ICOI Indonesia 2012

2012 International Conference of Organizational Innovation

ISBN 978-986-85682-6-6

2012 International Conference of Organizational Innovation

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International Conference of Organizational Innovation

International Association of Organizational Innovation, USA

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July 10-12 2012

Location

Airlangga University, Campus B, Jalan Airlangga No.4 Surabaya, 60286 Indonesia

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JULY 10 – 12, 2012

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Application Of Garch Model For Index Lq45 And Jii Period 2000 – 2011

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Abstract

Volatility is a measurement statistically in price variation of an instrument. Investor who conducts an investment in assets having high volatility will tend to deal with higher risk as compared with investor who conducts an investment in assets having low volatility.

The objective of this research is to model volatility of data instrumentt index LQ45 and JII from period 2000 to 2011. The result of stationarity test shows that data index LQ45 and JII is stationary, so it has been done a modeling by using ARIMA. The best ARIMA model for index LQ45 is ARIMA(1,0,12), while for index JII is ARIMA(1,0,0). But after doing heteroscedasticity test to the best ARIMA model, it has been detected that data still contain heteroscedasticity element. Hence, in determining the volatility, which is a risk indicator of a index, it will be obtained by using Autoregressive Conditional Heteroscedasticity/Generalized Autoregressive Conditional Heteroscedastic (ARCH/GARCH) approach. The criterion of a best model option is based on the values of AIC and SIC are smallest than several model available.

The final result shows that for index LQ45, a best model for modeling the volatility is by using GARCH(2.2) as follow: $\sigma_t^2 = 0.000003548 + 0.164427 * e_{t-1}^2 - 0.131824 * e_{t-2}^2 + 1.48759 * \sigma_{t-1}^2 - 0.53134 * \sigma_{t-2}^2$. While for index JII, a best model is by using GARCH(1.2) as follow: $\sigma_t^2 = 0.0000199 + 0.0141732 * e_{t-1}^2 + 0.452702 * \sigma_{t-1}^2 + 0.348864 * \sigma_{t-2}^2$. The value of volatility indexLQ45 is at 0.055849 and index JII is at 0.026165.

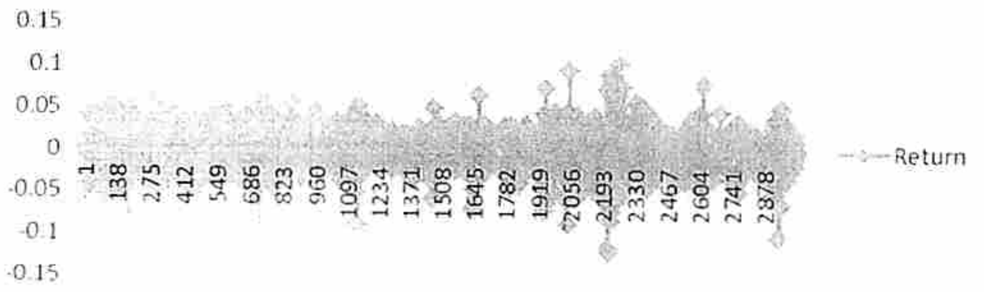
Keywords: Volatility, Index LQ44, Index JII , ARIMA, ARCH/GARCH, AIC, SIC.

RESEARCH BACKGROUND

Volatility is a statistical measurement of variation in the price from the an instrument. Investors who invest in assets that have a high volatility will likely face a higher risk than the investors who invest in assets that have low volatility.

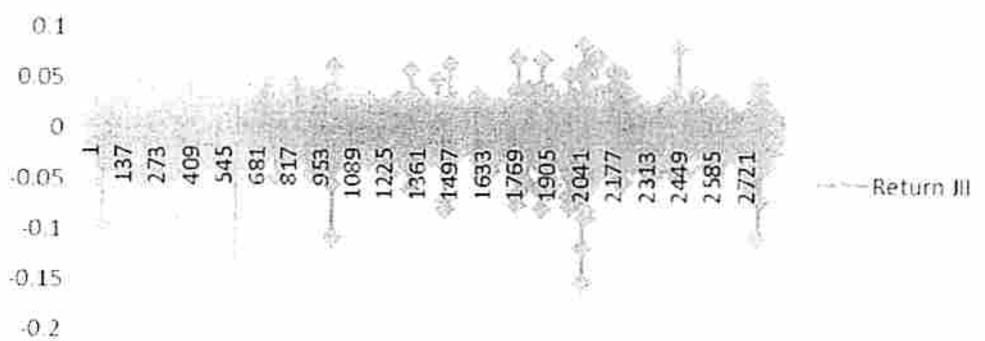
The purpose of this study is to model in advance the volatility of data instrument index LQ45 and JII period 2000 to 2011. The phenomenon of return data index LQ45 and JII period 2000 - 2011 was presented in the figures 1.1 and 1.2.

