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Wuryandani: The Behavior and Determinants of Stock Market Index in Indonesia

The Behavior and Determinants of Stock Market Index in Indonesia

Gantiah Wuryandani*

This research proves that the movement of Stock Market Index (JSX) in Indonesia does not follow random walk. Therefore, certain variables in financial market influence the movement of JSX. VECM and ECM testings show that regional index in ASEAN countries and Hongkong as well as exchange rate significantly affect JSX movement. This indicates a strong contagious effect of the stock market in Asia on the Indonesian stock market, which joined the exchange rate effects concurrently. On the other hand, monetary policy through Bank Indonesia rate (BI rate) less strongly affects the movement of JSX, albeit significant. Implicitly, this indicates that monetary policy transmission path through the stock market is still weak. Given the limited authority to intervene other country's stock market, the policy implication of this study suggests the authorities to maintain exchange rate stability. This especially relates to policies for speculative capital flows. It is the time for the authorities to establish policies to improve the effectiveness and efficiency of financial markets as financial intermediation.

Keywords: *Stock market, ARIMA, ARCH/GARCH, VECM, ECM, monetary policy*

Introduction

Stock market is a sub-sector in financial system in Indonesia that has been growing rapidly. The capitalization of the stock market trading statistic that is as high as double of banking asset reflects this development. Nonetheless, the role of stock market in financing economic activity through the initial public offering (IPO) in the primary market is relatively limited, as indicated by low statistic of its share. The share of financing through the stock market reached approximately 20% in the total financing of the economy through the banking and capital markets. Ratio of IPO to capitalization achieved at only 25%. This statistics confirms that the acceleration of secondary market development is higher than the primary market development. Thus, intermediation in the stock market has not grown in line with the expectation to support economic growth.

Liberalization and globalization in international financial system has encouraged foreign investor to flock their

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asset to emerging countries, including the stock market in Indonesia. The share of foreign investor ownership in Indonesia's stock market reachs consistently as high as around 60% in the last two years. Highly developed information technology supports global financial system integration and makes international transaction become borderless and promptly. Consequently, information spread out vastly and this creates contagion effect amongst countries especially in the same region. Asian financial crisis in 1997 and global financial crisis in 2008 are the evidences of this circumstance. The contagious effect is likely to cause fluctuations in the stock market including the associated impact of exchange rate movements and capital flows.

Even though Indonesia has bank-based industry in financial system, the stock market development should be vigilantly supervised. The main reason behind this is as contagious effect usually occurs through the stock market and foreign exchange market. In sequence, the stock market and foreign exchange market volatilities might jeopardize financial and monetary stabilities. There are some studies of the nexus between monetary policy and stock market as well as the monetary transmission channel through the stock market in Indonesia. Previous studies provided evidence of non-existence of monetary transmission path through the stock market.

Prior studies raise the question of whether stock price in Indonesia follows random walk or has characteristic of heteroskedasticity. If the stock price index follows random walk, then no factor can affect its movement. Conversely, if the stock price index does not follow random walk, then some factors affect its movement. What factors do significantly influence the stock price index? Are those domestic or international factors? Does monetary policy have a strong influence on the development of stock market? This study aims to explore the behavior and determinants of stock price index.

The next section of this paper discusses previous studies related to this research. Section 3 explains methodology used to test the hyphotheses in the study. Empirical result of the study presented in section 4, using univariate and multivariate testings. Last section concludes the result of this study.

Literature Review

Random walk theory

The theory of random walk developed after Malkiel (1973) wrote a book about random walk on Wall Street stock market. The theory states that the movement and direction of historical stock price and the overall market condition could not predict the future market movement. The mathematician Bachelier (1900) declared that stock price follows random walk and is unpredictable. His study was originally put forward as random walk hypothesis. Kendall (1953) then developed the theory and stated that stock price fluctuation is independent and has equal probability distribution. The theory of random walk can be explained by the theory of Brownian motion, proposed by Browning (1827) in testing the physics. Eistein (1905) supported this theory as a movement that is random.

