Leverage Effect and Market Efficiency of

Kuala Lumpur Composite Index

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Abstract

Stock market is a main source for raising new private capital in many developing countries including Malaysia. Therefore, its efficiency and leverage effect is utmost important and interest. This paper aims to estimate the leverage effect of Malaysian stock market using EGARCH as well as investigating its efficiency using Augmented Dickey-Fuller (ADF). Data used consists of weekly closing prices for Malaysia stock market indices, namely the Kuala Lumpur Composite Index (KLCI), from 9 January 2004 to 8 Jun 2007. Results show that the EGARCH model did not confirm the existence of the leverage effect. The KLCI possess a unit root with no trend but with drift or known as random walk drift. It suggests that KLCI is weak form hypothesis.

Keywords: Market efficiency, Leverage effect, Kuala Lumpur Composite Index (KLCI), Malaysia

1. Introduction

Stock market has been critical to many developing economies, playing important roles as source for new private capital and information dissemination. Hence, various empirical models, particularly time series models have been employed to study stock market leverage effect and efficiency. Time series models could explain the dynamics of financial time series and thus the applications of the ARCH model introduced by Engle (1982) or its extension Generalized Autoregressive Conditional Heteroscedasticity (GARCH) by Bollerslev (1986) in finance have become commonplace. Generally, this type of non-linear time series model is able to capture a special type of non-linearity in the data generating process, known as multiplicative non-linearity, or non-linear-in-variance, in which non-linearity affects the process through its variance (Hsieh 1989). For most financial data, one of the stylized features is that they do experience volatility clustering and thus GARCH models have been popular used for examined financial data because they are able to capture this clustering feature. Despite their popularity, the ARCH parameterization of the conditional variance does not have any solid grounding in economic theory, but represents 'a convenient and parsimonious representation of the data' (Hall et al. 1989).

Many studies have tries to estimates the leverage effect in the stock market. Many empirical studies use different kind of model to estimate the leverage effect. In which this paper will focus on the Exponential GARCH model to estimate whether there is leverage effect on the stock market. In earlier period many authors uses GARCH model to capture the leverage effect. But if GARCH shows the negativity in volatility, it's meaningless. So, non-negativity constraints have to be imposed on these parameters. Nelson (1991) stated that the non-negativity constraints in the GARCH model are too restrictive. He introduced the Exponential GARCH (EGARCH) model to overcome this

problem. EGARCH models the logarithm of the conditional variance where, the coefficient γ measures the asymmetric effect, which if negative, indicates that negative shocks have a greater impact upon conditional volatility than positive shocks of equal magnitude. EGARCH has certain advantages over GARCH. Firstly, by using the exponential formulation, the restrictions of positive constraints on the estimated coefficients in GARCH are no longer necessary. Secondly, GARCH fails to capture the negative asymmetry apparent in many financial time series. The EGARCH model solves this problem by allowing for the standardized residual as a moving average regressor in the variance equation, while preserving the estimation of the magnitude effect. Due to the argument about, this paper will apply EGARCH model to capture the Malaysia stock markets data.

Further studies will hold to examine the weak form market hypothesis. A vast number of the empirical studies on efficient market hypothesis in the stock markets have been examined, which asserts that stock market price should reflect the intrinsic value of underlying assets. According to Fama (1970), a market is efficient if prices fully reflect all available information on a particular stock market. This means that there are no opportunities for investors to make abnormal returns by exploiting information contained in the history of fundamental data (includes price movement as well as indicators of changing economic fundamentals). 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.

Fama (1970) categorized three forms of market efficiency which is weak form, semi-strong form and strong form. These three forms differ in terms term of the types of information which are used in developing investment strategies. This paper is concerned with the weak form test of the efficient market hypothesis only because if the evidence fails to pass the weak form test, there is no reason to examine strong forms before declaring the market inefficient on such evidence (Wong and Kwong, 1984). Efficient market hypothesis (EMH) states that weak-form efficiency exists if security prices fully reflect all the information contained in the history of past prices and movement. As McInish and Puglisi (1982) pointed out, a sufficient condition for weak-form efficiency is that stock price fluctuates randomly. Thus, a market is efficiency in weak-form if stock prices follow a random walk process. If capital markets are weak-form efficient, then investors cannot earn excess profits from trading rules based on past prices or returns. Therefore, stock returns are not predictable, and so-called technical analysis (analyzing patterns in past price movements) is useless. Following the seminal paper of Fama (1970) on market efficiency, a large number of empirical studies have been conducted which find evidence in support of efficient market hypotheses. But Fama's seminal paper set the theoretical basis for the concept of efficiency in capital markets, and the methodology for testing certain aspects of the hypothesis of efficient markets. Therefore, tests for Fama's efficient market hypothesis (EMH) in the context of stock market usually meant testing the null hypothesis that autocorrelation coefficient of different lags are statistically insignificant.