Figure 1.1
Return Index LQ45



Source: Indonesia Stock Exchange, processed (2012)

Figure 1.2
Return Index JII



Source: Indonesia Stock Exchange, processed (2012)

In the figures 1.1 and 1.2 it has been seen that the movement of return data index LQ45 and JII has a change movement that tend to be high. Once upon a time it may occur a sharp increase, and then it also occurs a sharp decrease. It can show that there is an high volatility in data index LQ45 and JII, furthermore in the determination of volatility, which is risk indicator of index, it will obtained by using *Autoregressive Conditional Heteroscedasticity/Generalized Autoregressive Conditional Heteroscedastic* (ARCH/GARCH)

Since the "discovery" in 1982, ARCH models have become a growth study with a wide range of variations on the original model. One that has become more famous is the generalized autoregressive conditional heteroscetasticity (GARCH), which was originally introduced by Bollerslev.

Autoregressive Integrated Moving Average (ARIMA)

GARCH method was applied through two processes: the process mean and process variance. Mean the process was first suggested by the Box-Jenkin (1976) by analyzing time series with a combination of autoregressive (AR) and moving average (MA). This method is then integrated into ARIMA to get a stationary time series.

Gujarati (2003) describe the Box-Jenkins methodology in four steps, namely identification, estimation, diagnostic checking, and forecasting. The general form autoregressive model of order p or AR (p) is

$Yt = \alpha 0 + \alpha 1\ Yt\text{-}1 + \alpha 2\ Yt\text{-}2 + \ldots + \alpha p\ Yt\text{-}p + \varepsilon t$ ....(1)

Yt : variables observed

$\alpha 0$: constants of autoregresif

$\alpha 1 \ldots \alpha p$: parameter of Yt-1 ... Yt-p

Common form of moving average model of order q, or MA (q) is :

$Yt = \beta 0 + \beta 1\ \varepsilon t + \beta 2\ \varepsilon t\text{-}1 + \ldots\ldots + \beta q\ \varepsilon t\text{-}q$.................................(2)

Yt : variables observed

$\beta 0$: constants of moving average

$\beta 1 \ldots \beta q$: parameter of $\varepsilon t \ldots \varepsilon t\text{-}q$

The general form ARIMA models with the autoregressive order p and moving average order q is the:
$Yt = \alpha 0 + \alpha 1\ Yt\text{-}1 + \alpha 2\ Yt\text{-}2 + \ldots + \alpha p\ Yt\text{-}p + \varepsilon t + Yt = \beta 0 + \beta 1\ \varepsilon t + \beta 2\ \varepsilon t\text{-}1 + \ldots\ldots + \beta q\ \varepsilon t\text{-}q$..(3)

Generalized Autoregressive Conditional Heteroscedastic (GARCH)

Bollerslev (1986) completed the result of work of Engle (1982) ARCH model by concluding AR process in heteroscedasticity of variants into Generalized Auto Regressive Conditional Heteroscedasticity GARCH (p, q) ; p is a family order of gARCH and q a family order of ARCH, described in the following equation:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i e_t^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-1}^2 \qquad \ldots (4)$$

with:

e_t^2 = residual at time point t
σ_t^2 = conditional variance in the time t
α_0 = constant
α_i = ARCH coefficient
β_t = GARCH coefficient
e_{t-i}^2 = residual at time point t-i (yesterday period)
σ_{t-i}^2 = conditional variance in the time t-i (yesterday period)

METHOD

DETERMINATION OF THE PERIOD

This study will be used daily LQ45 index information data with the 11-year period ranges from January 2000 until December 2011 and the daily index JII which since July 2000 until December 2011.

