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ASYMMETRY IN MEAN-REVERTING BEHAVIOR OF ASEAN STOCK MARKET RETURNS

ABSTRACT

The present paper characterizes the mean-reverting behavior of six ASEAN markets – Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam – using an autoregressive exponential GARCH-in mean model and daily data from August 2000 to May 2010. The results indicate fast speed of mean-reversion in the returns of these markets but with quite distinct patterns of return dynamics. The evidence seems strong to suggest asymmetric mean reversion and overreaction during market downturns in the Indonesian market. The Vietnamese market exhibits most persistent return autocorrelation with some evidence pointing to higher persistence during market downturns. However, there is no evidence indicating significant serial correlation in the markets of Singapore and Thailand. Finally, the leverage effect is documented in all markets except Vietnam. We tentatively attribute these differences to stages of market development and, accordingly their levels of efficiency, and to the degree of market volatility.

Keywords: *Asymmetry, Mean Reversion, Volatility, AR-EGARCH(1, 1), ASEAN Markets*

JEL Classification: *G10, G12*

I. INTRODUCTION

The presence of mean-reverting behavior in stock index returns is a subject that has captured great interest. Arguably, the autocorrelation in market returns can be either positive or negative. According to Koutmos (1998, 1999), 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. Meanwhile, the negative autocorrelation indicates that stock price changes tend to be followed by predictable changes in the opposite direction, which is consistent with the view that market agents overreact irrationally to shocks or deviations of stock returns from their long run values (De Bondt and Thaler, 1985, 1987). Pinpointing the presence of stock return autocorrelation and whether it is positive and negative is essential to investors for carving appropriate trading strategies. For instance, empirical evidence for significant autocorrelation indicates predictable return behavior and, if it is further found that the autocorrelation is negative, a contrarian trading strategy can be profitable.

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Recent literature has also acknowledged the possibility of asymmetric mean-reverting behavior of stock returns. This is in cognizant with the widely established results of asymmetric volatility of stock return that stock market declines tend to generate proportionately higher volatility than stock market upturns, the so-called leverage effect. As noted by Koutmos (1998, 1999), if the volatility responds asymmetrically to bad and good news, there is also the possibility that mean return can behave asymmetrically. This possibility stems from investors' higher risk aversion during market downturns and market specialists' easier task to maintain price continuity during market upturns, which result in faster return adjustments during market declines. The presence of asymmetry can also be due to asymmetry in business cycles where, as suggested by Sichel (1993), contractions tend to be steeper than expansion (i.e. sharpness) and troughs tend to be more pronounced than peaks (i.e. deepness). Since stock markets are fundamentally tied to business conditions, it is highly potential that the stock market will exhibit asymmetric patterns as well.

The issue of asymmetric adjustment of stock returns has been increasingly addressed and established in various empirical studies on particularly the developed markets. These include Koutmos (1998, 1999), Nam (2001, 2003), Nam, Pyun and Arize (2002), Nam, Pyun and Avard (2001), Nam, Pyun and Chu (2005), and Kulp-Tag (2007). Koutmos (1998) examines asymmetries in conditional means and conditional variances of nine developed markets and find clear evidence for asymmetric mean reversion for all markets except the UK and US. The serial correlations of stock returns in these markets are positive and significant following good news and, in most cases, are insignificant following bad news. These patterns indicate complete adjustments of the stock prices to their intrinsic values when they are 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 arrive at similar findings. A series of studies by Nam (2001, 2003), Nam, Pyun and Avard (2001), Nam, Pyun and Arize (2002) and Nam, Pyun and Chu (2005) further reaffirm faster adjustments of negative market returns. Nam, Pyun and Chu (2005) provide further evidence of negative serial correlation of stock returns after market downturns. Kulp-Tag (2007) applies Nam's (2001) framework to Nordic stock markets and document similar results for market overreaction during market downturns.

