DEPOCEN

Working Paper Series No. 2010/09

Day-Of-The-Week Effects in Different Stock Markets: New Evidence on Model-Dependency in Testing Seasonalities in Stock Returns

Le Long Hau*

* PhD student of Faculty of Applied Economics, University of Antwerpen, Belgium.
Lecturer of School of Economics and Business Administration (SEBA), Can Tho University (CTU)

Day-Of-The-Week Effects in Different Stock Markets:

New Evidence on Model-Dependency in Testing Seasonalities in Stock Returns

by Le Long Hau[1]

ABSTRACT

This paper investigates the day-of-the-week effects in the stock indexes of both developed and emerging markets as well as the MSCI world index from March 2002−May 2008 using regression models. The results show many daily effects, occurring from Monday to Friday, which are different from the weekend effect. No consistent daily effects were found for either returns or volatility in any market by any of the tested models, and the presence of effects seems to be model-dependent. Surprisingly, the MSCI world index exhibits a strong positive return on Monday and Wednesday. The leverage effect on the arrival of new information is reliably found in three developed markets and the MSCI world index.

Keywords: Anomalies, day-of-the-week effect, OLS, GARCH, Modified GARCH, GARCH-M, TGARCH, EGARCH.

[1] PhD student of Faculty of Applied Economics, University of Antwerpen, Belgium.
Lecturer of School of Economics and Business Administration (SEBA), Can Tho University (CTU)

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

Introduced by Fama (1970), the efficient market hypothesis (EMH) postulates that stock prices must efficiently reflect all available information about their intrinsic value. An efficient market is one where all unexploited profit opportunities are eliminated by arbitrage (Richard et al., 2004). Over the last decades, however, many empirical studies have indicated persistent and potentially exploitable day-of-the-week patterns in both stock returns and volatility in many countries. These daily anomalies present a challenge to the EMH and attract much attention from economists and market practitioners. From a financial perspective, there are three important reasons for examining the daily anomalies in markets. Firstly, the discovery of anomalous patterns in stock returns is important because of their effects on the trading strategies of investors (Cemal and Sibel, 2003). Secondly, it is also necessary for rational decision-makers to be aware of variations in the volatility of stock returns dependent on the day of the week and whether high or low returns are associated with a correspondingly high or low volatility for a given day. If investors can identify a certain pattern of volatility, it is easier to make investment decisions based on both the projected returns and the risks associated with the particular security (Kiymaz and Berument, 2003). Thirdly, the investigation of anomalous patterns may reveal evidence about the extent of market efficiency.

Several early studies of the US stock market documented negative stock returns on Mondays and positive returns on Fridays (Cross, 1973; Lakonishok and Levi, 1982; Rogalski, 1984; Keim and Stambaugh, 1984). These effects also seem to be present in the stock markets of other developed countries, such as Japan, Canada and Australia, although in some of these markets other effects are also present. For some European countries, the results are rather mixed, also exhibiting new anomalous patterns (Jaffe and Westerfield, 1985a, 1985b; Hawawini, 1984; Solnik and Bousquet, 1990). Mixed results have also been observed in emerging markets (Wong, 1992; Balaban, 1995; Choudhry, 2000). It should be noted that previous studies have used many different approaches to investigate the effects. Naturally, each study reflects the views and perspectives of its authors as well as their particular approach. This raises some doubts about the results, suggesting that patterns of daily anomalies uncovered in markets may be model-dependent. The fact that some studies of the same market show different or even contradictory results when employing different approaches may further support this hypothesis. Therefore, a study that simultaneously incorporates a number of approaches is necessary. To my knowledge, very few studies have attempted this, which is the motivation for choosing to conduct this type of study.

The present study investigates the patterns of daily anomalies in the stock indexes of eight markets and the MSCI world index (Morgan Stanley Capital International world stock price index) for the period between March 2002 and May 2008. The first contribution this paper makes to the current literature is to apply regression models to eight stock indexes that include developed markets – the US, the UK, France, Japan, Hong Kong and Singapore; emerging markets – Malaysia and Vietnam; and the MSCI world stock market index, to test whether patterns of daily anomalies discovered in the international markets are model-dependent. This study has the advantage of being broad in scope, as opposed to the majority of studies in the current literature, which are country specific or focus on a small group of countries with a narrow geographical coverage. The second contribution of this paper is to provide evidence of persistent patterns in day-of-the-week effects on these markets. Thirdly, the paper enhances the established literature by providing the most recent analysis of these markets.

The paper is organized as follows. After the introductory section, Section 2 will review the previous literature related to the topic and develop research hypothesis. Section 3 will explain the methodology employed. Section 4 will then discuss the data. Section 5 contains an analysis of the empirical results of the regression models. Section 6 will summarize main findings and discussions. Section 7 will provide a conclusion, followed by the bibliography and the appendix in Sections 8 and 9.

2. REVIEW OF SELECTED LITERATURE AND HYPOTHESIS DEVELOPMENT

Day-of-the-week effects have been found in numerous empirical studies of both developed and emerging markets in the past decades. In the US markets, a study by French (1980) investigated the daily returns of the S&P 500 for the period 1953–1977. The findings show a significant negative Monday effect and positive Wednesday, Thursday and Friday effects. The negative Monday effect is attributed to the tendency of companies to release unfavourable information over the weekend. Since investors come to expect this release, they discount stock prices appropriately throughout the week, causing the low Monday returns. Using the same approach, but over a different time period (S&P 500 daily returns for the period 1962−1978), Gibbons and Jess (1981) also found negative mean returns on Mondays. Jaffe et al. (1985) examined daily returns in the stock market indexes of Japan, Canada, Australia, the UK and the US. They found significant negative returns on Monday in the US, Canada and the UK, and on Tuesday for Japan and Australia, while a positive Friday effect was found in all the markets except the UK. They indicated that time-zone differences between such markets and the US market might account for the presence of the negative Tuesday effect. However, it was found that the time-zone difference could only explain the anomaly in the Australian stock market.

Turning to emerging markets, Wong et al. (1992) tested the difference in mean returns across days of the week in the stock market indexes of five Asian countries for the period 1975−1988. They found a significantly negative Monday effect in Singapore, Malaysia and Hong Kong, a negative Tuesday effect in Thailand, and a positive Friday effect in the four markets. Examining the daily data of the Istanbul Securities Exchange Composite Index for the period 1988−1994, Balaban (1995) found a significant positive Wednesday and Friday effect, and that Monday was the most volatile day for stock returns. Wong and Yuanto (1999) found a significant negative effect on Tuesdays and a positive effect on Fridays in the daily returns of the Jakarta Composite Index (Indonesia) for the period 1983−1997. Mookerjee and Yu (1999) explored the daily stock market indexes of the Shanghai and Shenzhen securities exchanges for the period 1990−1994. Significantly positive Thursday and Friday effects were observed in the Shanghai securities exchange, but no day-of-the-week effect was found in the Shenzen securities exchange.

Chusanachoti and Kamath (2002) investigated the Thailand stock market index for the period 1990−1998. The findings are similar to previous studies with respect to Monday, Tuesday and Friday, but they also found a negative effect on Thursday. Using the same methods, Lian and Chen (2004) studied the calendar behaviour of ASEAN stock markets for the period 1992−2002. In the pre-crisis period, they found a significant negative Monday effect in Malaysia, Singapore and Thailand, a positive Friday effect in Indonesia, and a positive effect on Wednesday and Thursday for the Philippines. However, during the crisis period, no seasonal pattern was found in any market. They explained that the daily seasonalities in these markets were due to the influence of the well-documented Monday negative effect in the US stock market. As such, the equity markets of these countries experienced very few seasonal daily effects during this volatile period of financial crisis. In the post-crisis period, there were significant negative effects on Monday, a positive effect on Friday in Thailand, and a significantly negative Tuesday effect in the Philippines. Most recently, Chia et al. (2006) used the TGARCH and EGARCH models, capturing possible asymmetry in stock market behaviour, to re-investigate calendar anomalies in the Malaysian stock market for the period 1993–2005. They also found evidence of negative Monday returns in the post-crisis period. However, when time-varying volatility in market returns was taken into account, some of the anomalies became insignificant. Moreover, findings from the analysis using the EGARCH and TGARCH models cast doubts on the appropriateness of previous studies of this market that employed GARCH and GARCH-M models.

In the Vietnamese stock market (Ho Chi Minh Stock Exchange), Loc (2006) employed OLS (Ordinary Least Square) and GARCH in combination with the market model of Brooks and Persand (2001) to examine the VN-Index (2002–2004). The results of the OLS models, both with and without market risk factors, exhibited significantly positive returns on Friday. Nevertheless, in both GARCH models, the positive Friday effect vanished and a significantly negative Tuesday effect was observed in the mean return equation. Additionally, Loc found that the average market risk levels seem to be the same across the days of the week for the stock market. In addition, adding dummy variables for each day of the week to the conditional variance equation of the GARCH models, the results consistently indicated a significantly negative mean return on Tuesday and Thursday, but no seasonal pattern in return volatility.