STATIONARITY TEST

Stasionarity test has been done to assure that data of return have been stationary. Stasionarity test of return data has been conducted by using ADF (Augmented Dickey-Fuler) test. In order to identify whether the return data have been stationary it can be carried out by comparing the value of ADF test with critical value. If the value of ADF test is smaller than critical value or has smaller probability than 5%, then the data have had no unit roots, in the other words it has been stationary. Conversely, if the value of ADF test is larger that critical value or has larger probability than 5%, then the return data still contain unit roots or in the other words the data are not yet stationary and it must be conducted a process of data differencing until the value of ADF test is smaller than its critical value.

HETEROSCEDASTICITY TEST

Heteroscedasticity test aims to determine whether the variance from the the data return is constant or time varying.

he first step is to estimate the equation moving average with the least square method. The second step is to test the White Heteroscedasticity test heteroscedasticity or ARCH-LM test. In the White ADF table number listed Heteroscedasticàty test F-Statistic and probability values. The hypothesis used is:

Ho : *volatility homoscedastic*
H_1 : *volatility heteroscedastic*

If the number is smaller than the probability of 5% then reject Ho at the α and it can be concluded that the data return is heteroskedastis. Meanwhile, if the probabilities are greater than 5%, then do not reject Ho and conclude that the data is homoskedastis.

If σ is homoskedastis, then the implied volatilities calculated using standard deviation, but if a heteroskedastis the implied volatilities are calculated by the method of ARCH / GARCH.

CALCULATION OF VOLATILITY

In calculating the volatility estimates for the LQ45 index and the index will be used JII GARCH models. But before, done with ARIMA modeling. Use of this ARIMA formula after the test stationarity, normality test and homoskedastisitas. If the nature of the data of return is heteroskedastis, not stationary and not normal, then do estimation using ARIMA method. Gujarati (2003) describe the ARIMA methodology in four steps, namely identification, estimation, diagnostic checking, and forecasting.

The first step is the identification of the ARIMA process. This step is done to know whether the observed data are stationary. If you do not stationary diferensi process until the data is stationary. Stationarity test is then performed using the Dickey-Fuller unit root test (Gujarati; 2003)

The second step is the estimation of parameters of autoregressive and moving average based on the order parameter (p and q) are obtained at the identification stage. The third step is to choose the appropriate ARIMA models. Good model is a model that has distributed residual random (white noise).

The fourth step is to do the forecasting value of the observed variables. The best forecasting model was tested again with heteroskedastis test to determine whether the data is still heteroskedastis. If the results show that the results are still heteroskedastis, we then propose a model of ARCH / GARCH.

Modeling of ARCH / GARCH done by estimating the mean equation process with ARCH method. ARCH and GARCH selected can be chosen from different orders of ARCH and GARCH orders and various types of ARCH / GARCH. From the calculation results table ARCH / GARCH variance equation obtained constants for the process and its Z-Statistic and probability, number Akaike Info Criterion (AIC) and Schwarz Criterion (SIC).

To the measurement of the volatility of ARCH / GARCH, there are several steps to choose a model that would be used. The first step to do is to test the significance of the ARCH coefficient or the coefficient of error (α) and GARCH coefficient or coefficient of variance (β). Coefficients were considered significant if the probability of the z-statistic is smaller than the probability of a critical value.

To determine the best GARCH, first performed modeling with ARCH (1), ARCH (2) to indicate the probability is not significant. GARCH modeling is then performed (1,1), GARCH (1,2) to GARCH order is reached indicating that the probability is not significant. Some models are then selected based on AIC and SIC numbers. Good model is a model that has a number of the smallest AIC and SIC. Volatility calculations performed to determine the extent of volatility index LQ45 and JII.

Implied volatilities can be obtained from the model equation ARCH / GARCH that has been obtained, where $\sigma t = \sqrt{ht}$.

RESULTS

STATIONARY TEST

The method used in this research is by seeing to do Augmented Dikey Fuller (ADF) test. Data have been said to be stationary if the statistic value of ADF > critical value of MacKinnon at α=1%, α=5% and α=10%. The result of data processing for stationary index LQ45 and JII tests can be seen in the tables 1 and 2.

