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SHORT-HORIZON ASYMMETRY IN CONDITIONAL MEAN OF ASEAN STOCK MARKET RETURNS

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ABSTRACT

This paper describes the return patterns of six ASEAN markets (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) using an autoregressive exponential GARCH-in mean model, also known as AR-EGARCH(1, 1)-M. Estimating the model for each market using daily data from August 2000 to May 2010, we find these markets generally have quick mean-reversion speeds but quite distinct patterns of return dynamics. In the Indonesian market, the evidence seems to strongly suggest asymmetric mean reversion and overreaction of the market during downturns. The Vietnamese market exhibits the most persistent return autocorrelation with some evidence pointing to higher persistence during market downturns. While there seems to be no asymmetric pattern in the return adjustment of the Malaysian and Filipino markets, there is no evidence indicating significant serial correlation in the markets of Singapore and Thailand. Thus, technical trading strategies are applicable for the markets of Indonesia and Vietnam only.

Keywords: Asymmetry, mean reversion, volatility, AR-EGARCH(1, 1)-M, ASEAN markets

JEL Classification: G10, G12

INTRODUCTION

The dynamic behaviour of stock market returns has received considerable attention in finance literature. At the core of this focus is the efficiency market hypothesis (EMH), which states that no market agents can reap abnormal profits; however, various studies have also examined the presence of both positive and negative autocorrelation structure in stock index returns. The presence of positive autocorrelation suggests partial adjustment of stock prices to their intrinsic values, which can be attributed to non-synchronous trading, time-varying short-term expected returns or risk premia, and market frictions (Koutmos, 1998, 1999). Meanwhile, the negative autocorrelation indicates that stock price fluctuations tend to be followed by predictable changes in the opposite direction; this trend is consistent with the view that market agents overreact irrationally to shocks or deviations of stock returns from their long run values (De Bondt & Thaler, 1985, 1987). Pinpointing the presence of stock return autocorrelation and discerning whether it is positive or negative are essential steps for investors in creating appropriate trading strategies. For instance, empirical evidence for significant autocorrelation indicates predictable return behaviour; furthermore, a contrarian trading strategy can be profitable if the autocorrelation is negative.

An interesting aspect that emerges in the empirical literature is the possibility of asymmetric mean-reverting stock returns. This is consistent with the widely documented asymmetric market volatility; in fact, the so-called leverage effect describes how stock market declines tend to generate proportionately higher volatility than stock market upturns. As noted by Koutmos (1998, 1999), if the market volatility responds asymmetrically to both bad and good news, the mean return may behave asymmetrically as well. This possibility stems from investors' higher risk aversion during market downturns and market specialists' ability to maintain price continuity during market upturns, which result in faster return adjustments during market declines. The presence of asymmetry can also be caused by business cycle fluctuations in which contractions tend to be steeper than expansion (i.e., sharpness), and troughs tend to be more pronounced than peaks (i.e., deepness), as suggested by Sichel (1993). Because stock markets are fundamentally tied to business conditions, the likelihood is strong that the stock market will exhibit asymmetric patterns as well.

The issue of asymmetric adjustment of stock returns has been an increasing focus of the empirical literature. Koutmos (1998) examines asymmetries in conditional mean and conditional variance of nine developed markets and finds clear evidence for asymmetric mean reversion for all markets except the UK and US. The serial correlations of stock returns in these markets are both positive and significant following good news, and in most cases, the correlations are insignificant following bad news, indicating complete adjustments of the stock prices to their intrinsic values when undervalued. In addition, the leverage effect is documented in all markets. In a subsequent study, Koutmos (1999) examines the issue for G-7 markets and arrives at similar findings. A series of studies by Nam (2001, 2003) and Nam et al. (2001, 2002, 2005) further reaffirm faster adjustments of negative market returns. In fact, Nam et al. (2005) provide more evidence of negative serial correlation of stock returns after market downturns. Kulp-Tag (2007) applies Nam's (2001) framework to

Nordic stock markets and documents similar results for market overreaction during downturns. More recently, Zhang and Li (2008) examine asymmetric dynamics of the Chinese stock market and suggest that stock returns in this market do exhibit asymmetric adjustment with negative returns often leading to overreaction. They further find that the leverage effect in the volatility pattern becomes more apparent as the market progresses.

