Egarch Model

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The EGARCH Model to Evaluate the Impact of New Information Regime on the Indonesia Stock Exchanges

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Abstract

The efficiency of the emerging markets assumes greater importance as the trend of investments is accelerating in these markets as a result of regulatory reforms and removal of other barriers for international equity investments. This study provides empirical evidence on the impact of new information regime on the efficiency of the Indonesia Stock Exchanges by using the weak-form efficiency test. This study uses data from the returns series of the Composite Index and selected individual companies before regulation changes from 1991 to 1995 and after regulation changes from 1996 to 2010. This paper employs the BDS test under EGARCH, which is widely used to distinguish random independent and identically distributed error terms.

The findings indicate that in general and exceptions the null hypothesis of independent and identically distributed (iid) error term is not rejected and insignificant at the 5% level on the composite index and individual companies before and after regulation changes and more prominent after the imposition of the new regime. The results suggest that it is difficult to reject the random walk hypotheses for most of the return series after the regulatory reform. This result confirms that the market is weak-form efficient, except for daily and weekly returns before regulation changes and except for daily return after regulation changes. The results also implied that the new information regime have impacted on the Indonesia Stock Exchange by making it becoming more efficient.

Keywords: Weak-form EMH, the Indonesia Stock Exchanges, the BDS Test under EGARCH Model and Information regime.
JEL: Classification: G10, G14, and G18.

1. Introduction

Stock market efficiency is an important concept, for understanding the working of the capital markets particularly in emerging stock market such as Indonesia. The efficiency of the emerging markets assumes greater importance as the trend of investments is accelerating in these markets as a result of regulatory reforms and removal of other barriers for the international equity investments. There is enough evidence concerning the validity of the weak-form efficient market hypothesis (EMH) with respect to developed and emerging stock markets of the world. The weak-form of the EMH postulates that successive one-period stock returns are independent and identically distributed (*iid*). This paper attempts to investigate the impact of new information regime on the Indonesia stock exchanges by using the BDS under EGARCH weak-form efficiency test.

This paper used two different models of the BDS under EGARCH tests as proposed by Brock et al. (1987) and Nelson (1991).

This rest of the paper is organized as follows. Section 2 overviews the efficiency evidence on the Indonesia market while section 3 describes the data collection procedure and methodology. Section 4 discusses the findings and section 5 concludes the paper.

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2. Review of Literature

Relatively few evidences were available evaluating the efficiency of the Jakarta Stock Exchange, Suad (1987) and Rusity (1990) found that the market is fairly efficient in the weak sense. However, Suad (1990), Balsius (1993) and Agus (1995) found that the sufficient conditions for weak form of efficincy were not satisfied.

Further, Suad (1990) also investigates the semi strong form efficiency using earning, additional issue, and new issues announcements. The general findings indicate that the market is not efficient in semi-strong form. Further studies by Rusiti (1990), Muhammad (1993), Agus (1995), Mutamimah (1995), Untung, and Sidharta (1998) substantiated the findings of Fuad (1990). Endang (2000) found that the share price response to bond announcements procedure an average excess return significantly different from zero while Eka (2000) found that the average abnormal return is significantly positive at pre-announcement date of merger and acquisitions.

In summary all evidence leads to the conclusion that the Indonesian stock market is generally inefficient.

3. Methodology and Data

The data originates from official publications of the Jakarta Stock Exchange.

3.1 The Data set

The data sets used in this paper consistent daily, weekly, and monthly closing prices of Composite Index and individual companies before regulation changes from 1991 to 1995 and after regulation changes from 1996 to 2010. The data for JSX Composite Index were extracted from the computer service of Daily Dairy and Companies' Annual Reports provide relevant data set for selected individual companies. The data set were divided into four categories. They are; (a) the Composite Index before regulation changes from 1991 to 1995, (b) the Composite Index after regulation changes from 1996 to 2010, (c) selected individual companies before regulation changes from 1991 to 1995 and (d) selected individual companies after regulation changes from 1996 to 2010. The individual company shares were more or less continuously listed in the JSX during the sample period. Companies are selected by based on the following criteria; (i) each companies must have 70% of traded prices recorded at the time of study, (ii) the companies are Indonesian domiciled, (iii) the annual reports were publicly available, (iv) the companies have been listed for at least 5 years, (vi) delisted, suspended and recently listed companies are excluded. 50 companies fulfil these criteria.