In addition to random walk theory, Fama (1960) developed efficient market hypothesis (EMH). In this hypothesis, it is impossible to obtain the maximum profit in stock market since stock price already reflects all information. Technical analyst who usually use chart opposed to this theory. Analysts said that historical price, notes, and other indicators determine stock price. Since stock price depends on investor's expectation, it is believed that historical prices affect future prices. There are three forms of efficient market hypothesis theory:

1) Weak form, when all historical prices or all information in the market fully reflects stock price; 2) Semi strong form, when available market and public information reveal stock price; 3) Strong form, when all information (market, public, and private) indicates stock price.

The nexus of monetary policy and stock market

Bordo et al. (2008) conducted a study of the relationship between inflation, monetary policy, and stock market conditions. Utilizing hybrid model in Qual VAR dynamic factor, this study shows that shock in inflation and interest rate have a negative impact on stock market condition. Minimizing volatility in the future inflation by monetary policy could diminish inflation risk premium and support stock market stabilization indirectly. Study by Christiano et al. (2006) by applying Ramsey optimization and price wage optimization indicates that monetary policy supports credit growth and then stock market movement optimally. Furthermore, Davig and Gerlach (2006) examined US stock market reaction upon the monetary policy announcement in the tranquil and turbulent circumstances. The Markov Switching model used proves that volatile stock market reacts in various ways at the time of the announcement of an unexpected monetary policy. In contrast, during tranquil condition, stock market reacts in a different way to the unexpected monetary policy and tends to uniform.

Applying GARCH and VAR, Baudus (2000) investigated monetary policy across countries and its relationship with the stock market. The result shows that there is a significant correlation between monetary policy and the stock market, especially in Japan, French, Germany, and United Kingdom. Furthermore, there is a link of monetary policy in one country to the stock market in other country. Blinder (1998) stated that monetary policy have an impact on macroeconomic for the reason that it moves prices in financial market such as long-term interest rates, stock values, and exchange rates. Similar to this result, Tarhan (1995) provided evidence that Federal Reserve policy affects asset price.

Ralph et al. (1999) argued that monetary transmission channel in stock market exists. Using corporate stock value and dividend, their simulation proved that stock market reacts significantly to the shock that occurred in the money supply. On the other hand, Zainuddin et al. (2002) insisted that monetary transmission through the stock market in Indonesia is weak and insignificant, either through the firm or household balance sheets channels. Mishkin (2001) confirmed that monetary policy by interest rate could affect the economy through asset prices. Therefore, the asset price movement is an important indicator that authorities should mull over in the monetary control. Similar to this result, study by Eichengreen and Tong (2003) using GARCH indicated that monetary quantities have an effect on the volatility in the stock market. This study designated that monetary policy is properly transmitted to stock market, hence monetary policy and its framework adopted has become a source of great shock for stock market.

Literature study by Cassola and Morana (2002) indicated there are four channels of monetary transmission through the stock market: 1) Effect on investment (Tobin's q); 2) Effect of Improved Firms's Balance Sheet to Investment; 3) Cash Flow Mechanism; and (4) Wealth Effect. In an efficient stock market, price movement contains information of economic condition. Many studies of stock market and monetary policy showed that there are differences of role and behavior of stock market in every country.

Stock market effect on monetary policy and economic condition

Study by Hayford and Malliaris (2002) explained that Federal Reserve considers S&P 500 index development in monetary policy decision. This study applied Taylor rule model, developed with the target of variable stock market price both on price earnings ratio and equity premium, besides inflation, and economic growth. Implementing the similar method, Chadha et al. (2003) did a study in some industrial countries. The study suggested that monetary authority in US, UK, and Japan exercise asset price and exchange rate in determining interest rate policy. Yet, research study by Filardo (2000) proved that highly attention of Federal Reserve on asset price has no improvement affect on economic stability.