Following this line of inquiry, this paper aims to discuss the return dynamics of six ASEAN stock markets in recent years: Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. More than a decade ago, Koutmos (1997) evaluates whether the emerging Asian stock markets (Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand) behave similarly as the developed markets in terms of their stochastic properties, volatility clustering and leverage effect. The results he obtains are surprisingly affirmative. More recently, Liau and Yang (2008) examine the mean and volatility asymmetry of seven Asian markets using daily data from 3 January 1994 to 31 March 2005 and find evidence for asymmetric mean reversion in these markets. Our study attempts to complement these two studies by looking at the asymmetric mean-reverting behaviour using data after the Asian crisis. We added Indonesia and Vietnam, which have not been considered previously in such analysis.

Because these markets are less developed and thus less efficient, we should expect more evidence of return serial correlation. However, determining if these autocorrelations are positive or negative proves to be difficult due to inefficiency and frictions, a relatively high volatility and an increase of less-informed and subsequently irrational traders. Given these differences, the earlier noted findings from the developed markets may not necessarily apply to these markets. Indeed, by including Singapore's more advanced market and Vietnam's less-developed but fast-growing market, we even expect differences in their return dynamics. The present analysis attempts to cater this interest and, at the same time, enriches the empirical literature on the subject for the emerging markets.

The paper is organised as follows. In the next section, we describe our empirical framework followed by the presentation of data preliminaries while the next section discusses estimation results. Finally, we provide conclusion with the main findings and some closing remarks.

EMPIRICAL APPROACH

The present paper provides the empirical framework for the analysis. To motivate our final specification and clarify model interpretation, we first specify the mean equation of stock return to follow an autoregressive process of order 1 as

$$R_t = \mu + \beta R_{t-1} + \varepsilon_t \tag{1}$$

where R is stock return computed as the logarithmic difference in the daily index under study. This specification stems from Koutmos (1998), who models the partial adjustment of the stock market index to its intrinsic value with the adjustment speed $(1-\beta)$. The parameter β measures the degree of frictions in the market or serial correlation in stock returns. If the coefficient β is 0, then the market price completely adjusts to its mean or intrinsic value. The greater the value of β, the larger the degree of market frictions is, or alternatively, the more persistent the market return is. In Koutmos' (1998) partial adjustment framework, the coefficient β is expected to be positive. However, the market can exhibit negative serial correlation arising from overreaction of market agents to past information. In both positive and negative cases, it is further expected that $|\beta| < 1$ for the return to be stationary and to exhibit mean-reverting behaviour.

The above equation assumes that the autocorrelation in stock return, or adjustment process, is symmetric. If the adjustment process to good and bad news is asymmetric, the above specification is misspecified (Koutmos, 1998). Existing empirical literature tends to agree that the stock market's mean-reverting process following a negative return is faster than following a positive one. In other words, the market tends to be more persistent on the incline rather than on the decline. As noted by Kulp-Tag (2007), allowance for this asymmetry paves the way for the possibility of market overreaction following market downturns and thus provides support to a technical trading strategy. Following Nam (2001) and Kulp-Tag (2007), we re-specify equation (1) to incorporate asymmetric mean-reversion in ASEAN markets as follows:

$$R_t = \mu + [\beta_1 + \beta_2 D_1(R_{t-1} < 0)]R_{t-1} + \varepsilon_t \tag{2}$$

where D_1 is a dummy variable taking the value of 1 if $R_{t-1} < 0$ and 0 otherwise. Based on equation (2), the degree of market persistence or serial correlation following positive returns is given by β_1 while that following negative returns is measured by $\beta_1 + \beta_2$. Thus, the significance of β_2 serves as evidence of asymmetric mean reverting behaviour of stock returns. With $\beta_1 > 0$, $\beta_2 < 0$ indicates faster mean-reversion or adjustment speed, and $\beta_2 > 0$ indicates more persistence in returns following market downturns. Then, it is possible that $\beta_1 + \beta_2 < 0$, which is assumed to indicate agents' overreaction following negative returns.