The main purpose of this paper will focus on the EGARCH to estimate the leverage effect of Malaysia stock market. Further studies will investigate the weak from efficiency for Malaysia stock market using Augmented Dickey-Fuller (ADF). The remainder of this paper is organized as follows. The second part will provide an extensive review of literature on the efficient market hypothesis with emphasis on time series studies. Part three will introduce the methodology with an emphasis on recent econometric developments in time series analysis. Part four will concentrate on the empirical results obtained from the research and the final part will provide conclusions of the research.

2. Literature review

In the literature, the family of GARCH models has grown at a wonderful rate. Engle (1995), Hentschel (1995) and Pagan (1996), among others, provided an excellent account of the variations and extensions of GARCH models over the years. In the GARCH models, the variance is time varying and this provides an alternative and useful measurement of volatility. Volatility refers to a statistical measure of the dispersion of a return distribution, and it is specified as the square root of the conditional variance estimated on the basis of the information available in t, and projected τ periods ahead (Schwert, 1990). In the literature, consensus has been reached that volatility in asset returns has some basic characteristics such as volatility clustering, leptokurtosis or fat tails, leverage effect and mean reversion.

Normally, the plot of financial time series data such as stocks, exchange rate is often observed that large and small changes tend to occur in clusters. That is, large returns are followed by more large returns, and small returns are followed by more small returns. This behavior was first evidenced by Mandelbrot (1963) and Fama (1965), and further reported by Baillie et al., (1996), Chou (1988) and Schwert (1989). The implication of volatility clustering is that volatility shocks today will influence the expected volatility many periods ahead. In this paper, the stock market

data will be plotted to check the volatility clustering. Figure 1 shows that stock market (KLCI) produces volatility clustering which larger return follows by larger return and smaller return follow by smaller return for the period from year 2004 to 2007.
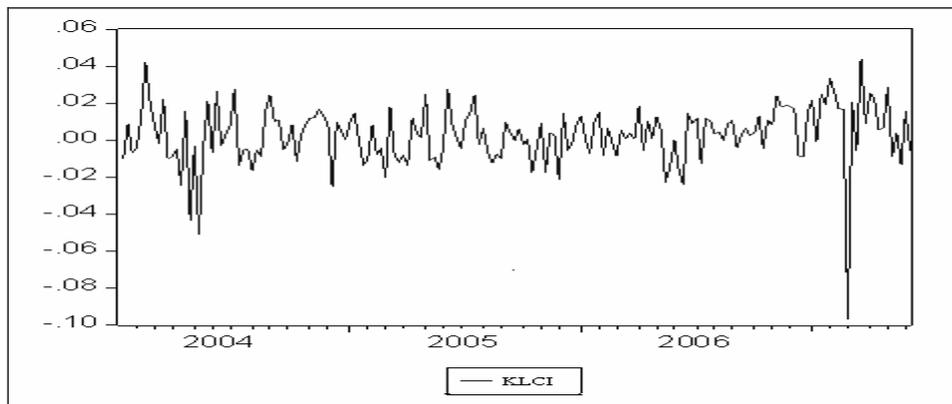
Figure 1. Volatility Clustering of the KLCI

Financial time series often show fat tails in their distributions. This phenomenon is usually referred to as leptokurtosis. Simply stated, this means that we observe more extreme values (outliers) than we expect to. Statistically, fat tails suggest that the kurtosis of the return series exceeds the kurtosis of a standard Gaussian distribution (Mandelbrot, 1963). Besides that, it is often observed in many stock returns that volatility is higher after negative shocks (bad news) rather than after positive shocks (good news) of the same magnitude. So volatility seems to be affected asymmetrically by positive and negative returns. This fact is called the leverage effect and was first noted in Black (1976). The leverage effect suggests that changes in stock prices tend to be negatively correlated with changes in volatility. Christie (1982) and Nelson (1991) both documented this negative relationship of volatility with equity returns. Engle and Ng (1993) described a News Impact Curve with asymmetric response to good and bad news. Therefore, this paper will concern the leverage effect of Malaysia stock markets data.

Most financial practitioners believe volatility is mean reverting. For example, Engle and Patton (2001) interpreted mean reversion of volatility as meaning that there exist a normal level of volatility, to which volatility will eventually return. Extremely long run forecasts of volatility should all converge to this normal level of volatility, and current information has no effect on the long run volatility forecast. The properties addressed above have important implications for the understanding of various volatility models, as the development of volatility forecasting models is largely motivated to capture and reflect these stylized facts in volatility.

