of the efficiency, such as autocorrelation and random walk tests, conclude that the market is informationally efficient. First reason for stock returns to deviate from random walk model is due to what is known as calendar anomalies/effects.

Second reason is that first differences of financial time series, such as stock prices, exchange rates, inflation rates, etc. often display wide swings,

or volatility, suggesting that conditional variance of financial time series is not constant over time. The question of how can we model such varying variance has led to the development of *autoregressive conditional heterocedasticity* (ARCH) model which is originally exploited by Engle (1982) comes in handy. This model allows the error variance, conditional on past variance, evolves over time as function of past errors.

A crucial point to be noted at this step is that in all the studies on efficiency the basic models are assumed to have accurately specified conditional mean. It is now too well-known that conclusion founded on models suffering from misspecification due to inappropriate conditional mean could be ambiguous and inaccurate. It is worth pointing out that in the perspective of studies on efficiency on the basis of ARCH/GARCH, Lumsdaine and Ng (1999) (see also, Weiss 1986; Tong 1990; Giles et al. 1993) have confirmed that in most cases the standard Lagrange Multiplier (Rao's score) test for testing the null of homoscedasticity causes over-rejection of the null hypothesis of conditional homoscedasticity if there is misspecification in conditional mean. It therefore becomes crucial to test for ARCH in the general context of a probably misspecified conditional mean and then take suitable steps for watching out against misspecification in the mean function in case the test rejects the null hypothesis of no misspecification of conditional mean. As declared by Lumsdaine and Ng, the misspecification problem referred to here can take place if the functional form and/or conditioning information set is misspecified. For linear dynamic models, important cases of such misspecifications are omitted shifts in the trend function, selecting a lag length in an auto-regression that is lower than the true order, failure to account for parameter instability, residual autocorrelation and omitted variables. In this context it is relevant to note that incorrectly specified conditional mean might as well cause misspecification of conditional variance. As a matter of fact, GARCH model would be correctly specified if there is no serial correlation. As a way out for this problem in the framework of studying serial correlation, Robinson (1991) and Woolridge (1991a, b) have recommended ways of robustifying tests for serial correlation to allow for possible misspecification of conditional variance.

The recent decade has witnessed a remarkable growth in the capital markets of Malaysia. Keeping up the spirit of corporatisation, the total number of listed companies on KLSE rose from 285 in 1990 to 793 in 2000. The market capitalization recorded a growth of RM362 billion during the period of 1990 to 2000. Capital mobilized in 1990 was RM9,930 million, which shot up surprisingly to RM19,116 million in 1997. With globalisation,

liberalisation and privatisation, the capital market has taken a dynamic shape in the Malaysian economy.

Such a superb growth in the Malaysian capital markets, I believe would have a crucial influence that leads financial market to achieve its desired level of perfectness and efficiency. Hence, the main objective of this study is to test informational efficiency of the Kuala Lumpur Security Exchange (KLSE) in terms of the daily Composite Index for the period 1st January 1977 – 3rd May 2002. Testing the weak-form efficiency of the KLSE will be the scope of the paper. Since, informational efficiency of Malaysian Security Market has not been examined exclusively using the ARCH-type models and account for the characteristic features and trading conditions of such rapidly growing markets (such as thin trading, low liquidity and possibly less informed investors), a non-linear general autoregressive heterocedastic (GARCH) model is estimated.

In conclusion, investigating the trend towards informational market efficiency on KLSE in order to accomplish allocational efficiency in the economy would provide a roadmap that heartens the financial markets and the economy as whole to move toward its preferential dynamism and perfectness.

LITERATURE REVIEW

This section sets out the review of literature on the Random Walk Hypothesis (RWH), one of the earliest economic models that have been used to explore efficiency of financial market. For a long time the RWH was taken to be equal to the EMH. Nonetheless, it is now recognized that the two are certainly different. On the other hand, the RWH literature takes up a basic responsibility in empirical examinations of the EMH.