More recently, few studies have also extended the analysis of stock market mean-reverting behavior to emerging markets. Zhang and Li (2008) examine asymmetric dynamics of Chinese stock market. Their empirical evidence indicates that stock returns in this market do exhibit asymmetric adjustment and negative returns tend to lead to overreaction. They further find that, as the market progresses, the leverage effect in volatility pattern becomes more apparent. Meanhile, Liau and Yang (2008) examine the mean and volatility asymmetry of 7 Asian markets using daily data from 3 January 1994 to 31 March 2005 and find evidence for asymmetric mean reversion in these markets.

Following this line of inquiry, the present paper examines the asymmetric mean-reverting behavior in market returns of six ASEAN stock markets – Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam – over recent years. The relatively little empirical attention given to these ASEAN markets does not commensurate wide interest in these markets in recent years and their increasing importance in the global financial scene. As these markets are less developed and are thus less efficient, we should expect more evidence for return serial correlation. However, whether their autocorrelations are positive or negative remain vague as they are characterized by a larger extent of inefficiency and frictions, a larger proportion of lessinformed and thus probably irrational traders and a relatively high volatility. Given these differences, the early noted findings from the developed markets may not necessarily apply to these markets. Indeed, by including more advanced market of Singapore and the least developed but recently fast-growing market of Vietnam in the region, 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.

To anticipate the results, we observe different patterns of their conditional means. The markets of Singapore and Thailand exhibit no autocorrelation in their returns suggesting complete mean reversion or random-walk behavior of stock prices. The positive autocorrelation is generally documented for the remaining markets. While there seems to be no asymmetric mean reversion in the markets of Malaysia and the Philippines, there is evidence of overreaction to negative news for the Indonesian market. The Vietnamese market demonstrates most persistence in its return dynamics and, interestingly, its persistence is enhanced during market downturns. Finally, except Vietnam, we document the presence of leverage effect in all markets.

The paper is organized as follows. In the next section, we describe our empirical framework. Section 3 presents data preliminaries while section 4 discusses estimation results. Finally, section 5 concludes with the main findings and some concluding remarks.

II. EMPIRICAL APPROACH

The present paper provides the empirical framework for the analysis. To motivate our final specification and clarify model interpretation, we follow Koutmos (1998) by characterizing the mean equation of stock return to follow an autoregressive process of order 1 as:

$$R_t = \mu + \beta R_{t-1} + \varepsilon_t \qquad (1)$$

where R is stock return computed as the logarithmic difference in the daily index under study. The focal parameter in (1) is β, which measures the degree of frictions in the market and serial correlation in market return. If the coefficient β is 0, then the market price completely adjusts to its mean or intrinsic value. The larger 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. It needs mentioning that the market return exhibits a random walk behavior or contains a unit root if β is indistinguishable from unity. Thus, the formulation of the mean equation obviates the need to conduct formal unit root tests to the return series. In our context, it is expected that $|\beta| < 1$ for the return to be stationary or to exhibit mean-reverting behavior.

The above equation assumes that the autocorrelation in stock return or the adjustment process is symmetric. If the adjustment process to good and bad news is asymmetric, the above specification is mis-specified (Koutmos, 1998). Existing empirical literature tends to agree that the mean-reverting process of stock market following a negative return is faster than following a positive return. In other words, the market tends to be more persistent in up direction than in down direction. As noted by Kulp-Tag (2007), allowance for this asymmetry paves the way for the possibility of market overreaction following market downturns and thus evidence in favor of 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:

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

where D_1 is a dummy variable taking the value of 1 if $R_{t-1} < 0$ and of 0 otherwise. Based on (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 an evidence of asymmetric mean reverting behavior of stock returns. With $\beta_1 > 0$, $\beta_2 < 0$ indicates faster mean-reversion or adjustment speed and $\beta_2 > 0$ more persistence in returns following market downturns. Then, it is possible that $\beta_1 + \beta_2 < 0$, which is taken to indicate agents' overreaction following negative returns.