Utilizing ordinary least square, Prastowo (2008) stated that there was no significant correlation between stock price by initial public offering and company's investment activities in Indonesia. Further research by Prastowo and Chawwa (2008) confirmed that development in the stock market activities has minimum effect on private consumption. Consequently, increases in the stock price have no impact on inflation. In addition, there is no monetary transmission through balance sheet channel in the stock market. Similar to this result, study in European stock market by Cassola et al. (2002) employing structural vector auto regression (SVAR) and vector error correction model (VECM) denoted that there is no direct impact of stock price on inflation.

Contagion effect in stock market

By means of VECM and stock market index in US and Europe in the period of 1999-2009, research by Anaraki (2009) verified that there was contagious effect of US stock market to the European stock market. US stock market movement influences monetary policy and exchange rate movement in the Europe as well. This result confirms that US stock market strongly affect global financial stability. Untoro and Widodo (2008) observed that regional stock movement, except Singapore and Hongkong, affect stock market development in Indonesia. This indicated the integration of regional stock market movement. Exchange rate volatility has also an effect on regional stock price movement and vice versa, even though within limited coefficient.

Methodology

Sample data used in this research is daily stock market index (JSX) for the period of 2006 – 2009, based on the availability of complete data. The selection of other variables based on financial and economic analysis of potential relationship with daily stock market index development. These variables are monetary policy rate (BIRATE), exchange rate (ER), overnight interest rate (ON), Rupiah inter-bank market volume (IB-RP), foreign exchange market volume (IB-FOREX), regional index composite of stock market in Asean and Hongkong (REGINDEX), gold price (GOLD), and oil price (OIL). The variables are in natural logarithmic form.

There are two hypotheses in this study, namely that stock market index movement does not follow random walk, and certain variables in financial market determine stock market index movement. Random walk test and univariate analysis of volatility in JSX utilize mean equation ARIMA (Autoregressive Integrated Moving Average) and ARCH/GARCH (Generalized Autoregressive Conditional Heteroskedasticity). The test of stock market index determinants is by implementing VECM (vector error correction model) and ECM (error correction model).

ARIMA (Autoregressive Integrated Moving Average)

Mean Equation ARIMA is built on the assumption that the stochastic data series has a structure related to long-term time trend, previous value (AR), and lag of disturbance value (MA). The representative equation of ARIMA (p,q) is the following:

$$y_t = \varphi_1 y_{t-1} + \ldots + \varphi_p y_{t-p} + \delta + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \ldots - \theta_q \varepsilon_{t-q} \quad (1)$$

GARCH (Generalized Autoregressive Conditional Heteroskedasticity)

Bollerslev and Taylor (1986) developed GARCH model, which is a further development of ARCH model introduced by Engle (1982). In general, there are two ways to find out whether there is ARCH/ GARCH effect from the mean equation model, namely:

1. Correlogram Squared Residuals
   Correlogram Squared Residuals presents the autocorrelation function (ACF) and partial auto correlation function (PACF) of the squared error as well as Ljung-Box Q statistic value until some specified lags. The ACF series of *Y* at lag *k* is defined as the following:

$$\tau_k = \frac{\sum_{t=k+1}^{T} (Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{T} (Y_t - \bar{Y})^2} \quad (2)$$

2. ARCH LM (Lagrange Multiplier) Test
   In addition to using Correlogram Squared Residuals to test ARCH/ GARCH effect, Engle also developed ARCH-LM test. The basic idea of this test is the error variance (σ_t^2) is not only the function of independent variable but also depends on previous residuals.

The formula of error variance is as the following:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \quad (3)$$

If the result of the mean equation test indicates there is an ARCH/GARCH effect or heteroskedasticity in the model, to overcome heteroskedasticity is examined by GARCH (1,1). Representation model of GARCH (1,1) is as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta y_{t-1} + \varepsilon_t \quad (4)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (5)$$

Equation (4) is an estimation of mean equation, and equation (5) is conditional variance of mean equation. ε_{t-1}^2 is ARCH and σ_{t-1}^2 is GARCH.