Firstly, we will be given some brief empirical events from emergent financial markets then exploring a number of evidence from Malaysian capital market.

Literature that presents empirical evidence for efficiency in emerging markets is limited and the results are mixed. For instance, Hong (1978) examined the efficiency of the Singapore Stock Exchange and found evidence that supporting efficiency in the weak form of EMH. A further study done by Ang and Pohlman (1978) on Far-East Asian stocks also found an evidence for the weak form efficiency. Alternatively, evidence that supporting the market inefficiency was found by Ghandi et al. (1980) in an analysis of the Kuwait stock market. Wong and Kwong (1984)

studied the behaviour of the daily closing prices of 28 Hong Kong stocks. The results of serial correlation coefficients proved that the successive stock price changes were dependent random variables. They concluded the Hong Kong market is not weak form efficient. Butler and Malaikah (1992) found sign of inefficiency in the Saudi Arabian Stock Market, but not in the Kuwaiti Market. It is hard to commit that the Nairobi Stock Market is efficient, as claimed by Dickinson and Muragu (1994), when there is evidence that some of the most developed markets in the world are exemplified by inefficiency (see, such as, De Bondt & Thaler 1985, 1987; Lo & Mackinlay 1988).

There has been numerous published works regarding the informational efficiency of the Malaysian financial market in international literature. For instance, Cheng (1978) analyzed the daily closing prices of 12 randomly selected industrial stocks over 30 month period beginning mid-May 1973. Although the autocorrelation tests in general supported the RWH, the run test rejected it extremely. Lim (1980) investigated the monthly closing prices of 30 actively traded stocks and 6 indices for the period June 1974 to June 1980. He concluded that the KLSE was weak from efficient for active stocks.

Lonjong (1983) employ monthly closing prices of 104 stocks over a similar period as Lim and achieved equivalent results. Nassir (1983) examined weak form efficiency using monthly data on 101 actively traded stocks from January 1974 to June 1980. He uncovered evidence that is confirming weak form efficiency.

Laurence (1986) studied daily closing prices of 16 Malaysian stocks for the period of June 1973 to December 1978 and concluded that KLSE showed evidence of weak form efficiency. Likewise, Barnes (1986) reported that the KLSE presented a degree of weak form efficiency by employing monthly closing prices of thirty selected stocks, for the June 1975 to June 1980.

Nevertheless, Salim (1984) analyzed the weakly closing prices of 100 stocks for the period of 1974 to 1982 and found mix results. Saw and Tan (1986) conducted a sturdy on Malaysian Stock Market through six sectoral indices and all-share index over the period 1975-1982, they recommended that the Malaysian Stock Market was not efficient in the weak form when weekly data were used, although some evidence appeared in favour of market efficiency when monthly data used.

Othman (1989) applied serial correlation and run tests on the weekly closing prices of thirty randomly selected stocks from the component stocks of the KLSE industrial index and New Strait Times industrial index

for the period of January 1977 to June 1988 He concluded that the Malaysian Stock Market was weak form inefficient.

In a larger research derived from 170 stocks traded on all sectors of KLSE from January 1977 to May 1985, Othman (1990), moreover, confirmed that findings do not support weak from efficiency. Annuar, Ariff and Shamser (1991), alternatively, performed a study of weak from efficiency on 82 individual stocks for the period of 1975 to 1989 by employing unit root model and time trends factors. The findings proved that almost 83% of the total sample had unit root, which meant that there was a 13% possibility that stock prices had been inefficient over the 15 year period. Therefore, it was concluded that even though the market was normally weak form efficient that could be misused by the technical analysts. Comparable result was reported again by Annuar and Shamser (1993) that the KLSE is weak form efficient using monthly closing prices of 260 listed companies in KLSE, the composite index and New Times industrial index, over the period of January 1975 to December 1989.