3.2. Methodology

3.2.1 The BDS Test under EGARCH

The standard GARCH models assume that positive and negative error terms have a symmetric effect on the volatility. In the other words, good and bad news have the same effect on the volatility in this model. In practice this assumption is frequently violated, in particular by stock returns, in that the volatility increases more after bad news than after good news. This so called

Leverage Effect appears firstly in Black (1976), who noted that: "a drop in the value of the firm will cause a negative return on its stock, and will usually increase the leverage of the stock. That there are rise in the debt-equity ratio will surely mean a rise in the volatility of the stock".

There has been growing evidence in the finance literature that financial asset returns exhibit nonlinearity, time-varying heteroscedasticity, volatility cluster and non-normality. To account for these conditions, an exponential generalized autoregressive conditional heteroscedasticity in a mean (EGARCH-M) model as suggested by Nelson (1991) and tested the hypothesis of non linear independence in the standardized residuals using Brock, Dechart and Scheinkman (BDS) statistic proposed by Brock et al. (1987). The EGARCH-M model would capture the asymmetric impact of shocks on the volatility of stock returns and the BDS statistic applied on the standardized residuals would provide a formal test of *iid* (independently and identically distributed) assumptions. The EGARCH-M model to be fitted on the return series would be of the form:

$$\Delta \log P_t = \beta_0 + \sum_{i=1}^{n} \beta_i \Delta \log p_{t-i} + \gamma \sigma_t + \varepsilon_t, \qquad (1)$$

$$\varepsilon_t | \Omega | \sim (0, \sigma^2),$$

$$\log(\sigma^2) = \delta_0 + \delta_1 \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \delta_2 \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \Psi \sigma_{t-1}^2 \qquad (2)$$

Equation (1) is the mean equation, which expresses stock return as a stable finite order autoregressive process augmented with a conditional standard deviation term. Equation (2) is the specification of the EGARCH model, which accounts for the asymmetric impact of shocks on the volatility of stock returns. The asymmetric impact is tested by hypothesizing that $\delta_2 \neq 0$, and the leverage effect is tested by the hypothesis that $\delta_2 < 0$.

4. The Findings

4.1 Descriptive Statistics

Table 1 (Panel A) presents the descriptive statistics for the Composite Index before regulation changes. The composite index has mean returns of 0.03% per share for daily, 0.14% per share for weekly, and of 0.51% for monthly. The values of standard deviation are 0.0183 for daily, 0.0445 for weekly and 0.0990 for

monthly returns. Table 1 (Panel B) shows the descriptive statistics for the composite index after regulation changes. The composite index has a mean return of 0.04% per share for daily, 0.19% per share for weekly, and of 0.103% for monthly. The values of standard deviation are 0.0090 for daily, 0.0279 for weekly and 0.0714 for monthly returns.

Panel C of Table 1 shows the daily stock returns on in companies which have mean values ranging from (0.35%) to 0% per share for daily, from (1.66)% to 0.15% per share for weekly, and from (0.728) % to 0.12% per share for monthly. The standard deviations range from 0.0199 to 0.0986 for daily, from 0.0481 to 0.2150 for weekly and from 0.1053 to 0.4492 for monthly returns. Table 1 (Panel D) shows the

mean of individual companies before regulation changes which range from (0.15) % to 0.09 % per share for daily, from (0.70) % to 0.41% per share for weekly, and from (3.06) % to 1.77% per share for monthly. The standard deviations range from 0.0141to 0.0979 for daily, 0.0318 to 0.1896 for weekly, and from 0.0708 to 0.3701for monthly.

Table 1: The Results of Descriptive Statistics

Panel A: the Composite Index before Regulation Changes			
	Daily	Weekly	Monthly
Mean	0.0003	0.0014	0.0051
Median	0.0004	0.0016	0.0063
Maximum	0.1318	0.1880	0.2502
Minimum	-0.1273	-0.1785	-0.3786
Std. Dev.	0.0183	0.0445	0.0990
Panel B: the Composite Index after Regulation Changes			
	Daily	Weekly	Monthly
Mean	0.0004	0.0019	0.0103
Median	0.0001	0.0016	0.0059
Maximum	0.0765	0.0994	0.1569
Minimum	-0.0598	-0.1474	-0.1888
Std. Dev.	0.0090	0.0279	0.0714
Panel C: the Individual Companies before Regulation Changes			
	Daily	Weekly	Monthly
Mean	-0.0035 to 0	-0.0166 to 0.0015	-0.0728 to 0.0012
Median	0 to 0	0 to 0	-0.0366 to0.0209
Maximum	0 to 1.6094	0 to 1.6094	0.0000 to 1.6094
Minimum	-1.8192 to -0.2549	-1.8192 to -0.2336	-1.8192 to -0.3151
Std. Dev.	0.0199 to 0.0986	0.0481 to 0.2150	0.1053 to 0.4492
Panel: D the Individual Companies after Regulation Changes			
	Daily	Weekly	Monthly
Mean	-0.0015 to 0.0009	-0.0070 to 0.0041	-0.0306 to 0.0177
Median	0 to 0	0 to 0	0 to 0
Maximum	0.2151 to 2.9957	0.2513 to 2.8622	0.3054 to 2.8258
Minimum	-2.4365 to -0.2412	-2.4617 to -0.2007	-2.4849 to -0.2877
Std. Dev.	0.0141to 0.0979	0.0318 to 0.1896	0.0708 to 0.3701