As can be seen from the literature, a large number of different models have been used to determine the day-of-the-week effects. Previous studies have made use of different models for different markets, or examined the same market over different time periods. In many cases the use of different models has produced different, sometimes contradictory results for various periods in the same market. Therefore, it is possible that many variations in the documented patterns of the day-of-the-week effect result from applying different models. A test of the same data set using different models may help determine whether the results are model-dependent. The following hypothesis which will be tested is that daily anomalous patterns arise from the use of different models.

3. METHODOLOGY

This section will describe the models used to test day-of-the-week effects in daily stock returns on the basis of the reviewed literature.

Day-of-the-week effects can be explored using a set of regression models. Initially, they can be tested with the standard OLS, with dummy variables representing days of the week. This approach has been employed in many previous empirical studies. The standard OLS can be represented as follows:

$$R_{it} = \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{1}$$

Where $R_{i,t}$ is the log return of the market index at day t, D_{it}'s (i = 1,2,…5) are dummy variables for Monday, Tuesday, Wednesday, Thursday and Friday, respectively (for example, $D_{1,t}$ = 1 if day t is Monday and 0 otherwise); α_{it} are the coefficients of the regression equation corresponding to the five dummy variables; u_t is an error term and assumed to be independently and identically distributed; and σ_t^2 represents the return variance. The constant of the regression equation is eliminated to avoid the trap of collinearity. For the sake of convenience, all terminology is maintained in the coming specifications. Therefore, only new concepts will be addressed, which will be explained as they are introduced.

It has long been documented in the finance literature that the homoscedasticity assumption of OLS is likely to be violated in the context of financial time series, that is, stock returns. If the assumption is not satisfied, the standard errors could be wrong, and, therefore, conclusions inferred from the model could be misleading (Brooks, 2002). To deal with this issue, the Generalised Autoregressive Conditional Heteroscedasticity

(GARCH) model developed independently by Bollerslev (1986) and Taylor (1986) will be applied. While the above OLS models characterize the mean return, GARCH models provide a more flexible framework for capturing the time-varying volatility in the return series. The present study only employs regressions with GARCH (1,1), which previous studies have commonly used, considering it to be sufficient for testing these effects.

GARCH (1,1) specification

$$R_{it} = \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{2}$$

$$\sigma_t^2 = \omega + \delta u_{t-1}^2 + \gamma \sigma_{t-1}^2$$

Where ω is constant, δ, γ are constants to be estimated.

To incorporate the day-of-the-week effects for both the return and volatility equations, the Modified-GARCH (1,1) specification with added dummy variables for each day of the week in the conditional variance equation is utilized (Berument and Kiymaz, 2001; Kiymaz and Berument, 2003).

Modified-GARCH (1,1) specification

$$R_{it} = \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{3}$$

$$\sigma_t^2 = \omega + \sum_{t=1}^{4} \alpha_i D_{it} + \delta u_{t-1}^2 + \gamma \sigma_{t-1}^2$$

In this modified specification, only four out of five days in the week are included in the conditional variance equation to avoid the collinearity problem in the regression model. Thus, D_{it}'s (i = 1,2,…4) are dummy variables for Monday, Tuesday, Thursday and Friday, respectively (Wednesday is excluded) (Loc, 2006).

Furthermore, the GARCH-M model, which allows for the conditional variance to have mean effects, is adopted to examine the effect under varying return volatility levels in the stock market. The market model using GARCH-M is not developed, as the conditional variance in the mean equation can already capture the total risk in the market.

GARCH-M (1,1) specification

$$R_{it} = \lambda_0 \sigma_t^2 + \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{4}$$

$$\sigma_t^2 = \omega + \sum_{t=1}^{4} \alpha_i D_{it} + \delta u_{t-1}^2 + \gamma \sigma_{t-1}^2$$

Where $\lambda_0 \sigma_t^2$ measures the reward-to-risk ratio (Kok and Wong, 2004).

It is worth noting here that the GARCH model assumes that upward and downward movements in the market will cause the same magnitude of volatility. This implies that the market reacts symmetrically to positive and negative news. However, it is commonly observed in stock markets that negative returns are followed by higher volatility than positive returns, the market reaction to bad and good news thus tending to be asymmetrical in nature (Engle and Ng, 1993). To incorporate this possible market behaviour, the Threshold GARCH or TGARCH (based on Zakoian, 1994; and Glosten et al., 1993) and the Exponential GARCH or EGARCH (based on Nelson, 1991) models are also estimated in the present study. The assumption of TGARCH is that unexpected changes in market returns have different effects on the conditional variance of the returns, while the exponential nature of EGARCH ensures that the conditional variance is always positive.

TGARCH (1,1) specification

$$R_{it} = \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{5}$$

$$\sigma_t^2 = \omega + \sum_{t=1}^{4} \alpha_i D_{it} + \delta u_{t-1}^2 + \gamma \sigma_{t-1}^2 + \phi u_{t-1}^2 I_{t-1}$$

where $I_t = 1$ for bad news ($u_t < 0$) and 0 otherwise.

In TGARCH, the use of ϕ captures the asymmetrical effect of good news and bad news ($u_t < 0$), as reflected in the differential effects on the conditional variances. In particular, good news has an impact of δ, while the impact of bad news is $(\delta + \phi)$. In addition, if $\phi \neq 0$, the news impact is asymmetrical. Moreover, a positive value of ϕ exhibits the presence of a leverage effect in that bad news increases volatility. Notably, the additional parameters, α_i 's are employed to capture the daily effects.

On the other hand, the EGARCH specification of conditional volatility utilized in this study may be expressed as:

$$R_{it} = \sum_{t=1}^{5} \alpha_i D_{it} + u_t \qquad u_t \approx (0, \sigma_t^2) \tag{6}$$

$$\ln(\sigma_t^{\,2}) = \omega + \gamma \ln(\sigma_{t-1}^2) + \delta \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \varphi \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \sum_{t=1}^{4} \alpha_i D_{it}$$

In EGARCH modelling, the logarithm of the conditional variance on the left-hand side implies that the leverage effect is exponential rather than quadratic. It implies that forecasts of the conditional variance are guaranteed to be non-negative. In this case, the existence of leverage effects can be tested by the hypothesis that $\gamma < 0$, whereas the impact is asymmetrical if $\gamma \neq 0$.

4. DATA

The data used in this study primarily consists of closing daily price indexes from eight stock markets, which can be divided into two groups: developed markets and emerging markets. The group of developed markets includes the US (S&P 500 composite), Japan (Nikko composite), the UK (FTSE all shares), France (Paris CAC 40), Hong Kong (DJTM Hong Kong) and Singapore (DJTM Singapore), while the group of emerging markets comprises Malaysia (DJTM Malaysia) and Vietnam (VN-Index). In addition, the MSCI world index is also included in this study. Data from the VN-Index was obtained via the Bank for Investment & Development of Vietnam Securities Company's website (<www.bsc.com.vn>), while the data for the other countries and the World Price Index were collected from DataStream. All data was obtained for the period from 1 March 2002 to 31 May 2008. The sample is relatively representative since it covers a wide range of markets with different levels of development. The US, the UK, Japan and France represent well-developed markets, while Singapore and Hong Kong can be considered to be relatively developed markets. Malaysia and Vietnam are emerging markets, with the Vietnamese market only recently being launched.

The index data will then be transformed into a time series of continuously compounded returns. Daily returns are computed as follows:

$$r_t = \log(p_t) - \log(p_{t-1}) = \log(p_t/p_{t-1})$$

Where p_t and p_{t-1} are the index value at time t and t-1.

5. EMPIRICAL RESULTS

Descriptive statistics for the sample

Table 1 presents the descriptive statistics for the data from the eight markets and the MSCI world index. Among all the markets, Vietnam has the highest overall returns, while Malaysia has the lowest. Monday and Thursday average returns show a similar pattern. However, the reverse order is found for the Tuesday average returns. Of special interest is the fact that a Wednesday positive average return can be observed in all markets, with the highest position being held by Vietnam and the lowest by the MSCI world index. The French market has the lowest average return on Friday, whilst Malaysia has the highest. Comparing means across all the days of the week, the UK and France have the highest mean return on Wednesday and the lowest on Thursday, while Hong Kong and Japan also have high mean returns on Wednesday, but have the highest mean returns on Friday. In the Malaysian and Singaporean markets, the highest mean returns are on Friday and the lowest on Monday. The US market shows the lowest return on Monday and highest on Friday. Summing up, all the markets show negative returns on Monday except the UK, the MSCI world index and Vietnam, while positive Friday returns can be found in all markets except France and the UK. These results might partly predict the presence of weekend effects in the markets.