The GARCH models have been known for more than two decades, most of their applications are on the widely traded financial markets of developed industrialized countries. However, there is a growing trend of their applications in the Asian stock markets, for instance forecasting volatility of stock returns (Choo et al. 1999), modeling the volatility of stock index futures market (Tan 2001) and determining volatility spillover effects among major Asia-Pacific stock markets (Hooy and Tan 2002). While these Asian studies involved different applications of GARCH models, none of them conducted a thorough investigation to determine the adequacy of the GARCH models.

This issue is of great importance to the field of finance in view of the wide application of GARCH models in understanding the relationship between risk and expected returns, particularly in the areas of asset pricing, portfolio selection and risk management. Motivated by the above consideration, this study contributes to the current literature by addressing the fundamental issue of GARCH adequacy in characterizing the behavior of Malaysia KLCI stock returns series. GARCH models are capable of capturing the first two properties of the return series, but their distribution is symmetric. Therefore, fails to model the leverage effect (good and bad news). To solve this problem, many nonlinear extensions of the GARCH model have been proposed in the last twenty years. Among the most widely spread are EGARCH of Nelson (1991), Threshold ARCH (TARCH) and Threshold GARCH (TGRACH), which were introduced independently by Zakoian (1994) and Glosten, Jagannathan and Runkle (1993). This paper will apply the EGRACH model that introduced by Nelson (1991) to test out the leverage effect.

Financial economists have studied the relationship between risk and expected returns and the conditional volatility of stock markets. For example, Baillie and DeGennaro (1990) studied the dynamics of expected stock returns and volatility in the U.S. stock markets. Poon and Taylor (1992) investigated the same relationship in the U.K. stock market. Both studies found volatility clustering, predictability, and persistence is presented in these markets. For

practical forecasting purposes, however, the predictability of various conditional volatility models is of most concern, whereas the results on this issue are inconsistent in the literature. Pagan and Schwert (1990) compared GARCH, EGARCH, the Markov switching regime and three nonparametric models for forecasting monthly U.S. stock return volatilities. The EGARCH, followed by the GARCH models, were found to perform moderately, while the remaining models produce very poor predictions.

Besides testing the volatility and the clustering effect of stock markets, there have been many studies on the random walk hypothesis (RWH) for stock markets efficiency for different countries. The rejection of the RWH implies that stock returns are predictable on the basis of its own lagged values, which can say that the markets are not weak-form efficiency. However, the empirical evidence of random walk on the weak form efficiency indicates mixed results. Conrad and Juttner (1973) applied parametric and non-parametric tests to daily stock price changes in the German Stock Market. They found that the random walk hypothesis is inappropriate to explain the price changes. Furthermore, Frennberg and Hansson (1993) examined the random walk hypothesis using Swedish data from 1919 to 1990. They found that Swedish stock prices have not followed a random walk in that period. Cooper (1982) studied world stock markets using monthly, weekly and daily data for 36 countries. He examined the validity of the random walk hypothesis by employing correlation analysis, run tests and spectral analysis. With respect to the USA and the UK, the evidence supports the random walk hypothesis. For all other markets, the random walk hypothesis can be rejected. Whereby, Panas (1990) could not reject the hypothesis of random walk and thus demonstrated that the Athens stock Market is efficient. This paper will studies the RWH for Malaysia stock market efficiency as well.

3. Methodology

3.1 EGARCH

The EGARCH model is an alternative choice to accommodate the asymmetric relationship between stock returns and volatility changes. EGARCH (1, 1, and 1) is chosen as the appropriate model for the return series.

$$\ln h_t^2 = w + \beta \ln \sigma_t^2 + \delta \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \qquad (1)$$

where h_t is the risk of the market. If γ hypothesis do not reject, then the model does not have leverage effect. If the γ is negative then it shows that the good news is better than bad news and vice versa. For the δ is to capture the negative value which to avoid the negativity constraint.

3.2 Weak form hypothesis

The weak EMH model can be return as

$$R_t = \alpha + \mu_t \qquad (2)$$

Expressing R_t as the differences between two successive logarithmic price indexes

$$\ln P_t = \alpha + \ln P_{t-1} + \xi_t \qquad (3)$$

Applying the augmented Dickey-Fuller test (ADF) test that addresses the problem of autocorrelation in ξ_t,

equation 3 may be tested by

$$\Delta P_t = \beta_1 + \beta_2 T + \lambda P_{t-1} + \tau_i \sum \Delta P_{t-1} + \mu_t \qquad (4)$$

with *T* being time trend. In performing the ADF test the lag length m is selected such that the new error term μ_t is

free of auto correlation. This paper uses Akaike Information Criterion to check the significant lag length to test.

4. Results

4.1 Data

In this study, the data consist of weekly closing prices for Malaysia stock market indices Kuala Lumpur Composite Index (KLCI), these indices collected from Bursa Saham Malaysia. The prices covering the sample period from 9 January 2004 to 8 Jun 2007 are transformed into a series of continuously compounded percentage returns, using the relationship: $r_t = \log(P_t / P_{t-1})$ where *Pt* is the closing price of the stock on week *t*, and P_{t-1} the price on the previous trading week.