In addition to (2), we also examine the return dynamics of stock returns following consecutive negative market returns for up to 4 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 and of 0 otherwise. As will be presented later, the occurrences of consecutive negative returns over three or four days in these ASEAN markets are not uncommon. Accordingly, this extension is worth pursuing since the market psychology can be different following a string of negative market returns. These models are referred as Model 1, Model 2, Model 3 and Model 4 for respectively one-period, two-period, three-period and four-period negative returns.

To complete our specification, we specify the error variances of equations (2) to (5) to be time-varying using GARCH-type models and consider incorporation of the time-varying volatility in the mean equations to capture mean-variance tradeoff in the return dynamics. It is well acknowledged that the financial time series tend to exhibit a leptokurtic property, i.e. a high-peaked and fat-tailed distribution, implying autocorrelation in their variance process. Engle (1982) develops the autoregressive conditional heteroskedasticity (ARCH) model to capture this leptokutic behavior of time series, which is later generalized by Bollerslev (1986) and hence the generalized ARCH model or GARCH. Nelson (1991) further extends the GARCH model by allowing the presence of asymmetric volatility in market returns by using the exponential GARCH model or EGARCH. With recent recognition of the asymmetric volatility, we employ an EGARCH specification in our modeling.

More specifically, our specification is the Asymmetric Autoregressive – Exponential GARCH – in mean model or, in short, asymmetric AR-EGARCH(1, 1)-M model. This model is expressed as:

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

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

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

Equation (6) is the mean equation as elaborated 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 generalized error distribution with mean 0, time-varying variance h_t and measure of thickness v. Finally, we use the exponential EGARCH to characterize the asymmetric time-varying variances. In the empirical implementation, we estimate the specified asymmetric AR-EGARCH(1, 1)-M first. If we find no evidence of asymmetric volatility, the asymmetric AR-GARCH(1, 1)-M is used instead. The "in-mean" term is further dropped from the model if it is found to be insignificant.

The choices of GED and EGARCH specification are in line with existing studies, the brief explanation of which is in order. As shown by Lee, Chen and Rui (2001) and De Santis and Imrohoroglu (1997), the GED has the ability to well capture the leptokurtic properties of 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. The GED distribution also has an advantage in that extreme observations exert no excessive influence on the parameter estimates (Koutmos, 1998). As noted, 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 (8), negative news (i.e. $\varepsilon_t < 0$) leads to higher volatility if $\theta_3 < 0$. This is termed as the leverage effect in the finance literature. Note also that the EGARCH requires no non-negativity restrictions of the parameters in the variance equation.

III. DATA PRELIMINARIES

We employ aggregate stock market indexes of the six ASEAN markets, namely, the Jakarta Stock Exchange composite index for Indonesia (JSE), the Kuala Lumpur composite index for Malaysia (KLCI), the Philippines Stock Exchange composite index for the Philippines (PSE), the Straight Times Index for Singapore (STI), the Stock Exchange of Thailand composite index (SET) for Thailand, and the Ho Chi Min VSE price index (VSE) for Vietnam. All indexes are expressed in local currency. The data are daily from August 1, 2000 to May 31, 2010, a total of 2565 observations. The data sample starts beyond the 1997/1998 Asian crisis so there should be no contamination effect of the crisis experienced by the markets in this region on their return dynamics. 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. Meanwhile, Figure 1 graphs the stock market indexes (in natural logarithm) and their returns for the six ASEAN markets.