ECM (Error Correction Model)

Sargan (1964) developed Error Correction Model (ECM) in wages and price modeling. David Hendry and others improved the model by utilizing it in macroeconomic modeling. Granger theorem (Granger 1983; Engle and Granger 1987) stated that if some variables are non-stationary I(1) and are cointegrated then there exists an error correction representation. The general form of ECM model form is as the following:

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_{it} + \gamma (y_{t-1} - x_{i(t-1)}) + \varepsilon_t \quad (6)$$

y_t is an endogenous variable (JSX), x_i is exogenous variables of which are monetary policy rate (BIRATE), exchange rate (ER), overnight interest rate (ON), Rupiah inter-bank market volume (IB-RP), foreign exchange market volume (IB-FOREX), regional index composite of stock market in Asia (REGINDEX), gold price (GOLD), and oil price (OIL). γ is the speed of adjustment of long run equilibrium or error correction term and ε_t is error.

VECM (Vector Error Correction Model)

VECM is a restricted form of VAR (Vector Autoregression) since the data is non-stationary time series and the combination is cointegrated. VECM model utilizes the information of restricted cointegration into the specification. Therefore, VECM is often referred to as a design for non-stationary series that is cointegrated. The specification of VECM restricts long run behavior of endogenous variables to converge to their cointegrating relationship, yet allowing for short run adjustment dynamic. The cointegration term is known as an error correction term as the deviation from the long run equilibrium that is rectified gradually through a series of partial short run adjustment. The general form of VECM model is the following:

$$\Delta y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-1} + \alpha\beta' y_{t-1} + \varepsilon_t \quad (7)$$

y_t is a vector of jointly determined non-stationary I(1) endogenous variables of which are daily stock market index (JSX), monetary policy rate (BIRATE), exchange rate (ER), overnight interest rate (ON), Rupiah inter-bank market volume (IB-RP), Foreign exchange market volume (IB-FOREX), regional index composite of stock market in Asia (REGINDEX), gold price (GOLD), and oil price (OIL). α represents the speed of adjustment coefficient of endogenous variable towards the equilibrium, β represents the unique nature of the cointegration space, e is a vector of random variables distributed as empirical white noise.

Table 1. Unit root Augmented Dickey-Fuller

Variable		JSX
ADF (level)		-1.4778
ADF (1st Diff)		-28.0228
Crictical value		
	1%	-3.437
	5%	-2.864

Result and Discussion

Stock market index (JSX) movement

Augmented Dickey Fuller (ADF) test shows that the hypothesis of JSX has a unit root in level, cannot be rejected. On the other hand, the ADF test of JSX at the first difference indicates that the hypothesis of JSX on a first level difference has a unit root, can be rejected. This result reflects that JSX is stationary at the first difference I(1). However, the Q-statistic of the JSX correlogram is significant at all lags. It demonstrates that the JSX variable still has auto correlation and might still contain heteroskedasticity element. To detect the existence of heteroskedasticity in the univariate equation of JSX, then be tested through ARIMA with lag 1 when ACF (autocorrelation function) and PACF (partial autocorrelation function) intersect threshold.

The mean equation ARIMA (1,1,1) is insignificant, yet ARIMA (1,1,0) and ARIMA(0,1,1) are equally significant. Since both ARIMA (1,1,0) and ARIMA (0,1,1,) are almost equivalently significant, then ARIMA (1,1,0) which has higher adjusted R-squared is selected. To determine whether the error of JSX variable still contains heteroskedasticity, correlogram residuals squared and ARCH LM test are applied. As correlogram residual squared ARIMA and ARCH LM test (F-Statistic=0, Chi Square=0) are significant, this indicates that error of JSX still contains heteroskedasticity. Therefore, to overcome heteroskedasticity in the model is examined through GARCH

Table 2. Correlogram of D(JSX)

Lag	Q-Stat	Prob.
5	16.24	0.0060
10	25.351	0.0050
15	38.918	0.0010
20	42.002	0.0030