Jarque-Bera tests were used to test the data set for normality. All the markets display a high significance in the Jarque-Bera tests, which means a violation of the normality assumption of the OLS. Consequently, these results indicate that GARCH-type models may be more appropriate, as they relax the assumption of normality.

Results for testing models.

OLS models:

Tables 2 and 3 present the results for the OLS models. The results of the standard OLS models for all markets show that only the Vietnamese market has a day-of-the-week effect, with a significant positive return on both Thursday and Friday, at 1%. The positive mean return on Friday partly indicates a weekend effect on this market. No day-of-the-week effects were found in the other markets.

To check for the ARCH effects and homoscedasticity, the present study makes use of the ARCH tests and White tests using cross terms. The results show that the ARCH test, with 5 lags for the residuals of the standard OLS, exhibits a high significance, at 1% for all markets and the MSCI world index, while all the coefficients of the White test are insignificant. These results reveal the presence of ARCH effects but no heteroscedasticity in the residuals of the models. In short, these findings suggest that even though the assumption of heteroscedasticity is valid, the ARCH effects are still consistently present. Therefore, it is possible that GARCH-type models are more appropriate than OLS for the present study.

GARCH (1,1) models

The results of the GARCH models can be found in Tables 2 and 3. Many patterns of day-of-the-week effects not observed using OLS are exhibited here for almost all of the markets and the MSCI world index. A significantly negative Tuesday return was found in the Japanese and Vietnamese markets at a 10% significance level. The Hong Kong market has a significantly negative return on Tuesday at 10% and on Thursday at 1%, but a positive return on Wednesday at 1% significance. For the other markets, Singapore shows a significantly positive Friday return at the level of 10%, while the weekend effect is discovered in the Malaysian market, with negative returns on Monday and a positive Friday return at 10% and 1%, respectively. In addition, the MSCI world index indicated a significantly positive return on Monday and Wednesday, with levels of significance of 1% and 5%, respectively.

In the variance equations, all coefficients of the three terms are highly significant at 1% through all models, which strongly supports the validation of GARCH modelling for the data. Furthermore, as expected, when using a GARCH model to estimate financial asset return data, the sum of the coefficients on the lagged squared error and lagged conditional variance for most markets, with the exception of Hong Kong and Vietnam, is close to unity. This means that shocks to the conditional variance are highly persistent in these markets (volatility clustering). For the Hong Kong and Vietnamese markets, the sum of these coefficients is slightly greater than unity, which shows a long trend in the tendency for volatile responses to shocks. Moreover, the sum of these coefficients is relatively large, implying that a large positive or negative return will determine the forecasts of future variance for a protracted period.

MODIFIED GARCH (1,1) models

The results of the modified GARCH models can be found in Tables 2 and 3. Even though GARCH (1,1) can capture the time-varying volatility in the return series, it does not consider volatility variation on any particular day. As it is possible that the daily effect on a certain day of the week may be due to variations in equity risk, a modified GARCH can take this into account. If an effect found in GARCH still exists in the mean equation of modified GARCH, it can be concluded that the effect is not due to variations in equity risk. However, if the effect on a certain day disappears in the mean equation of modified GARCH, while the dummy for that day in the variance equation is significant, the conclusion is that there is a daily market risk effect (Lucey, 2000). Using this model, the Japanese market further shows a positive return volatility on Thursday, at 10%. In the UK market, no pattern was seen in the mean return, but negative volatility on Friday was found at a 5% significance level. Hong Kong exhibits positive volatility on Thursday at 10% significance, in addition to the same pattern in mean returns as GARCH (1,1). While the daily pattern for the MSCI world index and the Singapore market are still unchanged, the Malaysian market shows an additional negative Thursday return.

In the variance equations, all coefficients of ARCH and GARCH terms are statistically highly significant in all the markets, and the shocks to the conditional variance are also highly persistent for most markets. Nevertheless, it should be noted that the average daily volatility of markets is relatively small, being almost zero for some markets, and it is not very different throughout the week. In particular, the large, developed markets of the US, Japan, France and the UK have a lower average daily volatility than the smaller markets. This can be explained by the relatively higher efficiency of the developed markets compared to the less developed.

Generally speaking, the similar daily patterns in mean returns with the GARCH (1,1) model are also found here for most markets and the MSCI world index. The findings reveal that the daily patterns in mean returns of all markets and the MSCI world index, observed by GARCH (1,1), are not influenced by daily volatility, except for Vietnam. For the Vietnamese market, the negative Tuesday return disappears, but no daily pattern in volatility is discovered, which is difficult to explain.

MODIFIED GARCH (1,1)-M models

In the financial literature, the expected return on an asset in general is related to its expected risk. This study takes account of risk by employing the modified GARCH-M, allowing the conditional variance to have mean effects. Table 2 and Table 3 display the results of this model. Astonishingly, most of the anomalous daily patterns in the markets shown in the modified GARCH disappear, with the exception of Hong Kong and Malaysia. For the Hong Kong market, negative Tuesday returns also vanish. However, negative returns on Monday, Tuesday and Wednesday occur for Vietnam, while the French market exhibits a positive Monday return for the first time. These newly discovered patterns were not detected by the modified GARCH model. The MSCI world index still shows the same results as in the mean return but with an additional positive volatility on Monday. In relation to the risk premium coefficient, $\lambda 0$, concerning the conditional variance in the mean return equations, not all these are significantly positive, as expected by the portfolio theory. More specifically, the coefficients for the markets of the US, France, Japan and Hong Kong are negative and insignificant. The UK market and the MSCI world index show a positive but insignificant coefficient, while the coefficients for Singapore, Vietnam and Malaysia are significantly positive at conventional levels. In comparison with Singapore and Malaysia, the risk premium coefficient for the Vietnamese market is more significant and much higher, which reflects the much higher extent of risk-return trade-off on this market compared with the other two. The fact that Vietnam is a very new, emerging market may adequately explain this finding, as the literature acknowledges that emerging markets always offer higher returns at high levels of risk.

It is worth noting here that many daily effects in the mean returns of markets found using OLS, GARCH and modified GARCH are no longer present when modified GARCH-M is applied. A possible explanation is that the observed effects in stock returns may be caused by the expected risk in mean returns, which is not documented thus far in the literature. Therefore, when conditional variance is taken into account, day-of-the-week effects no longer exist. Another possible explanation is that this may simply stem from model errors that allow conditional variance to affect the mean return.

MODIFIED TGARCH (1,1) models

As mentioned in the methodology section, one advantage of the TGARCH model over the GARCH and GARCH-M models is that the TGARCH model takes account of the possible asymmetry effects of good and bad news. The symmetrical effect of the arrival of new information implies that investors have a constant marginal rate of substitution. Nevertheless, economic theory suggests that investors with a convex utility function face a decreasing marginal rate of substitution while the consumption of goods rises. Consequently, the stock prices may display an asymmetrical effect. In particular, there may be a much greater response to bad news than to good news – the so-called leverage effect (Haitham and Bashir, 2007). The use of the TGARCH model is expected to provide more accurate results than GARCH or GARCH-M. The results of the mean and variance equation of the modified TGARCH for all the markets are presented in Table 2 and Table 3. For the Japanese market, the mean equation again indicates a significantly negative Tuesday return and the addition of a negative Thursday return at the level of 5% and 1%, respectively. Furthermore, positive volatility is present on Thursday at 10%

significance. For France, a positive return on Monday and Wednesday was observed at 1% and 5% significance, respectively. Although the pattern documented by the modified GARCH reoccurs here, the positive Wednesday return is no longer present in the Hong Kong market. The previous patterns discerned by the modified GARCH also appear for the MSCI world index and Malaysia, while new daily patterns in mean returns, a negative return on Monday and a positive return on Friday, arise in the Vietnamese market.

Considering coefficients of Φ that show the asymmetry effect of good and bad news for markets, the results indicate significant positive coefficients at conventional levels for the markets of the US, the UK, France and Vietnam, and for the MSCI world index. This provides evidence of the leverage effect with respect to the arrival of new information on these markets, where bad news increases volatility. The leverage coefficients of the other markets are also positive but insignificant.

