Analysis of Causality Relationship Between the Composite Stock Price Index (CSPI) Jakarta with Large Companies in Indonesia

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Abstract

The process of globalization lately, causes most countries pay great attention to the capital market, because it has an important and strategic role for a country's economic security. The existence of the global economic crisis has a significant impact on the condition of the Indonesian capital market. Capital market movements can be seen from the ups and downs of stock prices recorded in an index movement or better known as the Composite Stock Price Index (CSPI). This paper intends to examine the causality relationship between the Indonesian stock market and the Jakarta CSPI. The aim is to investigate the causality of the returns of large companies in Indonesia with the movement of CSPI stocks. The method used is granger causality test with Vector Autoregression (VAR) modeling and volatility modeling using GARCH model approach. Causality test results show that there is a direct relationship that affects and is influenced by the CSPI, and the relationship that affects each other between the company's stock market and the movement of the CSPI.

Keywords:
Capital Market, CSPI, Causality, VAR, GARCH.

1. Pendahuluan

The process of globalization lately, causes most countries pay great attention to the capital market because it has an important and strategic role for a country's economic security. The existing capital market in Indonesia is an emerging market which in its development is very vulnerable to macroeconomic conditions in general. The capital market is one of the drivers of the economy in a country, because the capital market is a means of forming capital and accumulation of long-term funds aimed at increasing public participation in the mobilization of funds to support national development financing. In addition, the capital market is also a representation to assess the condition of companies in a country, because almost all industries in a country are represented by the capital market. Capital markets that have increased (bullish) or decreased (bearish) can be seen from the ups and downs of stock prices recorded in an index movement or better known as the Composite Stock Price Index (CSPI). JCI is the value used to measure the combined performance of all shares (companies / issuers) listed on the Indonesia Stock Exchange (IDX). So that the CSPI and the company's stock price can be analyzed as a causal relationship.

Research on the relationship of causality in the capital market has been carried out by several researchers. Halsted (2019) conducted a research to see the causality of the composite stock price index and the exchange rate in Indonesia. The study uses secondary data obtained from the official websites of Bank Indonesia and the World

Bank. In this study using nominal exchange rates and a composite stock price index. Data analysis was performed using the granger causality model between the composite stock price index variable and the exchange rate. The results of the study showed that the composite stock price index caused the exchange rate and not vice versa. (Kearney, 1998; Kanas, 2000; Chiang et al., 2000; Apergis and Reizitis, 2001, Fang and Miller, 2002; Yu Hsing, 2008; Adjasi et al, 2011; Kumar, 2013; Billah et al., 2014) conducted research on the relationship between the exchange rate and the stock market performance in Korea during the Asian crisis and found a significant exchange rate depreciation on the stock market performance. Lin (2012) found that there is causality from the stock market and exchange rates in both countries (Philippines and Thailand). Nieh (2009) shows a long-term positive causal relationship from either the Japanese or American exchange rates to stock prices in Taiwan. Zhao (2010) analyzed the exchange rates and indices in China and the results of observations of the absence of causality, this is in line with research Liu and Wan (2012) found no causal relationship between the stock market and the exchange rate. Jiranyakul (2012) in his research in Taiwan found a causal relationship from the exchange rate to the stock market. In his research, Bhunia (2012) found a causal relationship from the exchange rate to the stock market in India.

Based on the description above, this paper intends to conduct research on Causality Relationship Between the Composite Stock Price Index (CSPI) Jakarta with Large Companies in Indonesia. The object of research in this study is the number of joint stock prices of several large companies in Indonesia. The aim is to measure the level of significance of the causality relationship between CSPI and shares of large companies in Indonesia.

2. Research Methodology

the object being analyzed

The data used in this study are secondary data taken from www.finance.yahoo.com. For closing prices of Astra Graphia (ASGR), Bank Central Asia (BBCA), Citra Development (CTRA), Jasa Marga (JSMR), Indonesian Telecommunications (TLKM), Unilever Indonesia (UNVR), and Jakarta Composite Stock Price Index (JKSE) . The data is daily data from January 4, 2015 to December 30, 2018.

The steps taken during the study are broken down as follows:

Stage 1: Data Transformation

For example X_t the closing value of the Jakarta Composite Stock Price Index at time t, for $t = 1,2,\dots,T$ with T the number of observations of the data. For example, also X_t return closing state CSPI at time t, the return value can be calculated by the equation:

$$X_t = In\left(\frac{X_t}{X_{t-1}}\right)$$

Stage 2: Stationary Data Test

Testing the time series data stationarity for the variable returns of large company stock prices and the return of the Composite Stock Price Index used in this study uses the Augmented Dickey Fuller test (ADF) with the help of Eviews 8. The hypothesis used is,

H_0: ADF_{test} >*MacKinnon Critical Value* (there is a unit root)

H_1: ADF_{test} <*MacKinnon Critical Value* (no root unit)

where the test criterion is reject H_0 if the t-statistic value of the ADF test is smaller than the p-value of each percentage level.persentase level.