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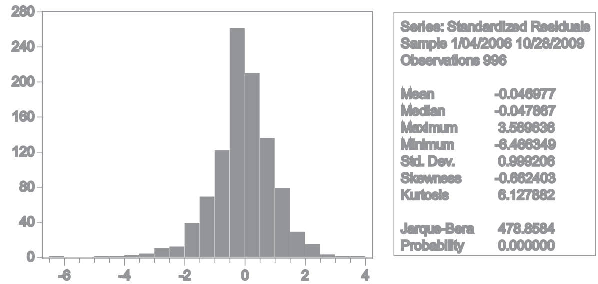
Table 3. Mean equation ARIMA

ARIMA	Parameter	Coefficient	p-value	Adj. R-squared	SSR	AIC	SIC
	C	1.1550	0.3300				
(1,1,1)	AR1	0.2520	0.3370	0.0113	1051770.0000	9.8061	9.8209
	MA1	-0.1390	0.6030				
(1,1,0)	C	1.1650	0.3180	0.0122	1051916.0000	9.8043	9.8141

Table 4. Correlogram residuals squared of ARIMA (1,1,0)

Lag	Q-Stat	Prob.
5	251.5	0.0000
10	268.57	0.0000
15	288.31	0.0000
20	298.76	0.0000

Figure 1. Jarque Bera test



(1,1) test with Maximum Likelihood that required the residuals of the model has a normal distribution. Jarque Bera test shows a significant probability distribution of residuals; which indicates that the JSX does not have normal distribution. To surmount this condition, testing by GARCH (1,1) with Quasi Maximum Likelihood (QML) without normal distribution requirement, is more appropriate.

GARCH (1,1) model exhibits that all variables in the mean equation and conditional variance equation are significant with non-negative sign on the coefficient in conditional variance equation. This model indicates that there is no more heteroskedasticity in JSX variance. Further testing through correlogram residual squared and ARCH LM test (F-Statistic=0,06; Chi Square=0,06) are insignificant within 5% on all lags. This result represents that there is no heteroskedasticity in the GARCH (1,1) model. The result confirms that daily JSX movement determined by its lags and its error variance has no heteroskedasticity. Consequently, JSX movement does not follow random walk; hence, the initial hypothesis of this study is acceptable.

Stock market index (JSX) determinants

To test the variables that influence JSX movement, the following multivariate models are applied. The result of ADF unit root test exhibits that not all variables are stationary in level. Therefore, to generate stationary estimation since the variables is cointegrated, VECM and ECM models are utilized in multivariate model of JSX.

ECM (Error Correction Model)

Given the variables used in this study are not stationary in level, then, cointegration among the variables that occur can also be estimated by ECM (Error Correction

Table 5. GARCH (1,1) model

Variable	Coefficient	z-statistics	Prob.
Mean equation			
C	0.0015	3.5875	0.0000
$D(JSX)_{t-1}$	0.0843	2.1086	0.0350
Variance Equation			
C	0.0000	1.5265	0.1270
ε^2_{t-1}	0.1114	2.9117	0.0040
σ^2_{t-1}	0.8722	17.9389	0.0000
Adj. *R*-squared	0.0115		
Sum-squared resid	0.2983		
Akaike info criterion	-5.5262		
Schwarz criterion	-5.5016		

Table 6. Correlogram Residuals Squared of GARCH (1,1)

Lag	Q-Stat	Prob.
1	1.6157	
5	4.0607	0.0000
10	9.6065	0.0000
15	12.893	0.0000
20	21.009	0.0000

Table 7. Unit root Augmented Dickey Fuller test

Variable	LNJSX	BIRATE	LNER	LNGOLD	LNOIL	ON	LNIB-RP	LNIB-FOREX	REGINDEX
ADF(level)	-1.61808	-1.35422	-1.4106	-1.39698	-1.45198	-9.90307	-6.60772	-6.30903	-1.50056
ADF(1st Diff.)	-27.1806	-3.90168	-33.989	-30.5992	-23.9377	-13.9865	-24.0968	-17.2159	-31.7313
Critical value									
1%:	-3.4367								
5%:	-2.86425								