In addition to equation (2), we also examine the return dynamics of stock returns following consecutive negative market returns for up to four days as in Kulp-Tag (2007). This is done by estimating the following mean equations:

$$R_t = \mu + [\beta_1 + \beta_2 D_2 (R_{t-1} < 0, R_{t-2} < 0)] R_{t-1} + \varepsilon_t \tag{3}$$

$$R_t = \mu + [\beta_1 + \beta_2 D_3 (R_{t-1} < 0, R_{t-2} < 0, R_{t-3} < 0)] R_{t-1} + \varepsilon_t \tag{4}$$

$$R_t = \mu + [\beta_1 + \beta_2 D_4 (R_{t-1} < 0, R_{t-2} < 0, R_{t-3} < 0, R_{t-4} < 4)] R_{t-1} + \varepsilon_t \tag{5}$$

D_i for i = 2, 3, and 4 takes the value of 1 if the past returns for consecutive i days are negative; otherwise it takes the value of 0. As will be presented later, occurrences of consecutive negative returns over three or four days in these ASEAN markets are not uncommon. Accordingly, this extension is worth pursuing because the market psychology can differ following a string of negative market returns. These models are referred to as Models 1, 2, 3 and 4 for one-period, two-period, three-period and four-period negative returns, respectively.

To complete our specification, we specify the error variances of equations (2) to (5) to be time-varying using GARCH-type models and consider the incorporation of the time-varying volatility in the mean equations to capture mean-variance trade-off in the return dynamics. More specifically, our specification is the Asymmetric Autoregressive—Exponential GARCH—in mean model, also known as the ASAR-EGARCH(1,1)-M model. This model is expressed as

$$R_t = \mu + [\beta_1 + \beta_2 D_i] R_{t-1} + \lambda \log(h_t) + \varepsilon_t \tag{6}$$

$$\varepsilon_t \mid I_{t-1} \sim GED(0, h_t, v) \tag{7}$$

$$\log h_t = \theta_0 + \theta_1 \log h_{t-1} + \theta_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_3 \frac{\varepsilon_{t-1}}{h_{t-1}} \tag{8}$$

Equation (6) is the mean equation as described above but extended to include time-varying variances in natural log form. Then, given the information set up to time t–1, the model error term is assumed to have the generalised error distribution (GED) with mean 0, time-varying variance h_t and measure of thickness v. Finally, we use the exponential GARCH or EGARCH to characterise the asymmetric time-varying variances. In the empirical implementation, we estimate the specified ASAR-EGARCH(1,1)-M first. If we find no evidence of asymmetric volatility, the ASAR-GARCH(1,1)-M is used instead. The "in-mean" term is dropped from the model if it is found to be insignificant.

The choices of GED and EGARCH specification are in line with existing studies. As shown by Lee at al. (2001) and De Santis and Imrohoroglu (1997), the GED effectively captures the leptokurtic properties of a financial series. The GED distribution also nests other distributions as special cases. These include normal distribution (v = 2), double exponential or Laplace distribution (v = 1) and uniform distribution ($v \rightarrow \infty$). The value of parameter v below 2 suggests thicker tails of the distribution than the standard normal while the value above 2 indicates thinner tails. Another advantage of the GED distribution is that extreme observations exert no excessive influence on the parameter estimates (Koutmos, 1998). The EGARCH variance specification is based on widely documented evidence that positive and negative shocks have asymmetric influences on stock market volatility (see the aforementioned studies on developed markets). Based on equation (8), negative news (i.e. $\varepsilon_t < 0$) leads to higher volatility if $\theta_3 < 0$. This is known as the leverage effect in the finance literature. Note also that the EGARCH does not require non-negativity restrictions of the parameters in the variance equation.

DATA PRELIMINARIES

We utilise aggregate stock market indexes of the six ASEAN markets: the Jakarta Stock Exchange composite index (JSE) for Indonesia, the Kuala Lumpur Composite Index (KLCI) for Malaysia, the Philippines Stock Exchange composite index (PSE) for the Philippines, the Straight Times Index (STI) for Singapore, the Stock Exchange of Thailand composite index (SET) for Thailand, and the Ho Chi Min VSE price index (VSE) for Vietnam. All indices are expressed in local currency, and the data points cover the time period between August 1, 2000, to May 31, 2010, for a total of 2,565 observations. The data sample starts beyond the 1997–1998 Asian crisis, thus eliminating any crisis contamination effect on the return dynamics of the region's markets. Moreover, the price index of Vietnam is only available from August 2000 onwards. These data are retrieved from *Datastream International*. We compute daily returns for each market as the logarithmic difference in its corresponding market index.