Table 1

Descriptive Statistics of Market Returns

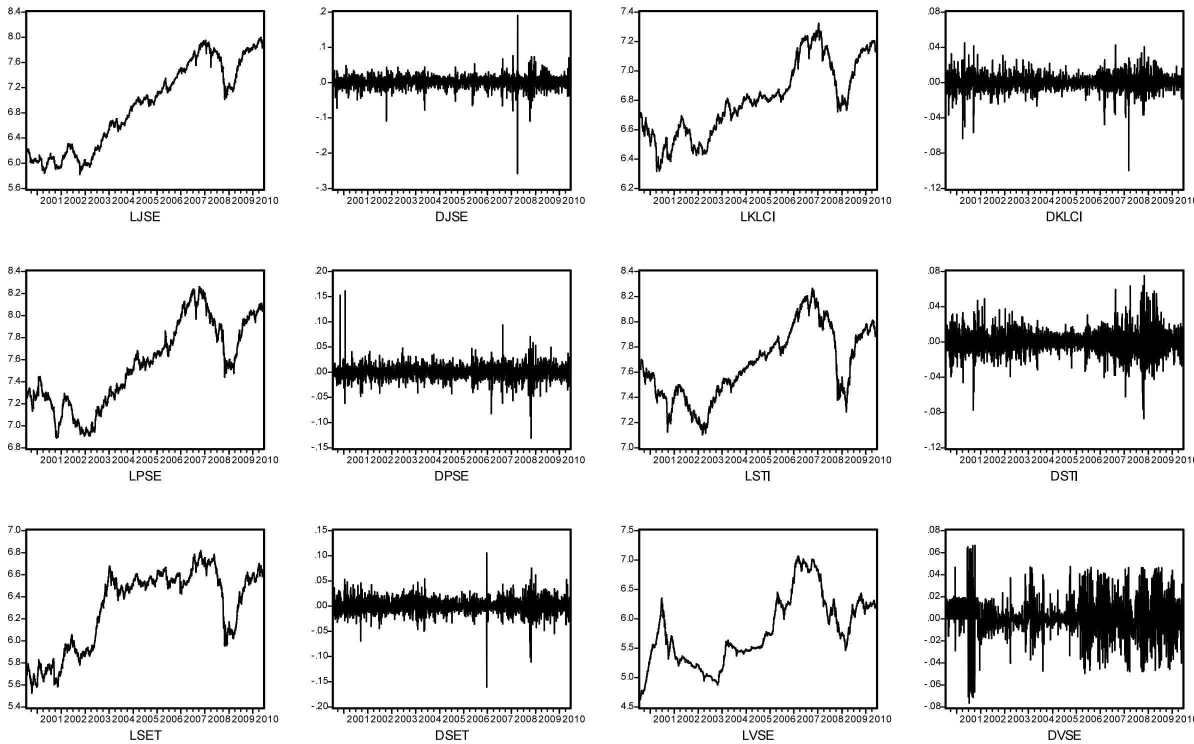
	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
Mean	0.000680	0.000183	0.000328	0.000110	0.000363	0.000627
Maximum	0.190719	0.045027	0.161776	0.075305	0.105770	0.066561
Minimum	-0.257802	-0.099785	-0.130887	-0.086960	-0.160633	-0.076557
Std. Dev.	0.016168	0.008929	0.014066	0.012970	0.014530	0.017062
Skewness	-1.471043	-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

Notes: the prefix "D" denotes first difference. JSE = Jakarta Stock Exchange composite index; KLCI = Kuala Lumpur composite index; PSE = Philippines Stock Exchange composite index; STI = Singapore Straight Times index; SET = Stock Exchange of Thailand composite index; and VSE = Ho Chi Min VSE price index. The source of these data is *Datastream*.

From Table 1, we may note that 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. It is interesting to note that 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 except the Philippines market are negatively skewed. 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 indicate deviations from the normal distribution in all ASEAN markets under study, which justify the use of GARCH-type models. These can be clearly seen in the return plots presented in Figure 1.

Figure 1:

Time-Series Plots of Stock Market Indexes and Returns



Notes: The prefix "L" denotes natural logarithms. See also notes from Table 1.

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. From Table 2, the six ASEAN markets can be divided into two groups. The first group records higher counts of consecutive positive returns than consecutive negative returns. These are 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. The markets of the Philippines and Vietnam make up the second group with the number of consecutive positive returns to be lower than that of the consecutive negative returns. While this pattern for the Philippines seems to accord well with 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 concretely uncover their potential asymmetric mean reversions.