MODIFIED EGARCH (1,1) models

Contrary to the GARCH and GARCH-M models, EGARCH relaxes the artificial non-negativity constraints on the model parameters in the variance equation. Furthermore, it can also incorporate the asymmetrical effect on stock returns, as did TGARCH. For this reason, compared with the other models applied in this paper, the modified EGARCH discovers a greater number of patterns in the day-of-the-week effect in both returns and volatility for all markets and the MSCI world index. The results of the modified EGARCH models are presented in Table 2 and Table 3. In the US and Vietnamese markets, day-of-the-week effects are only found in terms of volatility. Specifically, positive volatility on Monday and Tuesday is seen in the US for the first time, at the level of 10% and 1% significance, respectively. For Vietnam, positive Monday and Thursday effects are discovered at 5% and 1% significance. In contrast, some markets displayed daily effects only in mean returns. The markets of France and Malaysia exhibit the same patterns as found in the modified TGARCH model, while positive volatility on Thursday vanishes in the Japanese market. In turn, the Hong Kong market exhibits further significant positive returns on Monday and Wednesday at 1% significance; however, positive daily volatility on Thursday no longer exists. Singapore's market has a number of daily return effects, including a negative Monday effect and a positive Friday effect, both at a 1% significance level. Moreover, the positive Wednesday effect and the negative Thursday return are observed in the Singapore market at the level of 5%. As found with the modified TGARCH, the MSCI world index still revealed a significantly positive return on Monday and Wednesday, at 10% significance.

The leverage effect terms, φ, for the markets of the US, the UK, France and the MSCI world index are all significantly negative, indicating leverage effects in market reactions to positive and negative news. These findings are quite consistent with those of the TGARCH model, with the exception of Vietnam, where the coefficient becomes insignificant.

6. SUMMARY OF MAIN FINDINGS AND DISCUSSIONS

Many daily effects in returns and volatility are revealed by the use of different models across different markets. No pattern of daily effects has been reliably exhibited across all the models. Yet, those that are found to be present in at least six of the eleven models are as follows: six models offer no evidence of day-of-the-week effects, while no consistent daily effect can be found in the other models for the US, Japan, the UK and France. These results support those of Kohers et al. (2004), who found that the daily effects seem to disappear in these developed markets. For the Vietnamese market, a negative Tuesday return is reliably documented in eight models, which is similar to Truong (2006). In addition, a negative return on Tuesday is observed in seven models for Hong Kong, a result not seen in previous studies. As with Ho (1990), a positive return on Friday is shown in the Singapore market in six models. Negative Monday and positive Friday returns can be consistently observed for the Malaysian market in nine models. These findings were also present in a large number of previous studies (Ho, 1990; Wong et al. 1992; Choudhry, 2000; Lian and Chen, 2004; Chia et al. 2006). Interestingly, the MSCI world index displayed a positive return on Monday and Wednesday in five of the six tested models. Nevertheless, no daily volatility effects were consistently observed in any of the markets.

One of the most important findings is that in most cases the daily anomalies documented on two markets with relatively high correlation are not the same. Furthermore, no common daily effects can be observed among the five Asia Pacific countries despite their geographical proximity and similar time zones. The above findings imply that patterns of daily effects discovered in markets may partly depend on the model employed and not only on the data itself.

7. CONCLUSION AND FUTURE RESEARCH

Using a sample of eight stock market indexes from both developed and developing countries from March 2002–May 2008, this study investigated day-of-the-week. Additionally, it examined these daily patterns in the MSCI world index. A number of regression models, with daily dummy variables that are commonly employed in the literature, were used to test the daily effects in both mean returns and the return volatility of the markets. The models used are OLS, GARCH, modified GARCH (daily dummies added into the conditional variance equation of standard GARCH), modified GARCH-M, modified TGARCH and modified EGARCH. The descriptive results for all the markets show no clear evidence of the weekend effect that has long been documented in the literature, but daily effects do seem to appear randomly on other days of the week. Regression models for each of the eight markets and six models for the MSCI world index were then created to further analyse the day-of-the-week effects for each market. These analyses indicate a number of interesting results.

Firstly, the findings are highly mixed. Different models generally provide different results for the same market, indicating the model-dependency of daily effects. The more advanced models tend to show more effects than the less advanced ones. Secondly, no patterns of daily effects are consistently found across all models for each market. The present study found evidence of the disappearance of day-of-the-week effects for the markets of the US, the UK, Japan and France in six of the eleven models employed, whereby the results for the first two countries are strongly confirmed. Both the Vietnamese and Hong Kong markets indicate a negative return on Tuesday in eight and seven of the eleven models, respectively. A positive Friday return is observed in six of the models, while the weekend effect is found to be present in nine models. Interestingly, the study found the existence of positive returns on Monday and Wednesday in the MSCI world index, which is in fact impossible to explain in terms of economics. Finally, no consistent patterns of daily effects in stock return volatility were observed across all the markets. Nevertheless, the evidence of a leverage effect concerning the arrival of new information is robustly documented for the US, the UK, France and the MSCI world index in the TGARCH and EGARCH models.

With respect to theory, the findings may support G. William Schwert's opinion and the market efficiency hypothesis, which may still hold since evidence of daily anomalies seems to be inconsistent and difficult to explain in terms of economics. He stated that:

> *These [research] findings raise the possibility that anomalies are more apparent than real. The notoriety associated with the findings of unusual evidence tempts authors to further investigate puzzling anomalies and later try to explain them. But even if the anomalies existed in the sample period in which they were first identified, the activities of practitioners who implement strategies to take advantage of anomalous behavior can cause the anomalies to disappear (as research findings cause the market to become more efficient). (Schwert, 2003)*

The main limitation of the present study is that it does not investigate, through a comparison of all the models, which of them provides the best tests for each market, as each model has its own strengths and weaknesses. Future research may fill this gap. Moreover, a future study might choose to expand the number of markets in the sample and consider more models, so as to check the robustness of the conclusions of this paper.

8. REFERENCES

Abraham and Ikenberry, (1994). The individual investor and the weekend effect, ***Journal of Financial Quantitative and Analysis***, vol. 29, 263-277.

Admati, A. R. and P. Pfleiderer, (1988). Selling and trading on information in financial markets, ***American Economic Review***, vol. 78, 96–103.

Agrawal, A. and K. Tandon (1994). Anomalies or Illusions? Evidence from stock markets in eighteen countries, ***Journal of International Money and Finance***, vol. 13, 83-106.

Ajayi, Richard A., Seyed Mehdian and Mark J. Perry., (2004). The day of the week effect in stock returns: Further evidence from Eastern European emerging markets, ***Emerging Markets Finance and Trade***, vol. 4, 53-62.

Al-Loughani, N., and D. Chappell, (2001), Modeling the day-of-the-week effect in the Kuwait stock exchange, ***Applied Financial Economics***, 353-359.

Andrew W. Lo (1997). Market efficiency: Stock market behavior in theory and practice, Hartnolls Limited, Bodmin, Cornwall.

Athanassakos and Robinson (1994). The Day of the Week Anomaly: The Toronto stock exchange experience, ***Journal of Business Finance and Accounting***, vol. 21 (6), 833-856.

Balaban, Ercan., (1995). Day of the week effects: New evidence from an emerging stock market, ***Applied Economics Letters***, vol. 2, 139-143.

Balaban, Ercan, Asli Bayar and Ozgur Berk Kan (2001). Stock return seasonality and asymmetric conditional volatility in World equity markets, ***Applied Economics Letters***, vol. 8, 263-268.

Berg, Lennart,., (2003). Deterministic seasonal volatility in a small and integrated stock market: the case of Sweden, ***Finnish Economics Papers***, vol. 16, 61-71.

Berument, Hakan and Halil Kiymaz (2001). The day of the week effect on stock market volatility, ***Journal of Economics and Finance***, vol. 2, 181-193.

Berument and Kiymaz (2001). Day of the week effect on stock market volatility, ***Journal of Economics And Finance***, vol 25, 181-193.

Bollerslev, Tim., (1986). Generalized autoregressive conditional heterescedasticity, Journal of Econometrics, vol. 31, 307-327.

Brooks, Chris and Gita Persand., (2001). Seasonality in Southeast Asian stock markets: Some new evidence on day of the week effects, ***Applied Economics Letters***, vol. 8, 155-158.

Brooks, Chris., (2002). ***Introductory econometrics for Finance***, Cambridge, New York: Cambridge University Press.

Bruce N. Lehmann (1990). Fads, Martingale, and Market efficiency, ***The Quarterly Journal of Economics***, vol. 105, 1-28.

Cemal, O. and S. Guven, (2003). Stock returns and the day-of-the-week effect in Istanbul Stock Exchange, ***Allied Economics***, vol. 35, 959-971.

Chen, G., and C. Kwork, and O. Rui, (2000). The day-of-the-week regularity in the stock markets of China, ***Journal of Multinational Financial Management***, 139-163.

Chia, R., Liew, V. and Wafa, S., (2006). Calendar anomalies in the Malaysia stock market, ***Munich Personal RePEc Archive***.

Choudhry, Taufiq., (2000). Day of the week effect in emerging Asian stock markets: Evidence from GARCH model, ***Applied Financial Economics***, vol. 10, 235-242.

Chusanachoti, Jirayuth and Ravindra Kamath., (2002). Market conditions, return distributions, and the day of the week effects in Thailand: The experience of the 1990s, ***American Business Review***, vol. 1, 6-14.