Table 1 provides descriptive statistics of the return series. All markets exhibit positive returns over the sample period with the Indonesian market recording the highest daily return (0.068%) followed by the Vietnamese market (0.063%). The market of Singapore experiences the lowest return (0.011%) followed by the Malaysian market (0.018%). As reflected by the standard deviation, the markets of Indonesia and Vietnam also have the highest unconditional volatility while the Malaysian market records the least volatility. Interestingly, the market of Indonesia has the most extreme positive and negative returns and yet is less volatile than the Vietnamese market. This shows that these extreme values are rare occurrences in the Indonesian market while the Vietnamese market returns fluctuate widely within the minimum and maximum returns. All market returns are negatively skewed except for those in the Filipino market. The kurtosis statistics, which are substantially higher than 3, indicate excess peakness of the return distribution in all markets. The Jarque-Bera test statistics for normality soundly show deviations from the normal distribution in all ASEAN markets under study, thus justifying the use of GARCH-type models.

Table 1
Descriptive Statistics of Market Returns

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
Mean	0.000680	0.000183	0.000328	0.000110	0.000363	0.000627
Maximum	0.190719	0.045027	0.161776	0.075305	0.105770	0.066561
Minimum	–0.257802	–0.099785	–0.130887	–0.086960	–0.160633	–0.076557
Std. Dev.	0.016168	0.008929	0.014066	0.012970	0.014530	0.017062
Skewness	–1.471043	–0.966266	0.595114	–0.156424	–0.764576	–0.234291
Kurtosis	39.86122	13.56854	20.61313	7.909412	13.82205	5.626976
Jarque-Bera	146084.4	12331.63	33293.42	2585.388	12761.79	760.7143
P-values	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Table 2
Number of Consecutive Positive and Negative Returns

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
Total Observations	2564	2564	2564	2564	2564	2564
Positive Observations	1398	1425	1260	1374	1391	1437
Negative Observations	1066	1139	1204	1190	1173	1127
Two Positive Observations	732	696	618	606	593	642
Two Negative Observations	505	563	637	542	558	667
Three Positive Observations	384	376	315	270	294	360
Three Negative Observations	243	280	345	243	266	394
Four Positive Observations	207	215	144	134	131	216
Four Negative Observations	110	135	173	106	123	247

As a precursor to our formal analysis in the next section, we present the number of daily positive and negative returns and the number of consecutive positive and negative returns over 2, 3, and 4 days in Table 2. Based on the data, the six ASEAN markets can be divided into two groups. The first group records higher counts of consecutive positive returns than consecutive negative returns and includes the markets of Indonesia, Malaysia, Singapore and Thailand. Among these markets, the ratio of consecutive positive to negative return counts is highest for Indonesia and lowest for Thailand. Based on this, the Indonesian market seems to have the most potential in exhibiting asymmetric return dynamics. With the number of consecutive positive returns lower than that of consecutive negative returns, the markets of the Philippines and Vietnam are in the second group. While this pattern for the Philippines seems to fit its positively skewed distribution, the noted observation for the Vietnamese market is interesting. Particularly for the Vietnamese market, the return dynamics may be more persistent following consecutive market downturns. From this preliminary analysis of the return series, we may expect different return dynamics among these markets. We turn to our formal analysis next to discuss their potential asymmetric mean reversions.

ESTIMATION RESULTS

This section analyses the estimation results of the four models examined. Note that the sample runs through the recent 2007–2008 global financial crisis. To ascertain whether the crisis has any influence on the ASEAN market return dynamics, we also perform the analysis using the data up to 2006. The results are largely similar to the whole sample and, accordingly, not reported to conserve space. Notably, for the Vietnamese market, we find no evidence of asymmetric volatility. Accordingly, the time-varying variance is modelled using the standard GARCH(1,1). Moreover, the "in-mean" term is found to be insignificant in all markets except Singapore and Vietnam and, as a result, is dropped in the final specification for the markets concerned. Estimation results for one-period negative return (Model 1) to four-period consecutive negative returns (Model 4) are given respectively in Tables 3 to 6.