Table 1. Output of ADF test Statistik *Return* Index LQ45

Null Hypothesis: RETURNLQ45 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-49.91328	0.0001
Test critical values:	1% level	-3.432338	
	5% level	-2.862304	
	10% level	-2.567221	

*MacKinnon (1996) one-sided p-values.
Source: processed (2012)

Table 2 Output of ADF test Statistik Return Index JII

Null Hypothesis: RETURNJII has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-49.82053	0.0001
Test critical values:	1% level	-3.432460	
	5% level	-2.862358	
	10% level	-2.567250	

MacKinnon (1996) one-sided p-values.

Source: processed (2012)

Based on the result of root test of unit ADF in tables 1 and 2 it has been known that in the level of return data index LQ45 it has been stationary. This has been proved by statistic value of ADF (49.91328) > critical value of MacKinnon 1%, 5%, and 10%, so that root test unit supports the conclusion that data can be modeled by ARIMA.

ESTIMATION OF ARIMA MODEL

The results of data processing with the correlogram for the LQ45 index and index JII contained in tables 3 and 4.

Table 3 Correlogram Index lq45 Period 2000 – 2011

Date: 04/14/12 Time: 23:53
Sample: 1 3004
Included observations: 3004

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|* |	|* |	1	0.093	0.093	26.196	0.000
| |	| |	2	0.010	0.001	26.482	0.000
| |	| |	3	-0.008	-0.009	26.686	0.000
| |	| |	4	-0.019	-0.017	27.734	0.000
| |	| |	5	-0.014	-0.011	28.340	0.000
| |	| |	6	-0.016	-0.014	29.139	0.000
| |	| |	7	-0.021	-0.018	30.445	0.000
| |	| |	8	-0.015	-0.012	31.118	0.000
| |	| |	9	-0.007	-0.005	31.273	0.000
| |	| |	10	-0.007	-0.006	31.407	0.001
| |	| |	11	0.016	0.016	32.182	0.001
| |	| |	12	0.050	0.046	39.635	0.000
| |	| |	13	0.020	0.010	40.873	0.000
| |	| |	14	0.041	0.038	46.001	0.000
| |	| |	15	0.017	-0.024	46.848	0.000
| |	| |	16	0.010	0.015	47.153	0.000
| |	| |	17	0.012	0.012	47.583	0.000
| |	| |	18	0.012	0.013	48.026	0.000
| |	| |	19	0.014	0.014	48.582	0.000
| |	| |	20	0.024	0.024	50.283	0.000
| |	| |	21	0.008	0.006	50.467	0.000
| |	| |	22	-0.031	-0.030	53.294	0.000
| |	| |	23	0.006	0.012	53.397	0.000
| |	| |	24	0.038	0.037	57.763	0.000
| |	| |	25	0.045	0.038	63.887	0.000
| |	| |	26	0.032	0.023	67.063	0.000
| |	| |	27	0.001	-0.002	67.065	0.000
| |	| |	28	0.008	0.008	67.240	0.000
| |	| |	29	-0.036	-0.036	71.283	0.000
| |	| |	30	-0.005	0.001	71.357	0.000
| |	| |	31	0.015	0.017	72.070	0.000
| |	| |	32	-0.033	-0.037	75.314	0.000

Source: processed (2012)

From Table 3, obtained the order AR (p) the maximum is obtained when the PAC through the dashed lines in lag 1, while the order of MA (p) the maximum is obtained when the AC through the dotted line at lag 1.

