3.4.1.3 ARCH / GARCH Model Estimation

Dalam model GARCH, nilai parameternya diestimasi dengan cara yang sama dalam mengestimasi model regresi. Estimasi model GARCH dilakukan dengan merujuk Tahap 7, dan hasil estimasi diberikan dalam Tabel 5.

Table 5. Estimation of the GARCH Model

GARCH Model	AIC Value	SIC Value
GARCH (1,1)	-6.673605	-6.643510
GARCH (1,2)	-6.671646	-6.636535

Based on the results of Table 5, the above estimation can be concluded that the best model used to model stocks in the first group is GARCH (2.1) because it has the smallest AIC and SIC values.

3.4.1.4 Partial and Total Verification Test

After selecting the best model, then the chosen model needs to be t-stat tested to determine the significance of each independent variable in influencing the related variable. Partial and total tests are carried out by referring to Stage 8 using Eviews 8 software, and the results are given in Table 6. After partial testing, the α_0, α_1 constants influence the related variable ($\sigma_t{}^2$) but the α_2, β_1 constant is not affect the related variable ($\sigma_t{}^2$).

Next, to find out whether or not there is a serial correlation in the model, a re-test of the presence of the ARCH effect in residuals is performed using the ARCH-LM test.

Table 6. Tes ARCH-LM model GARCH (1,1)

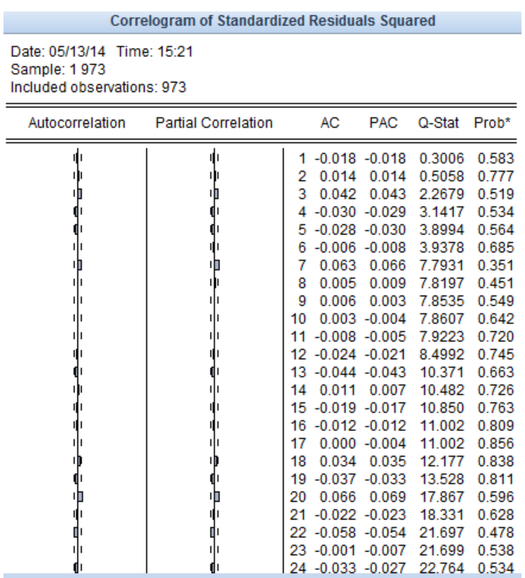
Heteroskedasticity Test: ARCH

F-statistic		Prob. F(1,970)	0.5847
Obs*R-squared	0.299402	Prob. Chi-Square(1)	0.5843

Based on Table 6, the probability of Obs * R-squared is greater than the significance level of 0.05 (5%). So it can be concluded that there has been no ARCH effect in stock residuals in the first group.

3.4.1.5 GARCH Model Diagnostic Test

In the diagnostic test carried out by referring to Step 9, with the help of Eviews 8. The analysis will be used is to do the Ljung-Box $Q\ (m)$ statistical test and the ACF / PACF plot of the squared residual corelogram standardized in Figure 1, to see if there are any serial correlation or not in residuals.



Correlogram of Standardized Residuals Squared

Date: 05/13/14 Time: 15:21
Sample: 1 973
Included observations: 973

	AC	PAC	Q-Stat	Prob*
1	-0.018	-0.018	0.3006	0.583
2	0.014	0.014	0.5058	0.777
3	0.042	0.043	2.2679	0.519
4	-0.030	-0.029	3.1417	0.534
5	-0.028	-0.030	3.8994	0.564
6	-0.006	-0.008	3.9378	0.685
7	0.063	0.066	7.7931	0.351
8	0.005	0.009	7.8197	0.451
9	0.006	0.003	7.8535	0.549
10	0.003	-0.004	7.8607	0.642
11	-0.008	-0.005	7.9223	0.720
12	-0.024	-0.021	8.4992	0.745
13	-0.044	-0.043	10.371	0.663
14	0.011	0.007	10.482	0.726
15	-0.019	-0.017	10.850	0.763
16	-0.012	-0.012	11.002	0.809
17	0.000	-0.004	11.002	0.856
18	0.034	0.035	12.177	0.838
19	-0.037	-0.033	13.528	0.811
20	0.066	0.069	17.867	0.596
21	-0.022	-0.023	18.331	0.628
22	-0.058	-0.054	21.697	0.478
23	-0.001	-0.007	21.699	0.538
24	-0.033	-0.027	22.764	0.534

Figure 1. Standardized Residual Squared Corelogram

From Figure 1, the above shows that ACF and PACF are not significant, which is indicated by the probability value of the Ljung-Box Q (m) statistic that is greater than the confidence level of 0.05 (5%) so that it can be concluded that the residuals of the model are white noise and there is no serial correlation in residuals. In addition, white noise testing is also performed using the GARCH model residual data normality test. Normality testing is carried out with the help of Eviews 8 software, and the results are given as Figure 2.