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

Notes: the prefix "D" denotes first difference. JSE = Jakarta Stock Exchange composite index; KLCI = Kuala Lumpur composite index; PSE = Philippines Stock Exchange composite index; STI = Singapore Straight Times index; SET = Stock Exchange of Thailand composite index; and VSE = Ho Chi Min VSE price index. The source of these data is *Datastream*.

4. ESTIMATION RESULTS

This section discusses the estimation results of the four models examined, which are implemented using EVIEWS. 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. Take note that, for the Vietnamese market, we find no evidence of asymmetric volatility. Accordingly, the time-varying variance is modeled using the standard GARCH(1, 1). Moreover, the "in-mean" term is found to be significant on in the markets of Singapore and Vietnam. Estimation results for one-period negative return (Model 1) to four-period consecutive negative returns (Model 4) are given respectively in Table 3 to Table 6.

The coefficients of variance equations are statistically significant in all markets and all models. A common feature of the results is that the market volatilities of the ASEAN markets examined 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 standardized error in the variance equation is negative and significant at 1% significance level. This means that past negative shocks or bad news is 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 standardized error coefficient. The heightened market volatility of the Indonesian market following market downturns in magnitude substantially higher than any other markets seems to suggest possible overreaction of market agents in Indonesia to negative shocks.

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 in all models and in 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 is significant at better than 10% significance level following three and four consecutive negative returns. This result conforms well to the noted relatively high volatility pattern in the Indonesian market. This means that, in Indonesia, a technical trading strategy based on buying the losers during market downturns, or the contrarian strategy, can be profitable.

Table 3:

Estimation Results - One Period

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
(a) Mean Equation						
μ	0.0000	0.0001	0.0000	-0.0042	0.0000	0.0043**
β_1	0.1055***	0.0995***	0.0717***	-0.0147	0.0010	0.2166***
β_2	-0.1053**	-0.0149	0.0025	-0.0385	-0.0011	0.0165
λ	---	---	---	-0.0005*	---	0.0004**
(b) Variance Equation						
θ_0	-1.3613***	-0.3991***	-0.8931***	-0.2366***	-0.6304***	0.0000***
θ_1	0.8607***	0.9733***	0.9155***	0.9872***	0.9430***	0.7699***
θ_2	0.2429***	0.1923***	0.2195***	0.1609***	0.1947***	0.2686***
θ_3	-0.1549***	-0.0585***	-0.0710***	-0.0659***	-0.0594***	---
v	1.0016***	1.1306***	1.0662***	1.3282***	1.0753***	1.2812***
(c) Model Statistics						
LL	7524.82	8942.53	7693.55	7794.60	7574.31	7705.07
F-Stat	3.2886***	7.6251***	4.4064***	0.0000	0.0000	21.892***

Notes: the model estimated Model (1). *LL* = Log Likelihood and *F-Stat* = F statistics for the model's overall significance. ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: author's estimation using EVIEWS.

Table 4:

Estimation Results - Two Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
(a) Mean Equation						
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**
(b) Variance Equation						
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***
(c) Model Statistics						
LL	7518.77	8939.72	7691.59	7991.47	7572.48	7701.92
F-Stat	2.8565***	8.1279***	4.4711***	0.0000	0.3930	22.153***

Notes: the model estimated Model (2). *LL* = Log Likelihood and *F-Stat* = F statistics for the model's overall significance. ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: author's estimation using EVIEWS.