Tabel 4 Correlogram index JII Period 2000 – 2011

Date: 04/15/12 Time: 00:04
Sample: 1 2843
Included observations: 2843

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
| |	| |	1	0.067	0.067	12.914	0.000
| |	| |	2	-0.005	-0.009	12.981	0.002
| |	| |	3	-0.007	-0.006	13.136	0.004
| |	| |	4	-0.020	-0.019	14.245	0.007
| |	| |	5	-0.002	0.001	14.253	0.014
| |	| |	6	-0.007	-0.008	14.407	0.025
| |	| |	7	-0.023	-0.023	15.978	0.025
| |	| |	8	-0.001	0.001	15.982	0.043
| |	| |	9	-0.007	-0.008	16.130	0.064
| |	| |	10	-0.012	-0.012	16.551	0.085
| |	| |	11	0.011	0.012	16.920	0.110
| |	| |	12	0.071	0.069	31.282	0.002
| |	| |	13	0.019	0.009	32.307	0.002
| |	| |	14	0.059	0.058	42.365	0.000
| |	| |	15	-0.007	-0.013	42.486	0.000
| |	| |	16	0.020	0.025	43.617	0.000
| |	| |	17	0.017	0.015	44.454	0.000
| |	| |	18	0.001	0.002	44.455	0.000
| |	| |	19	0.009	0.012	44.682	0.001
| |	| |	20	0.009	0.010	44.893	0.001
| |	| |	21	-0.004	-0.001	44.944	0.002
| |	| |	22	-0.021	-0.019	46.238	0.002
| |	| |	23	0.011	0.015	46.566	0.003
| |	| |	24	0.039	0.035	50.981	0.001
| |	| |	25	0.030	0.022	53.501	0.001
| |	| |	26	0.026	0.016	55.493	0.001
| |	| |	27	0.001	0.000	55.498	0.001
| |	| |	28	0.014	0.010	56.073	0.001
| |	| |	29	-0.028	-0.031	58.384	0.001
| |	| |	30	-0.008	-0.005	58.567	0.001
| |	| |	31	0.000	-0.001	58.567	0.002
| |	| |	32	-0.032	-0.034	61.569	0.001
| |	| |	33	-0.014	-0.011	62.153	0.002
| |	| |	34	0.006	0.010	62.272	0.002
| |	| |	35	0.004	0.002	62.329	0.003
| |	| |	36	-0.001	-0.008	62.335	0.004

Source: Processed (2012)

From table 4, obtained the order AR (p) the maximum is obtained when the PAC through the dotted line at lag 14, lag12, and lag 1, while the order of MA (p) the maximum is obtained when the AC through the dotted line at lag 14, lag 12 and lag 1 in the correlogram table.

Having established the order of AR and MA that may be suitable, the next is to determine the estimated value of the parameters in ARIMA models. Tables 5 and 6 in a row is the best estimate of the LQ45 index and index JII.

Table 5 Estimation Results of Model LQ45 Index, ARIMA (1,0,0)

Dependent Variable: RETURNLQ45
Method: Least Squares
Date: 04/20/12 Time: 12:24
Sample (adjusted): 2 3004
Included observations: 3003 after adjustments
Convergence achieved after 3 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000667	0.000352	1.894215	0.0583
AR(1)	0.093369	0.018163	5.140561	0.0000

R-squared	0.008729	Mean dependent var	0.000666
Adjusted R-squared	0.008398	S.D. dependent var	0.017567
S.E. of regression	0.017493	Akaike info criterion	-5.253397
Sum squared resid	0.918293	Schwarz criterion	-5.249396
Log likelihood	7889.975	Hannan-Quinn criter.	-5.251957
F-statistic	26.42536	Durbin-Watson stat	1.998791
Prob(F-statistic)	0.000000		

Inverted AR Roots	.09

Source: Processed (2012)

Based on Table 5 shows that the parameter estimation of AR (1) statistically significant at α = 5%. AIC and SIC values is quite low compared to the estimated ARMA model of the other. F test also showed significant results at α = 1%.

Table 6 Estimation Results of Model Index JII, ARIMA

Dependent Variable: RETURNJII
Method: Least Squares
Date: 04/20/12 Time: 12:27
Sample (adjusted): 2 2843
Included observations: 2842 after adjustments
Convergence achieved after 6 iterations
MA Backcast: -10 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000510	0.000388	1.312307	0.1895
AR(1)	0.066140	0.018726	3.532071	0.0004
MA(12)	0.064814	0.018742	3.458156	0.0006

R-squared	0.008999	Mean dependent var	0.000509
Adjusted R-squared	0.008300	S.D. dependent var	0.018235
S.E. of regression	0.018159	Akaike info criterion	-5.178227
Sum squared resid	0.936176	Schwarz criterion	-5.171944
Log likelihood	7361.261	Hannan-Quinn criter.	-5.175961
F-statistic	12.88944	Durbin-Watson stat	1.998300
Prob(F-statistic)	0.000003		

Inverted AR Roots	.07			
Inverted MA Roots	.77-.21i	.77+.21i	.56-.56i	.56-.56i
	.21+.77i	.21-.77i	-.21+.77i	-.21-.77i
	-.56+.56i	-.56+.56i	-.77-.21i	-.77+.21i

Source : Processed (2012)

Based on Table 6 shows that the parameter estimation of AR (1) and MA (12) is statistically significant at $\alpha = 5\%$. AIC and SIC values is quite low compared to the estimated ARMA model of the other. F test also showed significant results at $\alpha = 1\%$.