Table 8. Contegration Regresion of JSX

Variable	Coefficient	t-statistic	Prob.
C	3.510	7.579	0.000
BIRATE	-0.053	-29.285	0.000
LNER	-0.499	-13.228	0.000
LNIB-RP	0.004	1.617	0.106
ON	-0.002	-4.035	0.000
LNIB-FOREX	0.000	0.052	0.959
LNREGINDEX	0.687	45.345	0.000
LNGOLD	0.263	15.436	0.000
LNOIL	0.078	8.386	0.000
R-squared	0.980		
Adjusted *R*-squared	0.980		
Durbin-Watson stat	0.151		

Model). ECM makes corrections to prevent or reduce errors that occur in the long run towards equilibrium.

Ordinary least square (OLS) in Table 8 shows that there is a long-term cointegration regression equation, in which almost all variables except foreign exchange market are significant to the JSX, at a quite high adjusted *R*-squared of 0.98. Nevertheless, the low Durbin Watson Statistics suggests the equation still contains positive auto correlation. To overcome the auto correlation in the equation, ECM is formed. In the long term, regional index (LNREGINDEX) and exchange rate (LNER) have high coefficients and strongly affect JSX movement. Gold (LNGOLD), oil (LNOIL), inter-bank RP (LNIB-RP), and monetary policy (BIRATE) significantly affect JSX movement in the limit of α 5-10%, at adjusted *R*-squared of 0.484.

Table 9. ECM of JSX

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000	0.000	0.612	0.541
Long Run				
D(BIRATE)	-0.013	0.007	-1.910	0.057
D(LNER)	-0.330	0.062	0.530	0.000
D(LNIB-RP)	-0.002	0.001	-1.673	0.095
D(ON)	0.000	0.000	0.444	0.657
D(LNIB-FOREX)	-0.001	0.001	-0.594	0.552
D(LNREGINDEX)	0.545	0.024	22.408	0.000
D(LNGOLD)	0.103	0.029	3.512	0.001
D(LNOIL)	0.051	0.024	2.164	0.031
Short run				
D(LNJSX(-1))	0.084	0.032	2.621	0.009
D(BIRATE(-1))	-0.006	0.007	-0.836	0.403
D(LNER(-1))	-0.146	0.063	-2.320	0.021
D(LNIB-RP(-1))	0.001	0.001	0.554	0.580
D(ON(-1))	0.000	0.000	0.497	0.619
D(LNPUVAL(-1))	-0.001	0.001	-1.290	0.197
D(LNREGINDEX(-1))	-0.013	0.030	-0.446	0.656
D(LNGOLD(-1))	0.016	0.029	0.541	0.589
D(LNOIL(-1))	-0.005	0.024	-0.193	0.847
ECM(-1)	-0.064	0.011	-5.760	0.000
R-squared	0.494			
Adjusted *R*-squared	0.484			
Durbin-Watson stat	2.030			

The ECM coefficient of -0.064 is significant which signify that approximately 6.4% of long-term imbalances in JSX growth is adjusted daily. This suggests that long-term equilibrium will transpire at period of day 16. In the short term, only JSX lag (LNJSX(-1)) and exchange rate lag (LNER(-1)) significantly affect JSX growth, in the limit of $\alpha = 5\%$. In addition, exchange rate and regional index have high coefficient which represent a highly influence to JSX growth movement. This equation contains no more auto correlation with Durbin Watson statistic around 2 and adjusted *R*-squared 0.49. The ECM testing accepts the initial hypothesis of this study that the movement of certain variables in the financial market determines JSX growth.

VECM (Vector Error Correction Model)

VECM model utilizes all eight variables consist of LNJSX, BIRATE, LNER, LNGOLD, LNOIL, ON, LNIB-RP, LNIB-FOREX, and LNREGINDEX. Based on criteria for lag selection, using Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ), the optimal lag for VECM is lag 1 for endogenous interval.