Clare, A.D., Ibrahim, M.S.B. and Thomas, S.H., (1998). The impact of settlement procedures on day of the week effects: Evidence from the Kuala Lumpur stock exchange, ***Journal of Business Finance and Accounting***, vol. 3&4, 401-418.

Cross, F., (1973). The behavior of stock price on Fridays and Mondays, ***Financial Analyst Journal***, vol. 29, 67-69.

Engle, R.F. and Ng, V.K. (1993), 'Measuring and Testing the Impact of News on Volatility', ***Journal of Finance***, 48, 1022 – 1082.

Fama, E., (1965). The behavior of stock market prices, ***Journal of Business***, vol. 38, 34-105

Foster, F., and Viswanathan, S., (1990). A theory of the interday variations in volume, variance, and trading costs in securities market**s, *The society for financial studies,*** vol. 3, 593-624.

Fortune, F., (1991). Stock market efficiency: An Autospy, ***New England Economic Review***, vol. 1, 17-40.

French, Kenneth R., (1980). Stock return and the weekend effects, ***Journal of Financial Economics***, vol. 8, 55-69.

French, K. R. and Roll, R. (1986). Stock Return Variances: The Arrival of Information and Reaction of Traders, ***Journal of Financial Economics***, vol. 17, 5-26.

Gibbons, M., and P. Hess, (1981). Day-of-the-week effects and assets returns, ***Journal of Business***, vol. 54, no. 4.

Glosten, L.R., Jaganathan, R. and Runkle, D. (1993). On the Relation between the Expected Value and the Volatility of the Normal Excess Return on Stocks, ***Journal of Finance***, vol. 48, 1779–1801.

Grossman, S., (1976). On the efficiency of competitive stock markets where trades have diverse information, ***Journal of Finance***, XXXI (2), 573-585.

Grossman, S., and Stigliz, J., (1980). On the impossibility of informationally efficient markets, ***American Economic Review***, 70 (3), 393-408.

Haitham and Bashir, (2007). Market efficiency, time-varying volatility and the symmetric effect in Amman stock exchange, ***Managerial Finance***, Vol. 33, pp. 490-499

Hawawini, G., (1984). European equity markets: Price behavior and efficiency, ***Salamon Brothers Center/NYU,*** Monograph 4/5.

Ho, Y.K., (1990). Stock return seasonalities in Asia Pacific Markets, ***Journal of International Financial Management and Accounting***, vol. 2, 47-77.

Jaffe, J., and R. Westerfield., (1985a). The Weekend Effect in Common Stock Returns: The International Evidence, ***Journal of Finance,*** vol. 40, 433-454.

Jaffe, J., & Westerfield, R. (1985b). Patterns in Japanese common stock returns: day of the week and turn of the year effect, ***Journal of Financial and Quantitative Analysis***, vol. 20, 261–272.

Jaffe, J. and R. Westerfield., (1989). Is there a monthly effect in stock market returns: Evidence from foreign countries, ***Journal of Banking and Finance***, vol.13, 237-244.

Keim, B and Stambaugh, F., (1984). A further investigation of the weekend effect in stock returns, ***Journal of Finance***, vol. 39, 819-835.

Kok, K.L. and Wong, Y.C. (2004a). Seasonal Anomalies of Stocks in ASEAN Equity Markets', ***Sunway College Journal***, vol. 1, 1-11.

Kartono Liano, Gow-Cheng Huang, and Benton E. Gup (1993). A twist on the Monday effect in stock returns: A Note, ***Journal of Economic Business***, vol. 45, 46-67.

Kiymaz, Halil and Hakan Berument., (2003). The day of the week effect in stock market volatility and volume: International evidence, ***Review of Financial Economics***, vol. 12, 363-380.

Kohers, G., N Kohers, V. Pandey and T. Kohers., (2004). The disappearing Day-of-the-week effect in the World's largest equity markets, ***Applied Economics Letters***, vol. 13, 167-171.

Lakonishok, Josef and Maurice Levi., (1982). Weekend effects on stock return: A note, ***Journal of Finance***, vol. 3, 883-889.

Lian, Kok Kim and Wong Yoke Chen., (2004). Seasonal anomalies of stocks in ASEAN equity markets, ***Sunway College Journal***, vol. 1, 1-11.

Loc, T.D., (2006). Equitisation and stock-market development: The case of Vietnam, ***Ph.D thesis***, the University of Groningen.

Lucey, B.M. (2000). Anomalous Daily seasonality in Ireland?, ***Applied Economics Letters***, vol. 7, 637 – 640.

Nelson, D.B. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach, ***Econometrica***, vol. 59, 347–370.

Mookerjee, Rajen and Qiao Yu., (1999). An empirical analysis of the equity markets in China, ***Review of Financial Economics***, vol. 8, 41-60.

Osborne, M., (1962). Periodic structure in the Brownian motion of stock prices, ***Operations Research***, vol. 10, 345–79.

Paul A. Samuelson (1965). Proof that properly anticipated prices fluctuate randomly, ***Industrial Management Review***, vol. 6, 41-49.

Penman, H., (1987). The distribution of earning news over time and seasonalities in aggregate stock returns, ***Journal of Financial Economics***, vol. 18, 199-228.

Persand, G., and C. Brooks, (2001). Seasonality in Southeast Asian stock markets: some new evidence on day-of-the-week effect, ***Applied Economics Letters***, vol. 8, 155-158.

Poshakwale (1996). Evidence on Weak Form Efficiency and Day of the Week Effect in the Indian Stock Market, ***Finance India***, vol X (3), 605-616.

Poshakwale, Sunil and Victor Murinde., (2001). Modeling the volatility in East European emerging stock markets: Evidence on Hungary and Poland, ***Applied Financial Economics***, vol. 11, 445-456.

Raymond, P.H., Thomas, F., and Dennis, J., (1993). Good news, bad news, volume, and the Monday effect, ***Journal of Business Finance and Accounting***, vol. 6, 881-892.

Richard Roll (1992). Volatility in U.S. and Japanese Stock Markets, ***Journal of Applied Corporate Finance***, Vol. 5, 1.

Rogalski, R. J. (1984). New Findings Regarding Day-of-the-Week Returns over Trading and Non- Trading Periods: A Note. ***Journal of Finance,*** vol. 35, 1603-1614.

Rozeff, M. and W.Kinney, (1976). Capital market seasonality: The case of stock returns, ***Journal of Financial Economics*** vol. 3, 379-402.

Savva, C., Osborn, D. and Gill, L., (2006). Periodic Dynamic Conditional Correlations between Stock Markets in Europe and the US, ***Centre for growth and Business cycle research.***

Schwert, G. William (2003). Anomalies and Market Efficiency, ***Handbook of The Economics of Finance***, Elsevier Science B.V.

Solnik, B. and Bousquet, L. (1990). Day-of-the-week effect on the Paris bourse, ***Journal of Banking and Finance***, vol. 14, 461-468.

Vijay Singal (2004). Beyond the random walk: A guide to stock market anomalies and low-risk investing, ***Oxford University Press***.

Wong, Kie Ann, Tak Kee Hui and Choy Yin Chan., (1992). Day of the week effect: The evidence from developing stock markets, ***Applied Financial Economics***, vol. 2, 49-56.

Wong, K., and K.Yuanto, (1999). Short-term seasonalities on the Jakarta stock exchange, ***Review of Pacific Basin Financial Markets and Policies***, vol. 2, No.3, 375-398.

Zakoian, J.M. (1994). Threshold Heteroskedastic Models, ***Journal of Economic Dynamics and Control***, vol. 18, 931-944.

http://www.bsc.com.vn

9. APPENDIX

Table 1. Descriptive statistics for daily returns in eight countries and the MSCI world index (%)