It implies that monthly return is much higher the weekly and daily return, however risk of monthly return also much higher that daily and weekly consistent with higher risk and higher return concept

4.2. The results of the Unit Root Test

Stationary test is one of the important prerequisites for evaluating time series data. In this study, the Augmented Dickey Fuller (ADF) and Philip-Peron (PP) tests are employed. Table 2 (Panel A, B, C, D and E) presents the results which indicate that, the null hypothesis of unit root theory can be rejected for the Composite Index and individual companies before and after regulation changes.

Table 2 shows that the ADF and PP test statistics are significant at the 1% level for level form and first different that the data is stationary.

Table 2: The Results of Unit Root Test

Panel A: the Composite Index before Regulation Changes		
	ADF Test	P-P Test
	First Difference	First Difference
	t-Statistic	Adj. t-Stat
Daily	-17.4622***	-24.6469***
Weekly	-8.1384***	-13.0923***
Monthly	-6.4105***	-6.4121***
Panel B: the Composite Index after Regulation Changes		
	t-Statistic	Adj. t-Stat
Daily	-38.9751***	-38.9713***
Weekly	-22.4198***	-22.5256***
Monthly	-8.2041***	-8.9385***
Panel C: the Individual Companies before Regulation Changes		
	t-Statistic	Adj. t-Stat
Daily	-40.7259 to -10.8283***	-42.2596 to -29.4082***
Weekly	-18.6024 to -5.2396***	-25.6747 to -12.3282***
Monthly	-9.6540 to -3.6574***	-10.7477 to -3.9995***
Panel: D the Individual Companies after Regulation Changes		
	t-Statistic	Adj. t-Stat
Daily	-60.7486 to -29.8746***	-61.0292 to -42.7570***
Weekly	-25.5835 to -11.4480***	-25.2437 to -19.2903***
Monthly	-14.5155 to -7.6777***	-31.7881 to -7.7980***7

The *t*-statistics based on Augmented Dickey-Fuller (ADF) and Philips-Peron (PP) regression with allowance
for level and intercept respectively. *** implies the significance at 1% level.

4.3 Weak-Form Efficiency Test results

The weak form efficiency test result is based upon the BDS test under Exponential Generalized Autoregressive Conditional Hetoroscedasticity (EGARCH). This section is divided in two sections; the first section examines the volatility of the Composite Index before regulation changes from 1991 to 1995 and after regulation changes from 1996 to 2010. The second section examines the individual companies before regulation changes from 1991 to 1995 and after regulation changes from 1996 to 2010 respectively.

4.3.1. The Brock, Dechart and Scheinkman (BDS) Test Results under Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH)

The Brock, Dechart and Scheinkman (BDS) test results under Exponential Generalized Autoregressive Conditional Hetoroscedasticity (EGARCH) model are divided in two sections. The first section examines independently and identically distributed (*iid*) of the returns on Composite Index before and after regulation changes. The second section tests the individual companies before and after regulation changes for all return series.

(i) The Results on Composite Index before and after Regulation Changes

The BDS tests under EGARCH results on Composite Index before and after regulation changes are reported in Table 8.