Annuar, Ariff and Shamser (1992) furthermore analyzed monthly closing prices of all stocks traded for the period of January 1975 to December 1989 to explore the market ability to anticipate the information content of changes in annual earning and dividend announcement in a less developing and comparatively thinly traded KLSE using Dimpson- Fowler- Rorke 2 leads/ 2 lags model. In general results suggested that the random behaviour of the abnormal returns after the announcement time for both earnings and dividend increases and decreases suggest that KLSE is semi-strong efficient market.

Furthermore, Lian and Leng (1994) examined the weak form efficiency of the KLSE employing run tests, serial correlation test, modified Box-Pierce, Q test and Van Neumann's ratio test to analyze composite index, sectoral indices and newly constructed man board all-share Emas index. The results of different statistical tests on the KLSE stock indices suggested that KLSE is weak form efficient with respect to monthly data. They additionally concluded that KLSE has advanced its efficiency and altered from generally weak form inefficient market in the mid 1980's to a weak form efficient market by the late 1980's and early 1990's.

More lately, Habibullah (1998) investigated the relationship between money supply and stock prices in the KLSE to determine the level of market informational efficiency using the co-integration and error -correction model (ECM). Habibullah concluded that his finding is inconsistent with the efficient market hypothesis (EMH) since market participants will

be able to predict stock prices in the market using information on broad money supply, M3, as a trading rule to earn excess returns.

Yakob (2001) on the other hand, employed monthly data running from 1989:01 to 2001:03. Using M1 to represent monetary aggregate and Kuala Lumpur Composite Index as a proxy of stock prices, the month-to-month rate of change was computed to generate new series that represent changes in M1 and KLCI. He found that the variability of the past values of money growth has no significant long-run relationship with stock prices, as evident by the lack of co-integration between the moving average of standard deviation for monetary growth and stock prices. He concluded that such discovery on the Malaysian stock market is however consistent with the concept of efficient market since past information does not seem to affect the contemporary stock prices. As such, it suggests that market has already considered past information of market uncertainty in determining stock prices.

DATA AND METHODOLOGY

Daily observations of the Kuala Lumpur Securities Exchange Composite Index (KLSECI) are employed to investigate the informational efficiency of the Malaysian Stock Market for the period of 1st January 1977 – 3rd May 2002. 6223 observation are used for analysis. KLSECI is a weighted index using closing prices of stocks and published by the KLSE. Data resources are obtained from the Capital Market Board.

We use the first differences of logarithm to calculate unconditional logarithmic return as follows:

$$(1-L)\log(CI_t) = \log(CI_t) - \log(CI_{t-1}), \tag{2}$$

where L is the lag operator and CI indicates return to the KLSECI on the day t.

Then, the following two regressions are estimated to check whether it is suitable to use ARCH models.

First, to capture the volatility in the stock return as seen in the graph 2 we estimate very simple model:

$$\mathrm{CI}_t = a_1 + u_t, \tag{3}$$

where CI_t = return to KLSE composite index and u_t = random term.

Notice that besides intercept, there is no other explanatory variable in the model. From the data we obtained the following regression:

$$\hat{CI}_t = 0.00034$$

$$t = 1.71$$

$$d = 1.79.$$

What does this intercept stand for? It is simply the average rate of return on the KLSECI, or the unconditional mean value of CI_t. Therefore, over the sample period the average daily return on the KLSECI was about 0.00034 percent.

Now, we use ARCH-LM test to ensure whether there is ARCH effect or not. Residuals that we obtained from previous regression are regressed up to 6th lag. The results are as follows:

$$\hat{u}_t^2 = 0.000094 + 0.44\hat{u}_{t-1}^2 + 0.05\hat{u}_{t-2}^2 + 0.01\hat{u}_{t-3}^2 + 0.07\hat{u}_{t-4}^2 + 0.08\hat{u}_{t-5}^2 + 0.04\hat{u}_{t-6}^2$$

(5.97) (35.11) (3.35) (0.81) (5.24) (5.58) (–2.82)

$$n * R^2 = 1649.241, \tag{4}$$

where n represents number of observation used in the analysis.