HETEROSCEDASTICITY TEST

Heteroscedasticity test has an objective to identify whether error variance (residual variants) is constant (homoscedastic) or inconstant/variable (heteroscedastic). Heteroskedasticity test results on ARIMA models and JII LQ45 index can be seen in table 7 and table 8.

Table 7 *Output White Heteroskedasticity return* index LQ45

Heteroskedasticity Test: White

F-statistic	30.79835	Prob. F(4,2999)	0.0000
Obs*R-squared	118.5298	Prob. Chi-Square(4)	0.0000
Scaled explained SS	449.1674	Prob. Chi-Square(4)	0.0000

Source : Processed (2012)

Table 8 *Output White Heteroskedasticity return* index JII

Heteroskedasticity Test: White

F-statistic	2.526061	Prob. F(9,2819)	0.0070
Obs*R-squared	22.63267	Prob. Chi-Square(9)	0.0071
Scaled explained SS	101.4792	Prob. Chi-Square(9)	0.0000

Source: Processed (2012)

Based on Table 7 and Table 8 above, it can be seen that the probability of F-statistics (LQ45 and JII) is equal to 0.000000, where the probability is less than 5% (0.000000 <5%), so it can be concluded that the data is heteroskedastis. This shows that the calculation of volatility is by using GARCH models.

MEASUREMENT OF VOLATILITY MODEL WITH GARCH

MODEL ESTIMATION WITH ARCH/GARCH

Output of the result of estimation GARCH for index LQ45 and JII are in the tables 9 and 10.

Table 9 The Estimation Results Index LQ45, GARCH

MODEL	P=1	P=2	P=3	q=1	q=2	q=3	AIC	SIC
GARCH(1.0)	0.263810						-5.326636	-5.318634
GARCH(2.0)	0.239133	0.165705					-5.377902	-5.367900
GARCH(3.0)	0.171668	0.141609	0.189574				-5.407665	-5.395662
GARCH(1.1)	0.133061			0.815540			-5.451030	-5.441028
GARCH(1.2)	0.161931			0.518274	0.258863		-5.451019	-5.439017
GARCH(1.3)	0.157792			0.508555	0.333743	-0.060179	-5.450463	-5.436459
GARCH(2.1)	0.158636	-0.037649		0.833750			-5.450893	-5.438891
GARCH(2.2)	0.164428	-0.131824		1.487593	-0.531341		-5.451303	-5.437300
GARCH(3.1)	0.158914	-0.036751	-0.002477	0.835693			-5.450231	-5.436228
GARCH(3.2)	0.155040	0.058521	-0.003967	0.154279	0.555924		-5.449938	-5.433934
GARCH(3.3)	0.140758	0.097185	0.115947	-0.082345	0.019620	0.577623	-5.449567	-5.431563

Source : processed (2012)

In the table 9 it shows that best GARCH model for estimation of index lq45 is GARCH(2.2), because it has smallest AIC and SIC values as compared with other estimation models, where its estimation models are:

$$\sigma_t^2 = 0.000003548 + 0.164427 * e_{t-1}^2 - 0.131824 * e_{t-2}^2 + 1.48759 * \sigma_{t-1}^2 - 0.53134 * \sigma_{t-2}^2 \quad .... \ 11$$