Table 3: The Results of Parameter Estimation EGARCH Model on Composite Index before and after Regulation Changes

Panel A Before Regulation Changes (from 1991 to 1995)								
Times	Const	Variance equation				Adj R^2	S.E	DW
		C	δ_1	δ_2	Ψ			
Daily	0.00	-5.60 ***	0.60***	0.03	0.46	-0.01	0.01	1.33
Z Statistics	(-1.62)	(-11.03)	(13.77)	(1.00)	(8.95)			
Weekly	0.00	-6.76	-0.03	0.03	0.05	-0.02	0.03	1.66
Z Statistics	(0.82)	(-0.37)	(-0.14)	(0.31)	0.02			
Monthly	0.01	-1.32	0.11	0.05	0.78***	-0.09	0.07	1.51
Z Statistics	(1.50)	(-0.72)	(0.34)	(0.29)	(2.43)			
Panel B After Regulation Changes (from 1996 to 2010)								
Times	Const	Variance equation				Adj R^2	S.E	DW
		C	δ_1	δ_2	Ψ			
Daily	0.001**	-0.42***	0.25***	-0.04***	0.97***	-0.002	0.02	1.63
Z Statistics	(2.15)	-12.39	(18.52)	(-6.53)	(278.03)			
Weekly	0.003***	-0.32***	0.19***	-0.07***	0.97***	-0.01	0.04	2.07
Z Statistics	2.30	-5.00	5.25	-3.58	117.50			
Monthly	0.005	-0.66	0.03	-0.15	0.86***	-0.04	0.10	1.73
Z Statistics	0.51	-1.31	0.21	-1.24	9.99			

** Denotes significance at the 5% level and *** denotes significance at the 1% level.

Table 3 (Panel A) shows the BDS test results under EGARCH on Composite Index before regulation changes. The constant terms and the values of the arch parameters (δ_1) are insignificant at the 1% level for all series returns, except for daily returns. This indicates the presence of conditional heteroscedasticity for daily returns. The asymmetry coefficient (δ_2) is insignificant at the 1% level for all series returns. The garch parameter (Ψ) is positive and insignificant at the 1% level for all series returns, except for monthly returns. The sizes of the garch parameter (Ψ) are 0.46 for daily, 0.05 for weekly and 0.78 for monthly. Table 3 (Panel B) presents the BDS test results under EGARCH on Composite Index after regulation changes.

Table 4: The BDS Test Results under EGARCH on Composite Index before and after Regulation Changes

Panel A Before Regulation Changes (from 1991 to 1995)						
Companies	□□□	Z Statistics Dimension				
		2	4	6	8	10
Daily	1.5	5.97*	6.39*	6.52*	7.74*	8.91*
	1.0	6.50*	7.32*	8.17*	9.98*	11.85*
	0.75	6.49*	7.40*	8.73*	11.35*	13.35*
	0.5	6.25*	7.30*	8.54*	10.93*	10.23*
Weekly	1.5	0.22	1.03	1.56	1.85	2.53*
	1.0	1.14	2.12*	2.45*	2.34*	3.14*
	0.75	1.81	3.35*	3.88*	3.08*	3.21*
	0.5	2.67*	4.02*	4.12*	3.07*	1.97*
Monthly	1.5	-0.40	0.58	0.71	0.22	-0.73
	1.0	-1.86	-0.27	-0.18	1.42	-0.84
	0.75	-0.50	0.66	-1.70	-1.20	-0.78
	0.5	-2.20*	2.34*	-2.43*	-1.02	-0.65
Panel B After Regulation Changes (from 1996 to 2010)						
Companies	□□□	Z Statistics Dimension				
		2	4	6	8	10
Daily	1.5	5.75*	5.18*	4.17*	3.18*	2.61*
	1.0	5.06*	4.55*	3.42*	2.36*	1.88
	0.75	4.48*	3.92*	2.77*	1.83	1.22
	0.5	3.98*	3.33*	2.29*	2.80*	2.58*
Weekly	1.5	1.63	1.29	1.19	0.81	0.52
	1.0	0.98	0.78	0.71	0.42	-0.46
	0.75	0.68	0.53	0.53	-0.46	-1.35
	0.5	0.63	0.65	1.42	-1.33	-2.82*
Monthly	1.5	0.02	-0.23	0.38	1.01	0.97
	1.0	0.20	-0.20	-0.37	0.06	0.40
	0.75	0.54	-0.22	0.11	1.74	1.42
	0.5	-0.64	-1.16	-0.59	-1.79	-1.15

* Significance at the 5% level

The constant terms, the values of the arch parameters (δ_1) and the asymmetry coefficient (δ_2) are significant at the 1% level for all series returns, except for monthly returns. This indicates the presence of conditional heteroscedasticity for daily and weekly returns. The garch parameter (Ψ) is positive and significant at the 1% level for all returns series. The sizes of the garch parameter (Ψ) are 0.97 for daily, 0.97 for weekly and 0.86 for monthly.