We used following Whites general heteroscedasticity test under null hypothesis that there is no ARCH effect. That is,

$$n * R^2 \sim \chi_{df}^2, \tag{5}$$

where df is number of regressors in regression (3) and χ^2 is critical chi-square value. If the chi-square value obtained in (4) exceeds the critical value at chosen level of significance, the conclusion is that there is ARCH effect.

Now $n * R^2 = 1649.241$ and the 1 percent critical chi square value for 6 *df* is 16.8119. So, one can conclude, on the basis of the White test, that there is ARCH effect. Since, we have found ARCH effect then it is suitable to use the ARCH models when testing for informational efficiency of KLSE.

Since its discovery in 1982, ARCH modelling has turn into fashionable when analyzing for financial time series. One that becomes popular is *generalized autoregressive conditional heterocedasticity* (GARCH) model, originally proposed by Bollerslev (1986). The simple GARCH model is the GARCH (1, 1) model, can be written as:

$$Var\ (u_t) = \sigma_t^2 = \beta_0 + \beta_1 u_{t-1}^2 + \beta_2 \sigma_{t-1}^2 \tag{6}$$

which say that the conditional variance of u at time t depends not only on the squared error term in the previous time period {as in ARCH(1)} but also

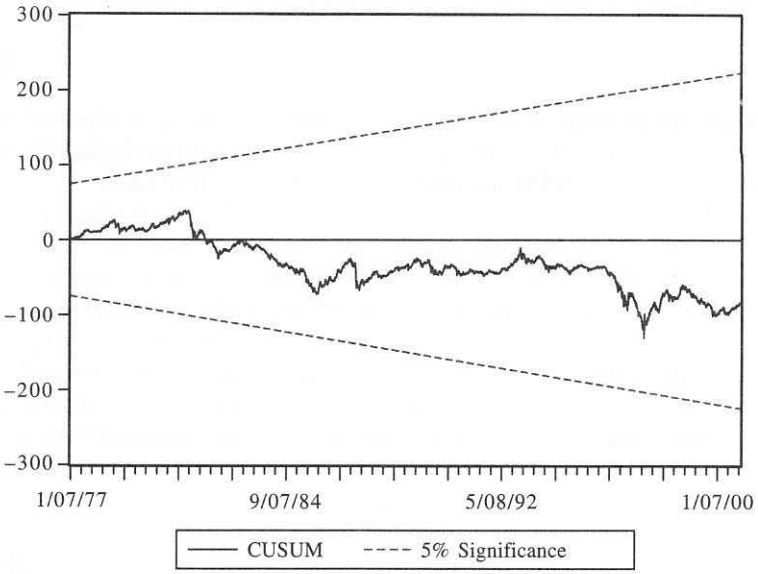
its conditional variance in the previous time period. This model can be generalized to a GARCH (p, q) model in which there is p lagged terms of the squared term and q terms of the lagged conditional variance. Thus, to investigate the informational efficiency of KLSE we estimated the following GARCH (1, 1) model:

$$\mathrm{CI}_t = \alpha_1 + \alpha_2 \mathrm{CI}_{t-1} + u_t \tag{7}$$

$$Var\ (u_t) = \sigma_t^{\ 2} = \beta_0 + \beta_1 u_{t-1}^2 + \beta_2 \sigma_{t-1}^2 \tag{8}$$

where CI_t is mean stock return to the KLSECI on current period, CI_{t-1} is return on previous period. σ_t^2 is the conditional variance and u_t is an disturbance term.