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	OVERALL
			UK			
Mean	0.0062	0.0057	0.0247	-0.0448	0.0067	-0.0003
Median	0.0594	-0.0271	0.1150	-0.0342	0.0531	0.0221
Maximum	4.0579	7.1562	5.5198	9.4494	4.8154	9.4494
Minimum	-4.3005	-4.9894	-8.3831	-6.4090	-7.1873	-8.3831
Std. Dev.	1.2935	1.4816	1.5965	1.5438	1.4047	1.4658
Skewness	-5.2507	47.9901	-83.9287	47.3569	-31.8744	-7.0943
Kurtosis	4.4609	6.2849	7.7069	9.6921	6.4498	7.4219
Jarque-Bera	24.4929***	133.2201***	284.0619***	519.6209***	140.0004***	1114.0610***
Observations	474	473	473	473	473	2366
			FRANCE			
Mean	-0.0040	0.0033	0.0279	-0.0169	-0.0103	0.0000
Median	0.0638	-0.0322	0.0642	-0.0382	0.0101	0.0109
Maximum	2.3090	4.0042	3.5270	4.6146	2.2975	4.6146
Minimum	-3.1520	-3.5257	-4.8348	-3.1849	-2.5727	-4.8348
Std. Dev.	0.7419	0.8750	0.8626	0.8179	0.7330	0.8072
Skewness	-45.2750	45.3661	-61.7690	20.4632	-32.4859	-10.6441
Kurtosis	4.9855	6.6554	8.5451	8.2939	4.6515	7.0996
Jarque-Bera	54.3693***	161.3557***	367.1181***	320.6975***	35.82519***	959.1827***
Observations	474	473	473	473	473	2366
			HONG KONG			
Mean	-0.0518	-0.0147	0.0243	-0.0885	0.1210	-0.0020
Median	-0.0300	-0.0910	0.2888	-0.4239	0.1513	0.0295
Maximum	27.4789	17.3322	16.0218	31.9119	22.2702	31.9119
Minimum	-19.7086	-16.7469	-24.7685	-19.6910	-34.4692	-34.4692
Std. Dev.	4.9585	4.6473	5.2149	5.6031	5.4952	5.1883
Skewness	34.0904	17.3223	-60.9424	90.3242	-69.0908	2.4986
Kurtosis	7.3545	5.1754	6.3289	8.4818	10.1250	7.9583
Jarque-Bera	221.7886***	55.19687***	142.9534***	378.9368***	599.1783***	1399.4170***
Observations	474	473	473	473	473	2366
			JAPAN			
Mean	-0.0005	-0.0053	0.0190	-0.0695	0.0515	-0.0009
Median	-0.0293	-0.0870	0.1810	-0.2603	0.0139	-0.0280
Maximum	10.8422	11.4567	10.5092	17.8325	11.2244	17.8325
Minimum	-8.4842	-7.5356	-14.0794	-11.0458	-16.6367	-16.6367
Std. Dev.	2.4585	2.5623	2.9110	2.9516	2.7849	2.7366
Skewness	19.3607	43.4160	-71.3595	82.3143	-44.1483	3.9606
Kurtosis	5.2229	7.1655	5.2353	9.4280	8.9862	7.7191
Jarque-Bera	58.1261***	65.41121***	220.5397***	500.8304***	416.4901***	1267.9080***
Observations	474	473	473	473	473	2366
			MALAYSIA			
Mean	-0.3811	0.1665	0.0189	-0.1518	0.3223	-0.0053
Median	-0.2511	-0.5307	0.5011	-1.8955	1.1116	-0.1753
Maximum	128.3292	76.5499	71.4856	88.7775	72.1366	128.3292

Minimum	-80.3345	-106.1740	-68.3993	-54.1053	-118.8715	-118.8715
Std. Dev.	20.1874	18.4245	17.4744	19.1106	20.5119	19.1487
Skewness	76.0519	-32.4157	-23.5228	66.9848	-91.8962	-0.7631
Kurtosis	10.3526	8.1089	5.9083	6.3728	8.7321	8.2510
Jarque-Bera	643.5997***	301.6760***	98.73233***	149.8145***	412.1769***	1569.362***
Observations	474	473	473	473	473	2366
SINGAPORE						
Mean	-0.1723	0.0201	0.0390	-0.1128	0.2095	-0.0034
Median	0.1514	-0.0969	0.4467	-0.7042	0.5266	0.0877
Maximum	61.9481	34.5711	28.1116	52.4905	38.3557	61.9481
Minimum	-41.9788	-44.2259	-42.1007	-35.7128	-66.3811	-66.3811
Std. Dev.	10.0795	9.0544	9.3631	10.4329	10.7073	9.9336
Skewness	53.8382	-9.5672	-47.2648	80.1980	-89.1533	-1.7565
Kurtosis	9.4646	6.2093	5.6540	7.3830	9.8494	8.1301
Jarque-Bera	490.3564***	117.5747***	90.28863***	247.7832***	569.8204***	1498.0110***
Observations	474	473	473	473	473	2366
US						
Mean	-0.0105	-0.0073	0.0207	0.0038	-0.0065	0.0001
Median	0.0002	-0.0487	-0.0250	-0.0450	-0.0084	-0.0197
Maximum	1.6356	2.3921	2.0882	1.9234	1.1857	2.3921
Minimum	-2.2981	-1.8901	-2.8564	-1.6476	-1.7572	-2.8564
Std. Dev.	0.4629	0.5320	0.4888	0.4614	0.4176	0.4734
Skewness	-32.7605	71.0264	17.7394	36.2320	-23.3262	21.4576
Kurtosis	6.6463	6.4000	9.5782	5.9281	4.7566	7.0416
Jarque-Bera	156.6876***	154.4469***	493.6655***	103.4968***	37.5764***	940.1668***
Observations	474	473	473	473	473	2366
VIETNAM						
Mean	0.0283	-0.0225	0.0454	0.0992	0.1412	0.0579
Median	-0.0548	-0.0357	-0.0135	0.0212	0.0476	-0.0041
Maximum	2.0188	2.0129	1.9757	2.1388	2.0563	2.1388
Minimum	-2.0634	-2.1590	-2.0823	-1.9661	-1.9810	-2.1590
Std. Dev.	0.6114	0.6333	0.5421	0.6041	0.5592	0.5902
Skewness	0.3726	0.0216	0.0709	0.5087	0.7280	0.3108
Kurtosis	5.3703	5.0216	5.8331	5.7701	5.3536	5.5798
Jarque-Bera	65.3354***	44.1233***	87.5046***	94.3414***	82.6558***	382.5889***
Observations	454	465	461	464	460	2304
MSCI world index						
Mean	0.0043	-0.0031	0.0176	0.0214	0.0148	0.0109
Median	0.0442	0.0201	0.0305	0.0189	0.0243	0.0245
Maximum	2.0635	2.0637	1.2578	1.4444	1.6552	2.0637
Minimum	-1.4866	-1.7045	-1.3009	-1.2866	-1.6606	-1.7045
Std. Dev.	0.3973	0.3543	0.3306	0.3554	0.3278	0.3530
Skewness	-7.0793	13.7266	-3.9808	40.7623	4.6020	8.5738
Kurtosis	6.9843	9.2105	4.9284	5.6402	8.2361	7.1978
Jarque-Bera	180.8065***	437.9900***	42.21754***	86.53141***	311.9577***	1004.6320***
Observations	474	473	473	473	473	2366

Note: ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Table 2. Summary of revealed patterns for all models for eight countries and the MSCI world index:

	OLS	GARCH(1,1)	MODIFIED GARCH(1,1)	MODIFIED GARCH-M(1,1)	MODIFIED TGARCH(1,1)	MODIFIED EGARCH(1,1)
US	No pattern	No pattern	No pattern	No pattern	No pattern	Return: no pattern Variance: Monday (+); Tuesday (+)
JAPAN	No pattern	Return: Tuesday (-)	Return: Tuesday (-) Variance: Thursday (+)	No pattern Variance: Thursday (+)	Return: Tuesday (-); Thursday (-); Tuesday return is lower. Variance: Thursday (+)	Return: Tuesday (-); Thursday (-);
UK	No pattern	No pattern	Return: no pattern Variance: Friday (-)	No pattern	No pattern	Return: Monday (+). Variance: Friday (-)
FRANCE	No pattern	No pattern	No pattern	Return: Monday (+)	Return: Monday (+); Wednesday (+); Monday return is higher.	Return: Monday (+); Wednesday (+); Monday return is higher
HONG KONG	No pattern	Return: Tuesday (-); Wednesday (+); Thursday (-); Thursday return is lower	Return: Tuesday (-); Wednesday (+); Thursday (-); Thursday return is lower Variance: Thursday (+)	Return: Wednesday (+); Thursday (+). Variance: Thursday (+)	Return: Tuesday (-); Thursday (-); Thursday return is lower. Variance: Thursday (+)	Return: Monday (+); Tuesday (-); Wednesday (+); Thursday (-). Wednesday return is highest and Thursday return is lowest

Table 2. Continued

SINGAPORE	No pattern	Return: Friday (+)	Return: Friday (+)	No pattern Variance: Monday (-)	No pattern	Return: Monday (-); Wednesday (+); Thursday (-); Friday (+); Thursday return is lowest, while Friday return is highest
MALAYSIA	No pattern	Monday (-); Friday (+)	Return: Monday (-); Thursday (-); Friday (+); Thursday return is lower	Return: Monday (-); Thursday (-); Friday (+); Monday return is lower	Return: Monday (-); Thursday (-); Friday (+); Thursday return is lower.	Return: Monday (-); Thursday (-); Friday (+); Monday return is lower
VIETNAM	Thursday (+); Friday (+); Friday return is higher	Return: Tuesday (-)	No pattern	Return: Monday (-); Tuesday (-); Wednesday (-) Tuesday return is the lowest	Return: Monday (-); Friday (+).	Return: no pattern. Variance: Monday (+); Thursday (+)
MSCI world index	No pattern	Return: Monday (+); Wednesday (+)	Return: Monday (+); Wednesday (+)	Return: Monday (+); Wednesday (+)	Return: Monday (+); Wednesday (+).	Return: Monday (+); Wednesday (+)