Then, the drawback residual of the equation is tested again by the BDS test to examine independently and identically distributed (*iid)* on Composite Index before and after regulation changes are shown in Table 4. Table 4 (Panel A) shows the BDS test results on Composite Index before regulation. The results show that the null hypotheses of independently and identically distributed changes (*iid*) and significant at the 5 % level are rejected for all the series except for monthly returns. This evidence indicates that these series do not follow the random walk hypothesis and the market is weak-form inefficient except for monthly returns.

Next, the BDS test results on Composite Index after regulation changes can be shown in Table 4 (Panel B). Table 4 (Panel B) shows that the null hypotheses of independently and identically distributed changes (*iid*) and insignificant at the 5 % level are not rejected for all the series except for daily returns. This result indicates that these series can follow the random walk hypothesis and the market is weak-form efficiency for all series except for daily returns. These results conclude that the Indonesia Stock Exchange is weak-form efficient on Composite Index before regulation changes for daily returns. However, that the Indonesia Stock Exchange is marginally weak-form efficient after regulation changes for weekly and monthly returns

(ii) The Results on individual Companies before and after Regulation Changes

The results relating to the BDS test under EGARCH model on individual companies before and after regulation changes. The most of the BDS test results on individual companies before regulation are rejected the null hypothesis. The results show that the null hypothesis of *iid* and significant at the 5% level are rejected for all return series except for monthly returns. The most of the BDS under EGARCH test results on individual companies after regulation changes show that the null hypothesis of *iid* and insignificant at the 5% level are not rejected for all return series except for daily returns. Table 5 shows the number of individual companies before and after regulation changes that the null hypothesis *iid* and insignificant at the 5% level are not rejected.

Table 5: The number of Companies which accepted the Null Hypothesis of *iid* for the BDS Test under EGARCH

Panel A: Individual Companies before Regulation Changes N=50		
Accepted H_0: RW	Quantity	%
Daily	11	22
Weekly	17	34
Monthly	36	72
Panel B: Individual Companies after Regulation Changes N = 50		
Accepted H_0: RW	Quantity	%
Daily	13	26
Weekly	29	58
Monthly	41	82

Table 5 (Panel A) shows the number of individual companies before regulation changes that the null hypothesis *iid* and insignificant at 5% level are accepted; there are 11 companies (22%) for daily returns, 17 companies (34%) for weekly returns and 36 companies (72%) for monthly returns. In Table 5 (Panel B) shows dual listed companies after regulation changes that the null hypothesis *iid* and results are insignificant at 5% level are accepted; there are 13 companies (26%) for daily returns, 29 companies (58%) for weekly returns and 41 companies (82%) for monthly returns respectively.

These results indicate that the majority of individual before regulation changes do not follow of the random walk and the market is weak-form inefficiency for all series except for those on monthly returns. However, these results indicate that the majority of individual companies after regulation changes follow the random walk hypotheses for all series except for daily returns and the market is the weak-form efficient. It's implies that the Jakarta stock exchange is weak-form efficient before regulation changes for monthly returns. However, that the Indonesia Stock Exchange is marginally weak-form efficient after regulation changes for weekly and monthly returns

5. Conclusions

This section presents the conclusions and implications of the study. The main objective of this study is to investigate the behaviour of stock prices in the Jakarta stock market before and after the imposition of the new information regime. These issues are analysed from the perspective of weak-form efficiency. This study covers four years period from 1991 to 1995 which involved the Composite Index and 50 selected individual companies before regulation changes and nine-year period from 1996 to 2010 for the Composite Index and individual companies after regulation changes for three different returns series namely daily, weekly and monthly returns.

The procedures are employed to test the weak-from efficient stock market for daily, weekly and monthly by using the BDS test under EGARCH,

The findings on the weak-form efficiency suggest that the BDS test results on the composite index and individual companies before regulation changes from 1991 to 1995 rejected the random walk hypothesis for all of the returns series, except for monthly returns and the market shows weak-from efficiency for monthly returns. However, the results of the BDS test under EGARCH on Composite Index and individual companies after regulation changes from 1996 to 2010 do not reject the random walk hypothesis except for daily returns. Based on an above of the conclusions for this study is that the Indonesian stock market is weak-form efficient after the imposition of the new information regime.

The findings of the study have a number of implications. For, the researchers, the study has shown that over an extended and comprehensive period of study and with a information regime that promotes transparency, in general, the behaviour of the Indonesian stock market more or less mimics the general behaviour of the developed securities markets. More deregulation and more disclosures might make the market prices reflect real values of companies listed on the Indonesian stock market.

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