The coefficients of variance equations are statistically significant in all markets and all models, thus supporting the widely documented evidence for the ARCH effect in the stock market return behaviour. A common feature of the results is how the market volatilities of the examined ASEAN markets tend to be persistent depending mostly on past volatilities. Meanwhile, past shocks only assume a secondary role. Except Vietnam, we also observe the presence of leverage effect in all markets. The coefficient of the standardised error in the variance equation is negative and significant at 1% significance level. This means that past negative shocks are likely to generate proportionately higher volatility than past positive shocks of the same magnitude. The impact of negative shocks tends to be strongest for the Indonesian market, as reflected by the magnitude of its once-lagged standardised error coefficient. The Indonesian market's heightened market volatility following substantially higher market downturns in comparison to other markets seems to suggest possible overreaction to negative shocks by Indonesian market agents.

Table 3
Estimation Results – One Period

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
μ	0.0000	0.0001	0.0000	–0.0042	0.0000	0.0043**
β_1	0.1055***	0.0995***	0.0726***	–0.0147	0.0010	0.2166***
β_2	–0.1053**	–0.0149	0.0022	–0.0385	–0.0011	0.0165
λ	–	–	–	–0.0005*	–	0.0004**
θ_0	–1.3613***	–0.3991***	–0.8925***	–0.2366***	–0.6304***	0.0000***
θ_1	0.8607***	0.9733***	0.9156***	0.9872***	0.9430***	0.7699***
θ_2	0.2429***	0.1923***	0.2200***	0.1609***	0.1947***	0.2686***
θ_3	–0.1549***	–0.0585***	–0.0711***	–0.0659***	–0.0594***	–
v	1.0016***	1.1306***	1.0700	1.3282***	1.0753***	1.2812***

Notes: the model estimated is: $R_t = \mu + [\beta_1 + \beta_2 D_1(R_{t-1} < 0)]R_{t-1} + \lambda \log(h_t) + \varepsilon_t$

$$\log h_t = \theta_0 + \theta_1 \log h_{t-1} + \theta_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_3 \frac{\varepsilon_{t-1}}{h_{t-1}}$$

with the generalised error distribution (GED) assumption. If there is no leverage effect, the standard GARCH is estimated instead. If the volatility in the mean equation is not significant, it is dropped from the equation. ***, ** and * denote significance at 1%, 5% and 10% respectively.

As expected, we observe different return dynamics of these six ASEAN stock markets. The common finding among these markets is the mean-reversion pattern of their returns with fast adjustment towards the mean value following either positive or negative returns. This is reflected by low estimated coefficients of the autoregressive term in the mean equation for all models and all markets. Still, the results for the mean equation roughly divide these markets into four distinct return dynamics. The market of Indonesia stands alone as the only market that exhibits asymmetric mean reversion and overreaction following market downturns. The autocorrelation of the Indonesian market during market downturns is significantly lower than that of market upturns, and, reflecting overreaction, the autocorrelation during market downturns (i.e. $\beta_1 + \beta_2$) is negative and significant (above the 10% significance level) following three and four consecutive negative returns. This result confirms the noted relatively high volatility pattern in the Indonesian market. Therefore, in Indonesia, the contrarian strategy, a technical trading strategy based on buying the losers during market downturns, can be profitable.

Table 4
Estimation Results – Two Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
μ	0.0003	0.0001	0.0000	–0.0038	0.0000	0.0038**
β_1	0.0779***	0.1015***	0.0750***	–0.0241	0.0005	0.2344***
β_2	–0.0632	–0.0316	–0.0061	–0.0210	–0.0331	–0.0304
λ	–	–	–	–0.0004*	–	0.0004**
θ_0	–1.3701***	–0.4064***	–0.8788***	–0.2394***	–0.6357***	0.0000***
θ_1	0.8601***	0.9727***	0.9168***	0.9871***	0.9424***	0.7706***
θ_2	0.2460***	0.1943***	0.2162***	0.1633***	0.1940***	0.2676***
θ_3	–0.1557***	–0.0591***	–0.0698***	–0.0655***	–0.0594***	–
v	1.0142***	1.1297***	1.0661***	1.3283***	1.0710***	1.2848***