Stage 3: Granger Causality Test

After the data is declared stationary, a granger causality test is carried out to see the causal relationship between the movement of the Jakarta Composite Stock Price Index and several share prices of large companies in Indonesia using Eviews 8 software. The hypotheses used are:

H_0 : P_{it}does not affectX_t

H_1: P_{it} affects X_t

With test statistics seen from the value of prob. against the F test, where the criteria for testing results reject H_0 if the test probability $F < \alpha = 5\%$.

When there is a directional relationship but it is not simultaneous then it is advanced to the next level, and when there is a directional and simultaneous relationship then it is advanced to the 11th level.

Stage 4: Grouping Data into Regression Models

Data were grouped from the results of the granger causality test for direct but not simultaneous relationships. Then proceed to the next stage.

Stage 5: Autocorrelation Test
To see the form of the relationship between the Jakarta Composite Index and the company an approach was made using a regression model to see the pattern of relationships with the Jakarta Composite Index movement. The hypothesis used is: (Wei, 2006).
H_0 : There is no serial correlation to the residuals
H_1 : There is the serial correlation of the residuals
With the test statistics seen from the Watson durbin value close to 2, where the criteria for testing results reject H_0 if the value DW ≤ 2

Stage 6: Heteroscedasticity Test
After autocorrelation testing, hetroskedastis testing is performed to analyze the variance of errors. The hypothesis used is (Wei, 2006).
H_0 : The homoscedasticity assumption of the error component is fulfilled
H_1 : error is heteroskedastic
With the test statistics seen from the probability value Obs * R-Squared (p-value), where the criteria for testing results reject H_0 if $p - value \leq 5\%$

Stage 7: Estimation of the ARCH / GARCH model
To solve the heteroscedastic problem, an estimate is made using the Autoregressive Conditional Heteroscedasticity (ARCH) model or Generaly Autoregressive Conditional Heteroscedasticity (GARCH). In the GARCH model, the parameter values are estimated in the same way in estimating the Regression model. In general, estimating a GARCH model cannot be done just once. A number of trials are needed in forming the GARCH model in such a way that a coefficient of parameters that meets the required and significant requirements is obtained.

Stage 8: Partial and Total Verification Test
After selecting the best variance model, just like the next model the variance model needs to be done t-stat test to determine the significance of each independent variable in influencing the dependent variable.

- Test constant α_0, with a hypothesis:
  $H_0 : \alpha_0 = 0$
  $H_1 : \alpha_0 \neq 0$
  Where the test statistics are $t_{rasio} = \frac{\alpha_0}{S.E\ \alpha_0}$ or prob value (t_{rasio}).
  Test criteria, reject H_0 if $t_{rasio} > t_\alpha$ or value prob(t_{rasio})< α.
- Coefficient Test α_i, with hypothesis:
  $H_0 : \alpha_i = 0$
  H_1 : Available $\alpha_i \neq 0$
  Where the test statistics are $t_{rasio} = \frac{\alpha_i}{S.E\ \alpha_i}$ or value prob(t_{rasio}).
  Test criteria, reject 〖H〗_0 if t_rasio>t_α or value prob(t_rasio)< α.

Stage 9: ARCH / GARCH Model Diagnostic Test
To define the GARCH model properly, residuals must be standardized as follows:

$$Z_t = \frac{\varepsilon_t}{\sigma_t}$$

If the model is suitable, then the series $\{\varepsilon_t\}$ does not contain the ARCH effect and the squared residuals of $\{\varepsilon_t\}$ are white noise, which means the squared residuals of $\{\varepsilon_t$ must be independent (uncorrelated) and normally distributed with an average approaching 0 ($\mu = 0$) and standard deviation σ. Meanwhile, to test whether the series $\{\varepsilon_t\}$ is white noise, it can be done by looking at the value of $Q(m)$ *Ljung-Box*.

Stage 10: VAR models
The Vector Autoregressive (VAR) model is the development of the autoregressive model (AR). If the AR of the current observation is influenced by previous observations of the data, then in the VAR mode the observation of the

time is influenced by previous observations of the data and other data. VAR models with ordep notated VAR (p) are expressed in the following equation (Wei, 2006: 394).

$$Z_t = \phi_1 Z_{t-1} + \cdots + \phi_p Z_{t-p} + a_t$$

3. Discussion result

3.1 Analyzed Data

Data transformation is performed to calculate the return value in each company stock referring to Phase 1, for example Jakarta CSPI data notated by variable x has a close price on January 4, 2015 is (IDR 2575.41) and on January 5, 2015 is IDR 2605.28 the results of the calculation are:

$$x_1 = \ln \frac{2605{,}28}{2575{,}41} = 0{,}011531$$

And so on to calculate the Jakarta returnIHSG until the last data and done in the same way for the variable p_1 is the ASGR stock price return, p_2 is the BCA stock price return, p_3 is the CTRA stock price return, p_4 is the stock price return JSMR, p_5 is TLKM stock price return,p_6 is UNVR stock price return.