Table 10 The Estimation Results Index JII, GARCH

MODEL	P=1	P=2	P=3	q=1	q=2	q=3	AIC	SIC
GARCH(1.0)	0.303408						-5.245619	-5.235147
GARCH(2.0)	0.255941	0.103694					-5.275120	-5.262554
GARCH(3.0)	0.196923	0.092058	0.127928				-5.290505	-5.275844
GARCH(1.1)	0.108013			0.848640			-5.340778	-5.328211
GARCH(1.2)	0.141732			0.452702	0.348864		-5.341594	-5.326933
GARCH(1.3)	0.141226			0.454028	0.353122	-0.004899	-5.340890	-5.324135
GARCH(2.1)	0.149086	-0.054393		0.867794			-5.341453	-5.326792
GARCH(2.2)	0.141439	0.001165		0.445210	0.355131		-5.340890	-5.324135
GARCH(2.3)	0.154513	-0.107842		1.147174	-0.041427	-0.170736	-5.340494	-5.321645
GARCH(3.1)	0.148523	-0.056180	0.003838	0.865620			-5.340762	-5.324007
GARCH(3.2)	0.144094	0.080933	-0.038446	-0.091682	0.825931		-5.341408	-5.322559
GARCH(3.3)	0.117404	0.118114	0.092580	-0.433676	0.164643	0.813863	-5.345288	-5.324344

Source : Processed (2012)

In the table 10 it shows that best GARCH model for estimation index JII is GARCH(1.2), because it has smallest AIC and SIC values as compared with model estimation yang lain, where its estimation models are:

$$\sigma_t^2 = 0.0000199 + 0.0141732 * e_{t-1}^2 + 0.452702 * \sigma_{t-1}^2 + 0.348864 * \sigma_{t-2}^2 \quad .... \ 12$$

ARCH-LM TEST FOR ARCH/GARCH MODEL

After obtaining the best model GARCH (pq), then the next step is to do the ARCH-LM test to evaluate the estimation results if the model still contains elements of heteroscedasticity or not. ARCH-LM test results JII LQ45 and shown in tables 11 and 12.

Table 11 ARCH-LM test for index LQ45 GARCH Model

Heteroskedasticity Test: ARCH

F-statistic	0.275682	Prob. F(1,3000)	0.5996
Obs*R-squared	0.275840	Prob. Chi-Square(1)	0.5994

Source : Processed (2012)

Table 12 ARCH-LM test for index JII GARCH MODEL

Heteroskedasticity Test: ARCH

F-statistic	0.020807	Prob. F(1,2839)	0.8853
Obs*R-squared	0.020822	Prob. Chi-Square(1)	0.8853

Source : Processed (2012)

Based on the ARCH-LM test contained in tables 4.12 and 4.13 shows that the estimated GARCH models are free from heteroscedasticity, as evidenced by the significance of> 5%.

MEASUREMENT VOLATILITY FOR INDEX LQ45 and JII

By using equations 11 and 12, the obtained value and the volatility for the index JII indexLQ45 contained in Table 13.

Table 13 Volatility of LQ45 and JII

Index	Volatility (σ)
LQ45	0.055849
JII	0.026165

Source : Procedeed(2012)

From Table 13 above shows that the risk of LQ45 index is greater than the index due to the volatility index JII larger LQ45 index JII.

CONCLUTION

Based on the result of research it has been found that the result of stasionarity test indicating in data index LQ45 and JII, data are stationary, so it has been carried out a modeling by using ARIMA. The best ARIMA model for index LQ45 is ARIMA(1,0,12), while for index JII is ARIMA(1,0,0). But after doing diagnosis the existence of heteroscedasticity to The best ARIMA model, it has been detected that data still contain heteroscedasticity element. So in the determination of volatility, which is risk indicator of an index, it will obtained by using Autoregressive Conditional Heteroscedasticity/ Generalized Autoregressive Conditional Heteroscedastic (ARCH/GARCH) approach. The criterion of selection for the best model based on the values of AIC and SIC smallest than several model available.

The result of modeling shows that for index LQ45, the best model to model the volatility is by using GARCH(2.2) as follow: $\sigma_t^2 = 0.000003548 + 0.164427 * e_{t-1}^2 - 0.131824 * e_{t-2}^2 + 1.48759 * \sigma_{t-1}^2 - 0.53134 * \sigma_{t-2}^2$. while for index JII, the best model is by using GARCH(1.2) as follow:$\sigma_t^2 = 0.0000199 + 0.0141732 * e_{t-1}^2 + 0.452702 * \sigma_{t-1}^2 + 0.348864 * \sigma_{t-2}^2$. The value of volatility indexLQ45 is at 0.055849 and index JII is at 0.026165.

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