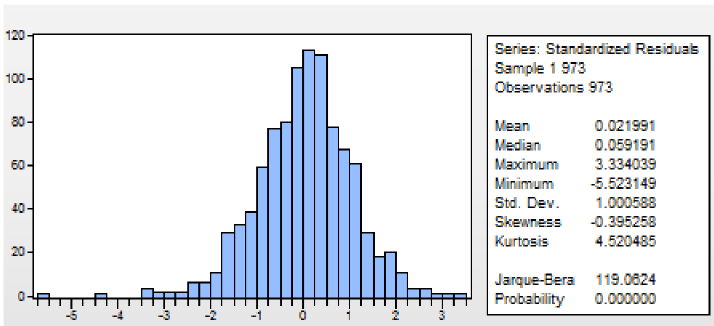


Figure 2. GARCH Model Residual Histogram (2,1)

In Figure 2, the histogram shows that the residuals are normally distributed. This is shown by: (a) the graph that follows the bell curve, and (b) the statistical value of Jarque-Bera which has a very large probability.

So, from the diagnostic test it can be concluded that the GARCH model (2.1) is white noise and normally distributed. So that the GARCH (2.1) model is good enough to be used in the modeling of stock data in the first group, with the GARCH (2.1) equation as follows:

$X_t = 0{,}005578 p_{1t} + 0{,}371095\, p_{2t} + 0{,}020058\, p_{3t} + e_t.$

$\sigma_t^2 = 0{,}00000421 + 0{,}096757 e_{t-1}^2 + 0{,}013481 e_{t-1}^2 + 0{,}839765 \sigma_{t-1}^2.$

3.4.2 Model Regresi Kelompok Kedua

Based on causality testing where large companies do not have a simultaneous relationship with the Jakarta CSPI stock movements. The results of the regression model output for the variables affected by the Jakarta Composite Index can be seen in Table 7.

Table 7. Results of the Regression model output

Dependent Variable: X
Method: Least Squares
Date: 05/12/14 Time: 14:44
Sample: 1 973
Included observations: 973

Variable	Coefficient	Std. Error	t-Statistic	Prob.
P1	0.004009	0.001573	2.548110	0.0110
P2	0.435058	0.014452	30.10416	0.0000
P3	0.020427	0.007166	2.850658	0.0045

R-squared	0.493390	Mean dependent var	0.000521
Adjusted R-squared	0.492345	S.D. dependent var	0.012686
S.E. of regression	0.009039	Akaike info criterion	-6.571562
Sum squared resid	0.079244	Schwarz criterion	-6.556515
Log likelihood	3200.065	Hannan-Quinn criter.	-6.565836
Durbin-Watson stat	2.078638		

Based on the outputs in Table 7 above, the equation is obtained: $X_t = \beta_1 p_{4t} + \beta_2\, p_{5t}$. Then do the research with the same steps for all stages in the second group, the GARCH equation (1.1) is obtained as the best model for modeling stock data in the second group, with the GARCH model equation (1.1) as follows:

$X_t = 0{,}102165\, p_{4t} + 0{,}2843321\, p_{5t} + e_t.$

$\sigma_t^2 = 0{,}00000464 + 0{,}145702 e_{t-1}^2 + 0{,}817790 \sigma_{t-1}^2.$

3.5 VAR Modeling Results

As has been proven in the causality test that between variables p_6 and x have a two-way and simultaneous relationship, so the model used to describe the relationship between the two capital markets uses the VAR model. VAR modeling is carried out by referring to Stage 10, carried out with the help of Eviews 8 software, and the results are given in Table 8.

Table 8. Estimation of the VAR Model

Vector Autoregression Estimates
Date: 03/26/14 Time: 08:15
Sample (adjusted): 3 973
Included observations: 971 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	X	P6
X(-1)	0.031558	-0.148022
	(0.03206)	(0.07351)
	[0.98436]	[-2.01350]
X(-2)	0.041050	-0.124549
	(0.03212)	(0.07365)
	[1.27806]	[-1.69112]
P6(-1)	0.020673	-0.313519
	(0.01389)	(0.03184)
	[1.48881]	[-9.84680]
P6(-2)	0.036679	-0.137784
	(0.01387)	(0.03180)
	[2.64514]	[-4.33324]
C	0.000424	0.001419
	(0.00041)	(0.00093)
	[1.04089]	[1.51946]

From Table 8, the above modeling can be carried out as follows:

$x = 0{,}000424 + 0{,}031558x_{t-1} + 0{,}041050x_{t-2} + 0{,}020673p_{6 \cdot t-1} + 0{,}036679p_{6 \cdot t-2}$

$p_6 = 0{,}001419 - 0{,}148022x_{t-1} - 0{,}124549x_{t-2} - 0{,}313519p_{6 \cdot t-1} - 0{,}137784p_{6 \cdot t-2}$

4. Conclusion

The equation model for the first group obtained the GARCH model (2.1), namely Jakarta's Jakarta Composite Index movement increased influenced by the movement of the company PT.Astra Graphia Tbk (ASGR) by 0.005578 points, the company PT. Bank Central Asia Tbk (BBCA) amounted to 0.371095 point, and PT. Citra Development Tbk (CTRA) of 0.020058 points. For the second equation model, the GARCH model (1.1) is obtained, namely Jakarta's JCI movement increased by PT. Jasa Marga Tbk (JSMR) by 0.102165 points, and PT. Telekomunikasi Indonesia Tbk (TLKM) of 0.2843321 point. While Jakarta CSPI and PT Unilever (UNVR) have a simultaneous relationship with the movement that is directly proportional, if Jakarta CSPI rises, PT. Unilever (UNVR) also experiences an increase and vice versa.

References

Fang, W.S. and Miller, S.M. (2002), "Currency depreciation and Korean stock market performance during the Asian financial crisis", University of Connecticut Department of Economics. Working Paper Series 2002-30.

Arif Billah Dar, Aasif Shah, Niyati Bhanja, Amaresh Samantaraya, (2014),"The relationship between stock prices and exchange rates in Asian markets: A wavelet based correlation and quantile regression approach", South Asian Journal of Global Business Research, Vol. 3 Iss 2 pp. 209-224 http:// dx.doi.org/10.1108/SAJGBR-07-2013-0061

Adjasi, C. K. D., Biekpe, N. B., & Osei, K. A. (2011). Stock prices and exchange rate dynamics in selected African countries: a bivariate analysis. African Journal of Economic and Management Studies, 2(2), 143–164. doi:10.1108/20400701111165623

Apergis, N. and Reizitis, A. (2001), “Asymmetric cross market volatility spillovers: evidence from daily data equity and foreign exchange markets”, Manchester School Supplement, Vol. 69, pp. 81-96.

Chiang, T.C., Yang, S.W. and Wang, T.S. (2000), “Stock returns and exchange rate risk: evidence from Asian stock markets based on a bivariate GARCH model”, International Journal of Business, Vol. 5 No. 2, pp. 97-117.

Yu Hsing, (2008),"The impacts of the stock price and country risk on the exchange rate in Singapore", International Journal of Development Issues, Vol. 7 Iss 1 pp. 56-61 http://dx.doi.org/10.1108/14468950810880026

Kearney, C. (1998), “The causes of volatility in a small internationally integrated stock market: Ireland, July 1975-June 1994”, Journal of Financial Research, Vol. 21 No. 1, pp. 85-104.

Kanas, A. (2000), “Volatility spillovers between stock returns and exchange rate changes”, Journal of Business Finance & Accounting, Vol. 27, pp. 448-68

Manish Kumar, (2013),"Returns and volatility spillover between stock prices and exchange rates: Empirical evidence from IBSA countries", International Journal of Emerging Markets, Vol. 8 Iss 2 pp. 108-128 http://dx.doi.org/10.1108/17468801311306984

Lin, C. H. 2012. “The Comovement between Exchange Rates and Stock Prices in the Asian Emerging Markets.” International Review of Economics and Finance 22: 161–172.

Nieh, C.C., and C.F. Lee. 2001. Dynamic relationship between stock prices and exchange rates for G7 countries. Quarterly Review of Economics and Finance 41: 477–90.

Zhao, H. (2010). Dynamic relationship between exchange rate and stock price: Evidence from China. Research in International Business and Finance, 24, 103–112. doi:10.1016/j.ribaf.2009.09.001.

Liu, L., & Wan, J. (2012). The relationships between shanghai stock market and cny/usd exchange rate: New evidence based on cross-correlation analysis. Structural Cointegration and Nonlinear Causality Test, Physica A, 391, 6051–6059. doi:10.1016/j.physa.2012.07.036.

Jiranyakul, K. (2012). Linkages between Thai stock and foreign exchange markets under the floating regime. Journal of Financial Economic Policy, 4, 305–319. doi:10.1108/17576381211279280.

Bhunia, A. (2012). A causal relationship between stock indices and exchange rates in India. Economics Bulletin, 31, 47–54.

Wei, William W.S. 2006. *Time Series Analysis Univariate and Multivariate Methods* (2nd ed.).Department of Statistics Temple University: Addison-Wesley Publishing Company

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