3.2 Stationary Data Test Results

The return data that has been calculated in sub-section 3.1, then carried out the stationarity test by referring to Phase 2. The stationarity test aims to make sure that the data return has been stationary, as a prerequisite for time series data analysis. Stationary test results for the six company shares are given in Table 1.

Table 1. Stationary Test Results

Variables	Critical Value at the level:			ADF_{test} Value	Prob.	Conclusion 1%
	1%	5%	10%			
x	-3.967547	-3.414458	-3.129363	-18.53363	x	-3.967547
p_1	-3.967567	-3.414468	-3.129369	-20.55699	p_1	-3.967567
p_2	-3.967518	-3.414444	-3.129355	-35.11327	p_2	-3.967518
p_3	-3.967518	-3.414444	-3.129355	-31.58663	p_3	-3.967518
p_4	-3.967547	-3.414458	-3.129363	-18.83595	p_4	-3.967547
p_5	-3.967547	-3.414458	-3.129363	-19.37230	p_5	-3.967547
p_6	-3.967528	-3.414448	-3.129358	-28.46386	p_6	-3.967528

Based on Table 1, it can be seen that the results ADF_{test} <*MacKinnon Critical Value* for all observations of data return. So that all observations of the return data used are stationary at the level of significance at 1%, 5%, and 10%. To test the data, a significance level of 5% is chosen for each data test.

3.3 Granger Causality Test Results

After the data return of all companies has been declared stationary, with reference to Phase 3, the Granger causality test is then performed. This test is carried out with the aim to find out whether or not there is a causal relationship between the Composite Stock Price Index and shares of large companies in Indonesia. The results of Grenger's causality test are given in Table 2.

Table 2. Granger Causality Test Results

H_0	$F_{-Statistik}$	Prob.
x does not affect p_1	2.68344	0.0456
p_1 does not affect x	1.10896	0.3445
x does not affect p_2	7.63669	0.0005
p_2 does not affec x	0.35919	0.6983
x does not affect p_3	5.67384	0.0032
p_3 does not affect x	1.53225	0.2166
x does not affectp_4	1.38929	0.2446
p_4 does not affect x	2.65791	0.0472
x does not affect p_5	0.25045	0.8610

p_5 does not affect x	5.47552	0.0010
x does not affect p_6	3.57227	0.0285
p_6 does not affect x	3.81651	0.0223

Based on the results of Table 2, the above shows that the variables $p_1, p_{2,} p_3$ are influenced by the variable x, for the variable p_4, p_5 affects the variable x, whereas for the variable p_6 has a simultaneous direct relationship with the variable x.

3.4 Results of Grouping Data in Regression Models

From the results of granger causality testing, the variables $p_1, p_{2,} p_3$, eferring to Stage 4, he data return can be grouped into the first group and the variable p_4, p_5 can be grouped into the second group, both groups are modeled with a regression model.

3.4.1 The First Group Regression Model

Based on causality testing in which large companies do not have a simultaneous relationship with the movement of the Jakarta CSPI shares. The output of the regression model for the variables affected by the Jakarta CSPI can be seen in Table 3.

Table 3. Output results of the Regression model

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 results of the output in Table 3 above, the equation: $X_t = \beta_1 p_{1t} + \beta_2\, p_{2t} + \beta_3 p_{3t}$

3.4.1.1 Autocorrelation Test Results

Based on Table 3, the output of the regression model above, referring to Stage 5, obtained Durbin Watson value of 2.078638> 2 means that there is no autocorrelation in the first group regression model.

3.4.1.2 Heteroscedasticity Test Results

After autocorrelation testing, hetroskedastis testing is conducted by referring to Step 6. The purpose of the hetroskedastis test is to analyze the variance of errors. To see the heteroscedasticity test results of each company can be seen in Table 4.

Table 4. Comparison of Default Error Values

Method / Variable	OLS Method	HC Method
p_1	0.001573	0.000817
p_2	0.014452	0.023649
p_3	0.007166	0.009672

Based on the results presented in Table 4, the comparison of standard error values for each method is different, but the results of the coefficient test with the t statistic show all the regression coefficients are significant, it can be concluded that heteroscedasticity is not a serious problem for this regression.

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

Autocorrelation	Partial Correlation		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.

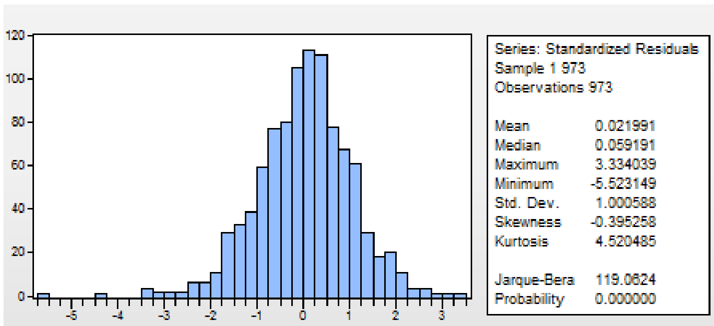

Figure 2. GARCH Model Residual Histogram (2,1)

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.

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