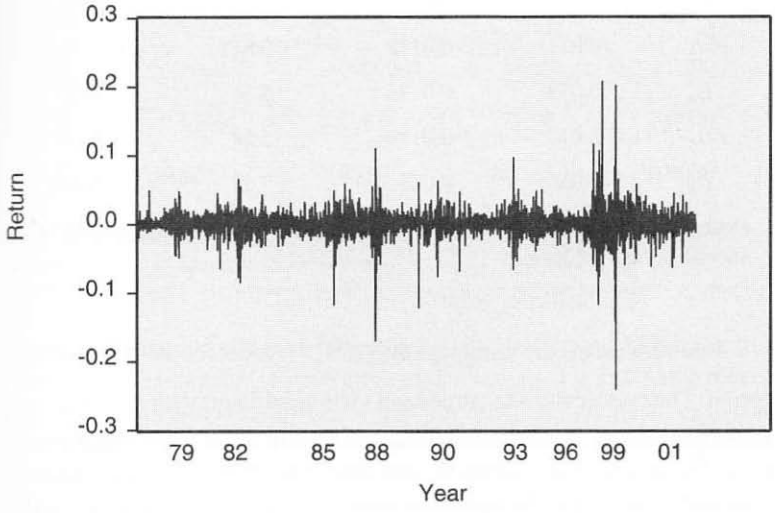
We also run the CUSUM (cumulative sum) test to check coefficient stability that is whether we need to split up sample period into subperiods. As it can be seen from the Graph 1 CUSUM test result verifies that coefficients are stable since they are within red, 2 standard error, lines. One that may suggest there is no need to divide sample period into subperiods.



GRAPH 1. CUSUM satbility test for sample period of 1st January 1977 – 3rd May 2002

DISCUSSIONS OF RESULTS

Graph 2 presents daily return in KLSECI (Kuala Lumpur Stock Exchange Composite Index) for the period of 1st January 1977– 3rd May 2002. It is evident from this graph that the returns in KLSECI display considerable volatility. Notice particularly the wide swing around the 1999 crash in stock prices.



* *Return to KLSECI*

GRAPH 2. First differences of logs of CI*

TABLE 1. Estimated OLS model

$$(\hat{\mathrm{CI}}_t = \hat{a}_1 + \hat{u}_t)$$

Variable	Coefficient	Std. Errors	Z-statis.	Significance
$\hat{a}_1$	0.0034	0.00020	1.71	0.0875

observation used: 6221
sample period: 1st January 1977 – 3rd May 2002

TABLE 2. ARCH-LM test

$$(u_t^2 = a_0 + a_1 u_{t-1}^2 + a_2 u_{t-2}^2 + \ldots\ldots + a_6 u_{t-6}^2)$$

Variable	Coefficient	Std. Errors	Z-statis.	Significance
a_0	0.000094	0.000016	5.97	0.0000
$\hat{a}_1$	0.45	0.0127	35.11	0.0000
$\hat{a}_2$	0.046	0.0139	3.35	0.0008
$\hat{a}_3$	0.011	0.0138	0.811	0.4176
$\hat{a}_4$	0.073	0.0138	5.24	0.0000
$\hat{a}_5$	0.077	0.0139	5.58	0.0000
$\hat{a}_6$	–0.036	0.013	2.82	0.0048

Observation used: 6215 Obs*R^2 = 1649.241 F-statictic=373.74
sample period: 1st January 1977 – 3rd May 2002

Table 2 presents the results of GARCH (1, 1) model for the entire sample period. The coefficient $\hat{\alpha}_2$ turned out to be significant with z-statistics of 16.82 (p value of about 0.0000) which is significant at a 1% significance level. The results here confirm that for the entire sample period the KLSE is predictable or say in other word, is weak form inefficient in terms of the daily Composite Index. To make further conclusion please consider that $\hat{\beta}_1$ and $\hat{\beta}_2$ are also statically significant with z-statistic of 22.98 and 141.85 (p value of about 0.0000) respectively. This is implies that the conditional variance of *u* and squared error terms in the previous period predicting its conditional variance and error term in the current period. Therefore, this trend also support that KLSE is not weak form efficient. Since, we can not only forecast the future stock prices on the basis of past stock prices but also forecast the conditional variance of *u* and error term for the forthcoming period on the basis of past values of conditional variance of *u* and error term.