Table 3. Results from all models for 8 countries and the MSCI world index

	US	JAPAN	UK	FRANCE	HONG KONG	SINGAPORE	MALAYSIA	VIETNAM	MSCI world index
Parameter									
OLS									
Monday	-0.0001	0.0000	0.0001	0.0000	-0.0005	-0.0017	-0.0038	0.0003	0.0000
	-0.3666	-0.0027	0.9445	-0.0827	-0.1649	0.7743	-0.3290	0.7621	0.1993
Tuesday	-0.0001	-0.0001	0.0001	0.0000	-0.0001	0.0002	0.0017	-0.0002	0.0000
	-0.2527	-0.0320	0.9488	0.0665	-0.0468	0.9733	0.1435	-0.6119	-0.1475
Wednesday	0.0002	0.0002	0.0002	0.0003	0.0002	0.0004	0.0002	0.0004	0.0002
	0.7209	0.1144	0.7812	0.5710	0.0772	0.9484	0.0163	1.2401	0.8192
Thursday	0.0000	-0.0007	-0.0004	-0.0002	-0.0009	-0.0011	-0.0015	0.0010***	0.0002
	0.1314	-0.4191	0.6138	-0.3457	-0.2814	0.8515	-0.1308	2.7039	0.9954
Friday	-0.0001	0.0005	0.0001	-0.0001	0.0012	0.0021	0.0032	0.0014***	0.0001
	-0.2261	0.3105	0.9403	-0.2096	0.3848	0.7279	0.2777	3.8576	0.6923
ARCH-LM test (5 lags)									
Prob (F-statistics)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
White test									
Prob (F-statistics)	0.2219	0.4164	0.3637	0.3173	0.4848	0.5618	0.6419	0.5980	0.3369
GARCH(1,1)									
Mean Equation									
Monday	0.0002	0.0006	0.0002	0.0005	0.0009	-0.0036	-0.0090*	-0.0002	0.0004***
	1.1194	0.6896	0.4601	1.5258	0.5574	-1.2445	-1.7247	-1.2639	2.3767
Tuesday	-0.0001	-0.0014*	-0.0006	-0.0004	-0.0026*	-0.0002	0.0003	-0.0003*	0.0001
	-0.8379	-1.6570	-1.2255	-1.3677	-1.8019	-0.0937	0.0598	-1.8079	0.7468
Wednesday	0.0002	0.0008	0.0001	0.0003	0.0037***	0.0028	0.0057	-0.0002	0.0004**
	1.1781	0.9876	0.2592	0.9971	2.5141	1.0678	1.1130	-1.2024	2.3891
Thursday	-0.0001	-0.0015	-0.0006	-0.0001	-0.0040***	-0.0036	-0.0075	-0.0001	0.0002
	-0.4538	-1.6101	-1.1716	-0.2437	-2.9267	-1.4224	-1.5283	-0.7210	1.3274
Friday	0.0000	0.0002	0.0000	-0.0002	0.0015	0.0052*	0.0132***	0.0002	0.0002
	0.0211	0.2706	0.0482	-0.5136	1.0194	1.7861	2.4921	1.4869	1.1530

Variance Equation									
ω	0.0000***	0.0001***	0.0000***	0.0000***	0.0002***	0.0008***	0.0027***	0.0000***	0.0000***
	3.7015	9.2107	6.6442	6.9407	7.4660	8.9935	8.9813	7.9912	4.0292
δ1	0.0856***	0.7241***	0.5876***	0.4560***	0.8017***	0.8481***	0.8529***	0.4044***	0.0657***
	6.9054	10.5149	10.3274	9.7825	11.7626	10.8034	10.5321	13.2435	6.3765
γ1	0.9002***	0.2360***	0.4244***	0.5019***	0.2356***	0.1576***	0.1569***	0.6474***	0.9192***
	70.2335	7.1930	16.6997	14.1695	8.2824	5.9509	6.1024	46.8075	77.0580
MODIFIED GARCH(1,1)									
Mean Equation									
Monday	0.0002	0.0007	0.0003	0.0005	0.0013	-0.0035	-0.0090*	-0.0002	0.0004***
	1.3144	0.8238	0.6648	1.5726	0.8619	-1.3422	-1.8090	-1.0958	2.5848
Tuesday	-0.0001	-0.0016*	-0.0007	-0.0004	-0.0025*	-0.0005	-0.0015	-0.0002	0.0001
	-0.5416	-1.7736	-1.3603	-1.2342	-1.7988	-0.2066	-0.2716	-1.5084	0.7044
Wednesday	0.0002	0.0012	0.0001	0.0002	0.0033**	0.0027	0.0070	-0.0002	0.0004**
	1.1267	1.4348	0.2690	0.5730	2.2658	0.9508	1.3393	-1.2671	2.4440
Thursday	-0.0001	-0.0014	-0.0006	0.0000	-0.0032**	-0.0032	-0.0095*	-0.0001	0.0002
	-0.4697	-1.4209	-1.1848	-0.1382	-2.0996	-1.1925	-1.9284	-0.3944	1.4239
Friday	0.0000	0.0002	0.0000	-0.0001	0.0008	0.0050*	0.0136**	0.0002	0.0002
	-0.1002	0.2813	0.0884	-0.4810	0.5914	1.7838	2.4026	1.5390	1.1616
Variance Equation									
ω	0.0000	0.0001***	0.0000***	0.0000**	0.0001**	0.0010***	0.0033***	0.0000	0.0000
	-1.6026	2.6138	2.6620	2.4115	2.4360	6.2565	5.3549	-0.7065	-1.2525
δ1	0.0881***	0.7122***	0.5884***	0.4434***	0.8151***	0.8493***	0.8503***	0.3951***	0.0699***
	6.9183	10.5689	9.8593	9.6882	11.5308	10.7369	10.5015	12.9413	6.3634
γ1	0.8994***	0.2541***	0.4176***	0.5157***	0.2366***	0.1581***	0.1624***	0.6541***	0.9186***
	72.6224	7.2874	14.1064	14.7420	8.2239	5.7801	6.2612	46.1488	80.5836
Monday	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0004	-0.0010	0.0000***	0.0000
	1.0505	0.3533	-1.2346	-0.7038	-0.1712	-1.6213	-1.1478	3.2571	0.3718
Tuesday	0.0000***	0.0000	0.0000	0.0000	0.0000	-0.0003	-0.0013	0.0000	0.0000***
	3.0873	0.8291	-0.4581	-0.3180	0.4600	-1.3440	-1.4396	0.4945	3.2236
Thursday	0.0000	0.0001*	0.0000	0.0000	0.0002*	-0.0001	-0.0013	0.0000	0.0000
	0.6405	1.7517	-0.2788	-1.1127	1.8648	-0.3103	-1.3303	1.6432	0.1779

Friday	0.0000	0.0000	-0.0001**	0.0000	0.0000	-0.0003	0.0005	0.0000	0.0000
	1.2597	-0.9530	-2.0153	-1.1062	-0.1351	-1.1489	0.5037	1.0692	1.3137
MODIFIED GARCH-M(1,1)									
Mean Equation									
λ0	-2.4681	-0.7655	1.1458	-3.1819	-0.5427	0.4216*	0.2162**	25.5995***	4.0744
	-0.3232	-0.7401	0.6492	-0.8696	-1.3673	1.7029	2.4982	3.0766	0.3849
Monday	0.0002	0.0003	0.0004	0.0005*	0.0009	0.0021	-0.0109**	-0.0007**	0.0003**
	0.9813	0.3664	0.9609	1.6618	0.8049	1.1986	-2.1992	-2.3527	2.1281
Tuesday	-0.0001	-0.0008	-0.0004	0.0000	-0.0012	-0.0021	-0.0032	-0.0006***	0.0000
	-0.3334	-1.1290	-0.9205	-0.0828	-1.0806	-1.0976	-0.9506	-2.7317	0.0106
Wednesday	0.0001	0.0001	0.0000	0.0003	0.0037**	0.0028	0.0033	-0.0011*	0.0004**
	0.6600	0.1623	0.0763	0.8596	2.4282	1.5212	0.9723	-1.7471	2.0989
Thursday	0.0000	-0.0006	-0.0002	0.0001	0.0030*	-0.0018	-0.0108**	-0.0001	0.0001
	-0.1551	-0.7109	-0.4959	0.3217	1.8298	-0.9395	-2.1362	-0.8870	0.5760
Friday	-0.0001	-0.0005	-0.0001	0.0001	-0.0005	0.0006	0.0121**	0.0001	0.0002
	-0.3250	-0.7855	-0.2658	0.3011	-0.4912	0.3391	2.0940	0.8919	1.0045
Variance Equation									
ω	0.0000***	0.0001**	0.0000**	0.0000**	0.0002**	0.0010***	0.0034***	0.0000***	0.0000
	-2.7843	2.6465	2.3337	2.4049	2.4850	6.2698	5.4565	12.0712	-1.2467
δ1	0.0649***	0.2905***	0.2133***	0.1322***	0.4057***	0.4755***	0.5025***	0.3647***	0.1358***
	5.8377	8.7282	7.6347	6.5535	9.1172	9.5893	9.5942	11.3775	6.7351
γ1	0.9276**	0.6899***	0.7627***	0.8478***	0.5816***	0.5374***	0.5036***	0.6680***	0.9897***
	82.9561	25.8077	30.3225	39.8970	17.5661	19.4304	15.3415	37.5463	79.8238
Monday	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0004*	-0.0004	0.0000***	0.0000
	0.9454	-0.1239	-0.5607	0.3064	-0.0105	-1.6964	-1.1496	3.0250	0.3751
Tuesday	0.0000***	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
	4.6208	-0.7037	-1.3635	1.1829	0.8221	1.1761	0.0856	0.6320	0.9469
Thursday	0.0000	0.0001*	0.0000	0.0000	0.0002*	0.0002	-0.0001	0.0000**	0.0000
	1.2586	1.7562	-1.1794	-0.0645	1.6252	1.1407	-0.2121	2.0534	0.6056
Friday	0.0000**	0.0000**	0.0000***	0.0000	1.8753	0.0000	0.0003	0.0000*	0.0000
	2.4969	-2.5765	-2.7191	-0.0269	-0.9497	0.1685	0.6103	1.7482	0.2187
MODIFIED TGARCH(1,1)									