Notes: the model estimated is: $R_t = \mu + [\beta_1 + \beta_2 D_2(R_{t-1} < 0, R_{t-2} < 0)]R_{t-1} + \lambda \log(h_t) + \varepsilon_t$

$$\log h_t = \theta_0 + \theta_1 \log h_{t-1} + \theta_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_3 \frac{\varepsilon_{t-1}}{h_{t-1}}$$

with the generalised error distribution (GED) assumption. If there is no leverage effect, the standard GARCH is estimated instead. If the volatility in the mean equation is not significant, it is dropped from the equation.
***, ** and * denote significance at 1%, 5% and 10% respectively.

The Vietnamese market is also distinct from the rest in several aspects. Apart from the absence of the leverage effect, the Vietnamese market is the only market that exhibits positive and significant mean-variance relationship. Second, while we note no evidence of asymmetric mean reversion following a negative return, two-period consecutive returns, and three-period consecutive returns, this market tends to exhibit the most persistence among the markets considered. The serial correlation coefficient is found to be higher than 0.2 in all models estimated, which is more than double those estimated for other markets. Moreover, we do find asymmetric mean reversion in the Vietnamese stock returns following four consecutive negative returns, an opposite pattern to the one observed for Indonesia. Namely, following market downturns over 4 consecutive days, the Vietnamese market tends to exhibit more persistence with a serial correlation of 0.36 during downturns as opposed to 0.20 during upturns. This finding is interesting because it contrasts the widely noted conclusions from other studies on developed markets stating that stock markets exhibit faster adjustments during the downturns. In short, what is observed for the developed markets or even other emerging markets may not necessarily be true for a specific emerging market at its early stage of development. Zhang and Li (2008) also document similar results during the initial sample periods in their analysis of the Chinese markets (Zhang & Li, 2008; Figure 2, p. 961).

Table 5
Estimation Results – Three Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
μ	0.0004*	0.0001	–0.00002	–0.0039	0.0000	0.0041***
β_1	0.0780***	0.1040***	0.0847***	–0.0200	0.0004	0.2211***
β_2	–0.1131**	–0.0746	–0.0853*	–0.0907	–0.0472	0.0235
λ	–	–	–	–0.0004*	–	0.0004***
θ_0	–1.3554***	–0.3967***	–0.8715***	–0.2346***	–0.6378***	0.0000***
θ_1	0.8617***	0.9734***	0.9175***	0.9874***	0.9421***	0.7699***
θ_2	0.2433***	0.1902***	0.2135***	0.1600***	0.1939***	0.2687***
θ_3	–0.1545***	–0.0587***	–0.0671***	–0.0655***	–0.0597***	–
v	1.0157***	1.1266	1.0578***	1.3260***	1.0689***	1.2780***

Notes: the model estimated is: $R_t = \mu + [\beta_1 + \beta_2 D_3 (R_{t-1} < 0, R_{t-2} < 0, R_{t-3} < 0)]R_{t-1} + \lambda \log(h_t) + \varepsilon_t$

$$\log h_t = \theta_0 + \theta_1 \log h_{t-1} + \theta_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_3 \frac{\varepsilon_{t-1}}{h_{t-1}}$$

with the generalised error distribution (GED) assumption. If there is no leverage effect, the standard GARCH is estimated instead. If the volatility in the mean equation is not significant, it is dropped from the equation.
***, ** and * denote significance at 1%, 5% and 10% respectively.

The markets of Malaysia and the Philippines exhibit no asymmetric mean reversion, with the exception of one case in the Philippines. Given low serial correlation in their returns, the aggregate stock prices of Malaysia and the Philippines tend to adjust quickly to their intrinsic values. In the case of the Philippines, we note complete adjustment following three consecutive returns whereby the sum $\beta_1 + \beta_2$ is insignificantly different from zero. Finally, the return autocorrelation of the Singapore and Thai markets is indistinguishable from zero regardless of the directions of the market movements. Thus, stock prices tend to exhibit a clear random walk behaviour and adjust completely to their intrinsic values only in these two markets.