4.2 Test for stationary

To provide a better description of the time dependant pattern that is important in modelling the series under study, it is necessary to test the stationarity of the return series, which is an approximation of the volatility process. This paper tests for stationarity can be performed by the Augmented Dickey-Fuller (ADF) unit root test. As reported in Table 1, show the result with no constant and no lagged term, the ADF t-statistic for the return series is –-7.374291, which is less than the critical value of –2.567926 at the 1% significance level. Therefore, we can reject the unit root hypothesis of the return process with a confidence level of more than 99%. Furthermore, in Table 1, the paper concludes that the KLCI return series are stationary.

Table 1. Augmented Dickey-Fuller Tests for Unit Root on the Returns of Malaysian KLCI for the period from 9th January 2004 to 8th Jun 2007

variable	t-statistic
KLCI	-7.374291*

Notes: The null hypothesis is that the series is non-stationary, or contains a unit root for the ADF.

The rejecion of null hypothesis for ADF tests based on the Mackinnin critical values

* indicates the rejection of the null hypothesis of non-stationary at 5% significance level.

4.3 Test for ARCH effect

The results of the ARCH LM test for the return series on the KLCI index in Table 2. It is interesting to see that lag 1 and lag 2 AR terms are not significant in the ARCH LM test, whilst lag 3 and lag 4 terms are significant in the test. This indicates that volatility displays a long memory, or long-term dependence. The ARCH LM test, in Table 2, F-statistic is significant, with a p-value of 0.088673 with a confidence level of 10%. This paper concludes that ARCH effects exist and the variance of the return series is non-constant. This result can be further confirmed by examining the correlogram of the squared standardized residuals from the mean equation the Q-statistics from lag 3 are highly significant, indicating the existence of an ARCH effect. It shows that the data have ARCH effect. The paper will proceed to test the EGARCH to determine the leverage effect.

Table 2. ARCH LM Test

F-statistic	2.056827	Probability	0.088673*

Note: (***), (**), (*) denotes significance at the 1%, 5% and 10% level respectively

4.4 Testing for EGARCH

$$h_t = -\ 8.909048\ +\ 0.514998\ \sigma_t\ +\ 0.346928\ \delta_t\ -\ 0.016686\ \gamma$$
$$\quad\ (1.9422941)\ \ (0.228860)\quad\ \ (0.168054)\quad\ \ (0.236854)$$

The EGARCH model did not confirm the existence of the leverage effect, because the measure of the leverage effect γ, which equals to –0.016686 is larger than the critical value, which indicates that any news in the market would not reflect in the stock market. The ARCH LM test in Table 3 indicates the F-stat cannot be rejected at any significant level; there is no ARCH effect left in the model. The paper uses LM autocorrelation test to find out the autocorrelation problem and find out that the result support the null hypothesis. Also, normality test been conducted to test whether the model is normal; the test supports also the null hypothesis. The paper shows that there is no misspecification error in the model.

Table 3. EGRACH LM Test

F-statistic	0.944166	Probability	0.439946

Note: (***), (**), (*) denotes significance at the 1%, 5% and 10% level respectively

4.5 Testing for weak form hypothesis

Table 4 illustrates that, the KLCI possess a unit root with no trend but with drift or known as random walk drift. It suggests that KLCI is weak form hypothesis. The paper shows that the F-stat is more than the critical value which this show that the null hypothesis cannot be rejected. The KLCI cannot be predicted or no technical analysis can be used to determine the price movement.

Table 4. Augmented Dickey-Fuller Tests for Unit Root on the Natural Logarithms of Malaysian KLCI for the Period from 9th January 2004 to 8th Jun 2007

variable	without trend	trend
KLCI	0.684266	-0.92001

Notes: The null hypothesis is that the series is non-stationary, or contains a unit root for the ADF.

The rejecion of null hypothesis for ADF tests based on the Mackinnin critical values

* indicates the rejection of the null hypothesis of non-stationary at 5% significance level.

5. Conclusion

In this paper, the EGARCH has been tested for KLCI. The result show that the market would not captured the bad or good news. The results may support the behavioural finance theory which indicates that people will think irrationally or the market is random walk. For example, a person purchase a stock with their prediction that the stock price expected to increase in the future, any bad news about the stock would effect his decision because the person believe his stock or may not want to admit that he made the wrong decision. So, this kind of person would hold the stock until it rises.

For the weak form EMH result show that KLCI move randomly which no one can predict the stock price movement. This result may be supportive with the EGARCH in the sense that the stock price has already fully reflected all available information into the market. Which any news cannot shift the stock price movements. Moreover, it can be said that any technical and fundamental analysis cannot be performed to predict the stock price.

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