Mean Equation									
Monday	0.0001	0.0004	0.0006	0.0009***	0.0007	-0.0041	-0.0094*	-0.0003**	0.0003**
	0.6937	0.4710	1.3172	2.8129	0.4774	-1.4644	-1.8220	-2.4972	2.1334
Tuesday	-0.0003	-0.0020**	-0.0003	-0.0001	-0.0029*	-0.0010	-0.0019	-0.0003	0.0000
	-1.1788	-2.1039	-0.5514	-0.1644	-1.9223	-0.3546	-0.3352	-1.1845	-0.1666
Wednesday	0.0001	0.0010	0.0005	0.0007**	0.0028	0.0021	0.0065	-0.0002	0.0003*
	0.5753	1.0557	0.9606	2.0059	0.7492	0.7148	1.1600	-0.4094	1.6883
Thursday	-0.0002	-0.0018*	-0.0002	0.0003	-0.0038**	-0.0038	-0.0099*	0.0001	0.0001
	-1.1386	-1.7517	-0.3960	0.9337	-2.2565	-1.2753	-1.8945	0.4780	0.8803
Friday	-0.0002	-0.0001	0.0004	0.0002	0.0004	0.0044	0.0129**	0.0005**	0.0001
	-0.7671	-0.0948	0.7766	0.6942	0.2443	1.5051	2.1864	2.0663	0.6927
Variance Equation									
ω	0.0000	0.0001**	0.0000***	0.0000**	0.0001**	0.0010***	0.0033***	0.0000***	0.0000
	-1.5679	2.5253	2.7079	2.1740	2.4142	6.2376	5.3574	10.1718	-1.0393
δ1	0.0402***	0.6310***	0.7367***	0.6240***	0.7418***	0.8067***	0.8311***	0.1507***	-0.0063
	2.8688	6.9619	7.3179	7.4493	7.0580	6.3780	7.1829	11.2913	-0.6796
Φ	0.1059***	0.1596	0.2691*	0.3800***	0.1428	0.0892	0.0422	0.0500*	0.1221***
	2.9199	0.9336	-1.9340	-3.8215	0.8508	0.4576	0.2290	1.8998	6.5642
γ1	0.9015***	0.2598***	0.4154***	0.5460***	0.2387***	0.1571***	0.1615***	0.5965***	0.9299***
	76.8143	7.4967	14.3512	17.1219	8.2540	5.7612	6.2289	29.4004	84.3545
Monday	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0004	-0.0009	0.0000***	0.0000
	1.0566	0.4375	-1.2990	-0.7608	-0.1280	-1.5782	-1.1289	-9.1751	0.3481
Tuesday	0.0000***	0.0000	0.0000	0.0000	0.0000	-0.0003	-0.0013	0.0000***	0.0000***
	2.9696	0.8228	-0.4296	-0.0911	0.4895	-1.3297	-1.4485	-10.6339	2.9331
Thursday	0.0000	0.0001*	0.0000	0.0000	0.0002*	-0.0001	-0.0013	0.0000***	0.0000
	0.6432	1.7637	-0.4103	-1.0456	1.8572	-0.3090	-1.3269	-11.5341	-0.0019
Friday	0.0000	0.0000	0.0000**	0.0000	0.0000	-0.0003	0.0005	0.0000***	0.0000
	1.1276	-0.9476	-2.0132	-1.0474	-0.1682	-1.1753	0.5085	-8.0219	1.2022
MODIFIED EGARCH(1,1)									
Mean Equation									
Monday	0.0000	0.0005	0.0009**	0.0008***	0.0029**	-0.0057***	-0.0131***	-0.0002	0.0003*

	0.0146	0.5889	1.9823	2.8483	2.4296	-2.6119	-3.1207	-1.6255	1.9076
Tuesday	-0.0003	-0.0016*	-0.0002	-0.0001	-0.0051***	-0.0014	0.0000	-0.0002	-0.0001
	-1.5935	-1.7445	-0.3775	-0.1761	-4.1826	-0.7270	-0.0022	-1.4515	-0.3776
Wednesday	0.0000	0.0002	0.0006	0.0006**	0.0076***	0.0056**	0.0038	-0.0001	0.0003*
	0.1835	0.2256	1.2566	2.0812	5.9638	2.3734	0.8013	-0.4972	1.7566
Thursday	-0.0003	-0.0016*	0.0000	0.0004	-0.0059***	-0.0099***	-0.0074*	-0.0001	0.0001
	-1.6314	-1.8054	0.0512	1.4266	-4.3820	-4.5445	-1.7568	-0.6164	0.9498
Friday	-0.0001	0.0004	0.0004	0.0003	0.0021	0.0101***	0.0141***	0.0002	0.0002
	-0.7461	0.5135	0.8422	1.0623	1.6416	4.1590	3.0098	1.3597	1.1515
Variance Equation									
ω	-0.4163***	-3.7716***	-2.7852***	-2.4089***	-2.9753***	-3.1008***	-2.4642***	-1.4130***	-0.3443***
	-3.8772	-12.9827	-13.7949	-9.7035	-17.2465	-14.5871	-14.4214	-11.6055	-3.0753
δ1	0.1458***	1.2284***	1.0330***	0.7906***	1.3568***	1.5064***	1.4369***	0.6198***	0.0823***
	8.2059	13.6752	14.5293	14.3370	16.4590	16.0910	13.7064	16.8073	4.0434
φ	-0.1212***	-0.0153	-0.1131**	-0.1425***	0.0044	-0.0151	-0.0243	0.0012	-0.0918***
	-4.1214	-0.2636	2.1532	3.2149	0.0768	-0.2633	-0.3891	0.0565	-7.0060
γ1	0.9927***	0.6479***	0.7765***	0.8201***	0.7101***	0.6413***	0.6936***	0.9356***	0.9857***
	296.8948	18.7684	35.7967	37.2462	27.7202	19.2020	23.8627	140.2281	344.4628
Monday	0.2660*	-0.0201	-0.0862	-0.0121	-0.1224	-0.1660	-0.1216	0.3044**	0.2550
	1.7205	-0.1590	-0.6939	-0.0958	-1.0134	-1.3571	-0.8979	2.3126	1.6179
Tuesday	0.4901***	0.0625	0.0902	0.0632	-0.1220	-0.1914	-0.0645	0.2290	0.1399
	2.6584	0.4707	0.6322	0.4226	-0.8463	-1.4386	-0.3980	1.5524	0.8008
Thursday	0.1964	0.0366	-0.0667	-0.1398	0.0100	-0.1107	-0.0182	0.4855***	0.0928
	1.0286	0.2563	-0.4848	-0.9186	0.0719	-0.8692	-0.1185	2.7793	0.4688
Friday	0.1529	-0.1143	-0.2446**	-0.1145	-0.1821	-0.1337	0.0613	0.1720	0.0594
	1.0173	-0.8987	-1.9906	-0.8658	-1.3983	-1.0614	0.4676	1.4043	0.3793

Note: ***, ** and * denote a significance level of 1%, 5% and 10%, respectively; t-value is presented below each coefficient.