Table 6
Estimation Results – Four Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
μ	0.0004**	0.0002	0.0000	–0.0035	0.0000	0.0041***
β_1	0.0718***	0.0946***	0.0785***	–0.0269	0.0001	0.2032***
β_2	–0.1951**	–0.0328	–0.0785	–0.0318	–0.0029	0.1600***
λ	–	–	–	–0.0004*	–	0.0004***
θ_0	–1.3694***	–0.3947***	–0.8720***	–0.2346***	–0.6521***	0.0000***
θ_1	0.8605***	0.9737***	0.9173***	0.9874***	0.9406***	0.7684***
θ_2	0.2482***	0.1909***	0.2135***	0.1605***	0.1964***	0.2718***
θ_3	–0.1555***	–0.0582***	–0.0680***	–0.0663***	–0.0609***	–
v	1.0192	1.1294***	1.0545***	1.3290***	1.0659***	1.2510***

Notes: the model estimated is:

$$R_t = \mu + [\beta_1 + \beta_2 D_4(R_{t-1} < 0, R_{t-2} < 0, R_{t-3} < 0, R_{t-4} < 0)]R_{t-1} + \lambda \log(h_t) + \varepsilon_t$$

$$\log h_t = \theta_0 + \theta_1 \log h_{t-1} + \theta_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \theta_3 \frac{\varepsilon_{t-1}}{h_{t-1}}$$

with the generalised error distribution (GED) assumption. If there is no leverage effect, the standard GARCH is estimated instead. If the volatility in the mean equation is not significant, it is dropped from the equation. ***, ** and * denote significance at 1%, 5% and 10% respectively.

The results we obtain are intriguing when viewed in light of the general uniformity of return dynamics documented for the developed markets by Koutmos (1998, 1999). The return dynamics in the ASEAN markets are far from being uniform, and this result deserves an explanation. We believe that the stages of stock market development and the degree of volatility may account for the results. Among the markets examined, the Vietnamese stock exchange is the most recent upcoming market but still lags behind other markets in region. Interestingly, the behaviour of the Vietnamese market tends to mimic the Chinese stock market during 1990 and 1991, as documented by Zhang and Li (2008). The Indonesian market is relatively more volatile. This is consistent with the finding of LeBaron (1992) that return autocorrelation and volatility are negatively related. Thus, the heightened volatility during market downturns, as captured by the leverage effect, may account for lower or even negative return autocorrelation during market downturns. Finally, the market of Singapore is the most advanced in the region, and thus, the finding of complete mean-reverting behaviour comes as no surprise. We admit that this explanation is tentative at best; in fact, it remains intriguing why the Thai market tends to behave in the same way as the market of Singapore. In short, further research is needed to account for the different dynamic patterns of stock market returns in these countries.

CONCLUSION

With the interest in dynamic patterns of stock returns in ASEAN markets, this paper empirically analyses the presence of asymmetric mean reversion and asymmetric volatility of six ASEAN markets: Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Among these markets, the Singaporean market is the most advanced, and the Vietnamese market is least developed. Moreover, the Indonesian and Vietnamese markets are relatively more volatile while the Malaysian and Singaporean markets are at the opposite end of the volatility spectrum. In the analysis, we make use of the asymmetric autoregressive specification of the mean equation and the exponential-GARCH specification of the variance equation to characterise stock return dynamics. In general, the adjustment process of the market returns is fast but shows evidence of quite distinct dynamic behaviour between August 2000 and May 2010.

The Indonesian market stands out as the only one that exhibits overreaction during market downturns while the Vietnamese market demonstrates the most persistence in its return behaviour, with a higher degree of persistence during the market downturns. No evidence is uncovered for the markets of Malaysia and the Philippines, and no evidence is found for significant serial correlation in Singapore and Thai stock returns. Finally, we find the presence of asymmetric volatility in all markets except the Vietnamese market. Consistent with the leverage effect, negative shocks tend to result in proportionately higher volatility than positive shocks of the same magnitude. We tentatively attribute the differences across these markets to the stages of market development and the degree of volatility. However, to clarify the reasons underlying these differences, further research is needed.

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