The Vietnamese market is 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, the market tends to exhibit most persistence among the market considered. The serial correlation coefficient is found to be higher than 0.2 in all models estimated, which is more than double to the ones estimated for other markets. Moreover, we do find asymmetric mean reversion in the Vietnamese stock returns following four consecutive negative returns with the pattern to be opposite to the one observed for Indonesia. Namely, following market downturns over 4 consecutive days, the Vietnamese market tends to exhibit more persistence having serial correlation of 0.36 during downturns as opposed to 0.20 during upturns. This finding is interesting since it counters the widely-noted finding of faster adjustment of stock markets during the downturns in other studies on developed markets. In short, what is observed for the developed markets or even other emerging markets as in our study 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 (see Zhang an d Li (2008, 961)).

Table 5:

Estimation Results - Three Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
(a) Mean Equation						
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***
(b) Variance Equation						
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***
(c) Model Statistics						
LL	7516.23	8937.18	7690.17	7988.60	7570.07	7699.37
F-Stat	7.1837***	8.5150***	4.3692***	0.0000	0.1352	21.721***

Notes: the model estimated Model (3). *LL* = Log Likelihood and *F-Stat* = F statistics for the model's overall significance. ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: author's estimation using EVIEWS.

The markets of Malaysia and the Philippines exhibit no asymmetric mean reversion except for one case for the Philippines. Given low serial correlation in their returns, the aggregate stock prices of Malaysia and the Philippines tend to adjust fast 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, only in these two markets, stock prices tend to exhibit a clear random walk behavior and adjust completely to their intrinsic values.

The results we obtain are intriguing when viewed in lights 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, which begs for explanation. We believe that stages of stock market development and degree of volatility may account for the results. Among the markets examined, the Vietnamese stock exchange is the recent upcoming market but still lags behind other markets in region. Interestingly, the behavior 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 the 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, accordingly, the finding of complete mean-reverting behavior comes at no surprise. We admit that this explanation is at best tentative and 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 different dynamic patterns of stock market returns in these countries.

Table 6:

Estimation Results - Four Periods

	DJSE	DKLCI	DPSE	DSTI	DSET	DVSE
(a) Mean Equation						
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***
(b) Variance Equation						
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***
(c) Model Statistics						
LL	7513.24	8932.53	7685.40	7984.27	7567.39	7698.89
F-Stat	0.3896	7.7610***	4.3351***	0.0000	0.0000	20.807***

Notes: the model estimated Model (4). *LL* = Log Likelihood and *F-Stat* = F statistics for the model's overall significance. ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: author's estimation using EVIEWS.

5. CONCLUSION

With the interest in dynamic patterns of stock returns in ASEAN markets, this paper empirically analyzes the presence asymmetric mean reversion and asymmetric volatility of six ASEAN markets – Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Among these markets, the Singapore 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 Singapore markets are at the other 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 characterize stock return dynamics. In general, the adjustment process of their market returns is fast but with evidence of quite distinct dynamic behavior of these markets and over August 2000 to May 2010.

The Indonesian markets stand out as the only market that exhibits overreaction during market downturns while the Vietnamese market demonstrates most persistence in its return behavior with the degree of persistence to be higher 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 do. We tentatively attribute the differences across these markets to the stages of market development and the degree of volatility. However, to be concrete as to the reasons underlying these differences, further research is needed.

REFERENCES

Bollerslev, T., (1986), "Generalized Autoregressive Conditional Heteroskedasticity," *Journal of Econometrics*, 31, 307-327.

DeBondt, W.F.M., and Thaler, R. H., (1985), "Does the Stock Market Overreact?' *Journal of Finance*, 40, 793-805.

DeBondt, W.F.M., and Thaler, R. H., (1987), "Further Evidence on Investor Overreaction and Stock Market Seasonality," *Journal of Finance*, 42, 557-581.

De Santis, G., and Imrohoroglu, S., (1997), "Stock Returns and Volatility in Emerging Financial Markets," *Journal of International Money and Finance*, 16, 561-579.

Engle, R. F., (1982), "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of UK Inflation," *Econometrica*, 50, 987-1008.

Koutmos, G., (1999), "Asymmetries in the Conditional Mean and the Conditional Variance: Evidence from Nine Stock Markets," *Journal of Economics and Business*, 50, 277-290.