In addition, as it can be seen from the Table 3 ARCH ($\hat{\beta}_1$) and GARCH ($\hat{\beta}_2$) terms are positive with the sum of 0.9815 that is approaching unity,

TABLE 3. Estimated GARCH (1, 1) model

$$(\hat{\mathrm{CI}}_t = \hat{\alpha}_1 + \hat{\alpha}_2 \hat{\mathrm{CI}}_{t-1} + \hat{u}_t)$$

$$(Var\ (\hat{u}_t) = \hat{\sigma}_t^{\,2} = \hat{\beta}_0 + \hat{\beta}_1 \hat{u}_{t-1}^2 + \hat{\beta}_2 \hat{\sigma}_{t-1}^2)$$

Variable	Coefficient	Std. Errors	Z-statis.	Significance
$\hat{\alpha}_1$	0.00067	0.00011	5.967	0.0000
$\hat{\alpha}_2$	0.2154	0.0128	16.82	0.0000
$\hat{\beta}_0$	0.000006	0.0000003	18.69	0.0000
$\hat{\beta}_1$	0.1545	0.0067	22.98	0.0000
$\hat{\beta}_2$	0.827	0.0058	141.85	0.0000

observation used: 6220
sample period: 1st January 1977 – 3rd May 2002

suggesting that volatility of return is highly persistent. Although, the return volatility appears to have quite long memory, it is still mean reverting: the sum of and is significantly less than one, implying that, even if it takes a long time the volatility process does return to its mean. Also note that turn out to be relatively significant implying that there is no serial correlation problem in the squared residuals is an indication that the simple GARCH (1, 1) process is a good fit for the conditional variances.

CONCLUSION

In this paper, we investigated the informational efficiency of KLSE in terms of daily observations of Composite Index applying the simple GARCH (1, 1) model. Since, suitability of ARCH-type models that have proven to be effective in capturing volatility-clustering characteristic in general exhibited by financial returns data.

This study concludes that KLSE is characterized by predictability and is therefore not informational efficient in the weak sense when using daily composite index for the period of 1st January 1977 – 3rd May 2002. We also concluded that volatility is very persistent on the KLSE. That is, if the market is highly volatile today, it will most likely be volatile tomorrow.

However, in the long run, our results suggest that volatility process will be returning to its mean.

The main message of this paper is that informational efficiency of the Kuala Lumpur Stock Exchange (KLSE), as in any other emerging market, is produced by improving liquidity, ensuring that investors have access to high quality and reliable information and minimizing the institutional restrictions on trading. Additionally, the evolution in the regulatory framework of the KLSE may mean that it was initially characterized by inefficiency and volatility but eventually will develop into an efficient and effectively functioning market which allocates resources effectively.

REFERENCES

Ang, J. J. & R. A. Pohlman. 1978. 'A Note on the Price Behaviour of Far Eastern Stocks'. *Journal of International Business Studies*, pp. 103-107.

Annuar, M. N. & M. Shamser. 1993. 'The Efficiency of the KLSE: A collection of Emprical Findings. Serdang, Penerbit UPM.

Annuar, M. N., M. Ariff & M. Shamser. 1992. 'A test of Semi-Strong Efficiency of the KLSE: The Effect of Annual Earnings and Dividend Announcements on Stock Prices'. *Malaysian Journal of Economic Studies* 29(1): 35-50.

Barnes, P. 1986. 'Thin Trading and Stock Market Efficiency: The Case of the Kuala Lumpur Stock Exchange'. *Journal of Business Finance and Accounting* 13.

Benatzi, S. & R. H. Thaler. 1992. 'Myopic Loss Aversion and the Equity Premium Puzzle'. *National Bureau of Economic Research Working Paper*, p. 4369.

Bollerslev, T., R. F. Engle & D. B. Nelson. 1994. 'ARCH Models, in R. F. Engle and D. L. McFadden (eds.)', *Handbook of Econometrics* IV, Elsevier Science B.V.

Bollerslev, T., R. Y. Chou & K. F. Kroner. 1992. 'ARCH Modelling in Finance: A Review of the Theory and Empirical Evidences'. *Journal of Econometrics* 52: 5-59.

Cheng, K. 1978. 'The Random Walk Hypothesis: An empirical Test with Malaysian Share Prices, *Occasional Paper*, No. 13. Bangi: UKM.

Dabba, R. E., K. Smith & J. Bracato. 1991. 'Test on the rationality of Professional Business Forecasts with Changing Forecast Horizons'. *Quarterly Journal of Business and Economics* 30.

DeBondt, W. & R. Thaler. 1985. 'Does the Stock Market Overreact'? *Journal of Finance* 40: 793-805.

DeBondt, W. F. M. & R. H. Thaler. 1987. 'Further Evidence of Investors Overreaction and Stock Market Seasonality'. *Journal of Finance* 42: 557-581.

Dickinson, J. P. & K. Muragu. 1979. 'Market Efficiency in Developing Countries: A Case Study of the Nairobi Stock Exchange'. *Journal of Business Finance and Accounting*.

Fama, E. F. 1970. 'Efficient Capital Markets: A Review of Theory and Empirical Work'. *Journal of Finance* 25: 383-417.

Gandhi, D. K., A. Saunders, et al. 1980. 'Thin Capital Markets: A Case Study of the Kuwaiti Stock'. *Applied Economics* 12.

Giles, D. E. A., J. A. Giles & J. K. Wong. 1993. 'Testing for ARCH-GARCH errors in a misspecified regression'. *Computational Statistics* 8: 109-126.

Granger, C. W. J. & A. P. Anderson. 1978. 'An introduction to bilinear time series models, Gottingen: Vaden hoeck and Reprecht'.

Habibullah, M. S. 1998. "The Relationship between Broad Money and Stock Prices in Malaysia: An Error Correction Approach". *Jurnal Ekonomi Malaysia* 32: 51-73.

Hallwood, C. P. & R. Mac Donald. 1994. 'International Money and Finance', 2nd. edition.

Higgins, M. L. & A. K. Bera. 1992. 'A class of nonlinear ARCH models'. *International Economic Review* 33: 137-58.

Hinich, M. J. & D. M. Patterson. 1985. 'Evidence of nonlinearity in daily stock returns'. *Journal of Business and Economic Statistics* 3: 69-77.

Hong, H. 1978. 'Predictability of Price Trends on Stock Exchanges: A Study of Some Far Eastern countries'. *Review of Economics & Statistics* 60: 619-621.

Hsieh, D. A. 1991. 'Chaos and nonlinear dynamics: application to financial markets'. *Journal of Finance* XLVI (5): 1839-1877.

Lanjong, M. N. 1983. 'A study of Market Efficiency and Risk Return Relationship in the Malaysian Capital Market'. *Unpublished PhD dissertation.* Catholic University of Levven.

Laurence, M. M. 1986. 'Weak Form Efficiency in the Kuala Lumpur and Singapore Stock Market'. *Journal of Baking and Finance* 10: 431-445.

Levich, M. R. 1979. 'The International Money Market: An Assessment of Forecasting Techniques and Market Efficiency', *JAI Press*, Inc.

Lian, K. K. & K. G. Leng. 1994. 'Weak Form Efficiency in the KLSE: New Evidence'. *Capital Market Review* 2: 45-58.

Lim, T. L. 1980. 'The Efficient Market Hypothesis and Weak Form Test on the KLSE'. *Unpublished MBA dissertation.* University of Sheffield.