Koutmos, G., (1999), "Asymmetric Index Stock Returns: Evidence from the G-7," *Applied Economic Letters*, 6, 817-820.

Kulp-Tag, S., (2007), "Short-Horizon Asymmetric Mean Reversion and Overreactions: Evidence From the Nordic Stock Markets," *Meddelanden Working Paper*, no. 524.

LeBaron, B., (1992), "Some Relations between Volatility and Serial Correlations in Stock Market Returns," *The Journal of Business*, 199-219.

Lee, C. F., Chen, G. M., and Rui, O., (2001), "Stock Returns and Volatility in China's Stock Markets," *Journal of Financial Research*, 24, 523-543.

Liau, Y.-S., and Yang, J.J.W., (2008), "The Mean/Volatility Asymmetry in Asian Stock Markets," *Applied Financial Economics*, 18, 411-419.

Nam, K., (2001), "Stock Overreaction and Contrarian Profits: Findings from Asymmetric Reversal Intrinsic in Time Series," Paper presented at the 2001 FMA Annual Meeting in Toronto, Canada, October.

Nam, K., (2003), "The Asymmetric Reverting Property of Stock Returns," *Studies in Nonlinear Dynamics and Econometrics*, 6(4), Article 2.

Nam, K., Pyun, C.S., and Arize, A., (2002), "Asymmetric Mean-Reversion and Contrarian Profits: ANST-GARCH Approach," *Journal of Empirical Finance*, 9, 563-588.

Nam, K., Pyun, C. S., and Avard, S., (2001), "Asymmetric Reverting Behavior of Short-Horizon Stock Returns: An Evidence of Stock Market Overreaction," *Journal of Banking and Finance,* 25, 807-824.

Nam, K., Washer, K. M., and Chu, Q. C., (2005), "Asymmetric Return Dynamics and Technical Trading Strategies," *Journal of Banking and Finance*, 29, 391-418.

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

Sichel, D. E., (1993), "Business Cycle Asymmetry: A Deeper Look," *Economic Inquiry*, XXXI, 224-236.

Zhang, B., and Li. X., (2008), "The Asymmetric Behavior of Stock Returns and Volatilities: Evidence from Chinese Stock Market," *Applied Economics Letters*, 15, 959-962.

ASIMETRIJA U PONAŠANJU KRETANJA PROSJEČNIH VRIJEDNOSTI ZARADA BURZE ASEAN-a

SAŽETAK

Ovaj rad obrađuje ponašanje kretanja prosječnih vrijednosti šest tržišta ASEAN-a – indonezijskog, malezijskog, filipinskog, singapurskog, tajlandskog i vijetnamskog – koristeći eksponencijalni autoregresijski GARCH-M model i dnevne podatke od kolovoza 2000. do svibnja 2010. Rezultati ukazuju na veliku brzinu povratka na prosječne vrijednosti u zaradama ovih tržišta no s jasno vidljivim uzorkom dinamike zarade. Postoje čvrsti dokazi koji ukazuju na asimetrično kretanje prosječnih vrijednosti i pretjerane reakcije za vrijeme pada tržišta na indonezijskom tržištu. Vijetnamsko tržište pokazuje najustrajniju autokorelaciju zarade s nekim dokazima koji upućuju na veću ustrajnost za vrijeme pada tržišta. Ipak, ne postoje dokazi koji bi upućivali na značajniju serijsku korelaciju na tržištima Singapura i Tajlanda. Na kraju, efekt poluge je zabilježen na svim tržištima osim vijetnamskog. Privremeno te razlike pripisujemo fazama razvoja tržišta i, u skladu s njihovim razinama efikasnosti, stupnju volatilnosti tržišta.

Ključne riječi*: asimetrija, lretanje prosječnih vrijednosti, volatilnost, AR-EGARCH(1,1), tržišta ASEAN-a*

JEL klasifikacija*: G10, G12*