Ljung, G. M. & G. E. P. Box. 1978. 'On a measure of lack of fit in time series models'. *Biometrika* 66: 67-72.

Lo, A. & A. MacKinlay. 1988. 'Stock Market Prices Do Not Follow Random Walk: Evidence from A Simple Specification Test'. *Review of Financial Studies* 1.

Lumsdaine, R. L. & S. Ng. 1999. 'Testing for ARCH in the presence of a possibly misspecified conditional mean'. *Journal of Econometrics* 93: 253-279.

Mansor Md. Isa. 1989. 'Share Price Behaviour on the Malaysian Stock Market: Some Empirical Evidence'. *Malaysian Journal of Economic Studies* 26(1): 1-20.

Opong, K. K., G. Mulloholland, A. F. Fox & K. Farahmand. 1999. 'The behaviour of some UK equity indices: an application of Hurst and BDS tests'. *Journal of Empirical Finance* 6: 267-282.

Ottman, Yong. 1989. 'The Price Behaviour of Malaysian Stocks'. *Malaysian Management Review* 24(3): 23-34.

Ottman, Yong. 1990. 'Thin Capital Markets: A study of Market Efficiency of Malaysian Stocks'. *Malaysian Management Review* 25: 49-62.

Robinson, P. M. 1991. 'Testing for strong serial correlation and dynamism conditional heteroskedasticity in multiple regression'. *Journal of Econometrics* 47: 67-84.

Sakai, H. & H. Tokumaru. 1980. 'Autocorrelations of a certain chaos. *IEEE Transactions on Acoustics, Speech and Signal Processing* 1: 588-590.

Salim, M. A. 1984. 'Share Price Behaviour of Common Stocks at the KLSE: An Empirical Study. *Unpublished MBA dissertation*. University of Malaya.

Samuelson, P. A. 1965. 'Proof that Properly Anticipated Prices Fluctuate Randomly'. *Industrial Management Review* 6: 41-49.

Saw, S. H. & K. C. Tan. 1986. 'The Malaysian All-Share Price Indices: 1975-1982. *Singapore Securities Research Institute*. Singapore, 70 pages.

Schatzberg, J. D. & R. R. Reiber. 1992. 'Extreme Negative Information and the Market Adjustment Process: The Case of Corporate Bankruptcy'. *Quarterly Journal of Business and Economics* 31.

Scheikman, J. & B. LeBaron. 1989. 'Nonlinear dynamics and stock returns'. *Journal of Business* 62: 311-337.

Sewell, S. P., S. R. Stansell, I. Lee and M. S. Pan. 1993. 'Nonlinearities in emerging foreign capital markets'. *Journal of Business Finance and Accounting* 20(2): 237-248.

Tong, H. 1990. 'Nonlinear Time Series'. *Oxford Science Publications*. Oxford.

Weiss, A. A. 1986. 'Asymptotic theory for ARCH models: estimation and testing'. *Econometric Theory* 2: 107-131.

Willey, T. 1992. 'Testing for nonlinear dependence in daily stock indices'. *Journal of Economics and Business* 44(1): 63-76.

Wong, K. A. & K. S. Kwong. 1984. 'The Behaviour of Hong Kong Stock Prices'. *Applied Economics* 16.

Wooldridge, J. M. 1991a. 'On the application of robust, regression-based diagnostics to models of conditional means and conditional variances'. *Journal of Econometrics* 47: 5-46.

Wooldridge, J. M. 1991b. 'Specification testing and quasi-maximum likelihood estimation'. *Journal of Econometrics* 48: 29-55.

Yakob, N. A. 2001. 'Monetary uncertainty and stock prices: The case of Malaysia'. *Department of Finance*. UKM, Malaysia.

Fakulti Ekonomi
Universiti Kebangsaan Malaysia
43600 UKM Bangi
Selangor Darul Ehsan
e-mail: ozerbalkiz@hotmail.com