Johansen Cointegration Test of variables indicates five cointegration equations based on trace test, since the variables do not have normal distributions. Not all variables are stationary in level; therefore, there is a cointegration among variables. Thus, estimation model by VECM can generate stationary estimation and errors. VECM results in Appendix 1 with an error correction on the JSX of -0.071, indicates that approximately 7.1% long run imbalances in the movement of the JSX is adjusted daily. Accordingly, within a period of at least 14 days after the first lag, equilibrium will be achieved. In the long run, only oil price (LNOIL) with lag 1 determines JSX movement significantly. An increase of 1 % in oil price will increase JSX movement by 5.872%. On the other hand, in the short run only lags of JSX (LNJSX(-1)) that significantly determines the JSX movement. An increase of 1% in lags of JSX will increase JSX movement by 0.151%.

Variance decomposition of VECM reveals that lag of JSX dominates JSX

Table 10. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	134.019	NA	0.000	-0.272	-0.225	-0.254
1	12329.780	24126.110	0.000	-26.637	-26.164*	-26.456*
79	19598.790	105.627*	0.000	-28.706*	4.925	-15.872

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 11. Johansen cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.248071	712.4166	179.5098	0.0001
At most 1 *	0.157233	428.4432	143.6691	0.0000
At most 2 *	0.134878	258.0622	111.7805	0.0000
At most 3 *	0.041287	113.7571	83.93712	0.0001
At most 4 *	0.037015	71.76262	60.06141	0.0037
At most 5	0.024384	34.19585	40.17493	0.1755
At most 6	0.007339	9.608039	24.27596	0.8772
At most 7	0.002275	2.271935	12.3209	0.9276
At most 8	0.000004	0.003844	4.129906	0.9591

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis(1999)*p*-values

Table 12. Variance decomposition of JSX

Period	S.E.	LNJSX	BIRATE	LNER	NIB-R	ON	LNIB-FOREX	LNREGINDEX	LNGOLD	LNOIL
1	0.017	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.057	91.327	0.404	0.676	1.387	1.299	0.051	2.675	1.438	0.743
20	0.078	82.491	0.746	1.222	1.640	1.807	0.027	9.029	2.335	0.703
30	0.094	75.427	0.988	1.562	1.514	1.941	0.019	15.285	2.743	0.521

Table 13. Effect of Cholesky one S.D. BI rate innovation

Period	LNJSX	BIRATE	LNER	LNIB-RP	ON	LNIB-FOREX	LNREGINDEX	LNGOLD	LNOIL
1	-0.001	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	-0.003	0.055	-0.001	0.000	0.008	0.001	0.004	0.002	0.003
20	-0.003	0.054	-0.003	0.000	0.009	0.001	0.006	0.006	0.010
30	-0.002	0.054	-0.004	0.001	0.009	0.001	0.007	0.010	0.016

composition, yet its role is declining over time. GARCH (1,1) model supports this result, which indicates that JSX movement is determined by its lags. In addition, regional index (LNREGINDEX) considerably influences JSX composition and tends to increase up to 15.3% at period of day 30. This result proves that there is a significant contagion effect from regional stock market movements in Asia to Indonesia stock market. International investor has a tendency to assign similar risk premium of the stock market in the countries, which is located at adjacent in the same region such as ASEAN. On the other side, overnight (LNON) and exchange rate (LNER) are not strongly influence the composition of JSX, only at around 1.5-1.9% up to period of day 30. Furthermore, monetary policy (BIRATE) has only around 0.99% role in the formation of JSX composition.

Based on Cholesky effect of shock in monetary policy (BIRATE), the pass through effect of an increase in BIRATE by 1% would reduce JSX growth by an average of about -0.05%. On in the other

Table 14. Effect of Cholesky one S.D. ER innovation

Period	LNJSX	BIRATE	LNER	LNIB-RP	ON	LNIB-FOREX	LNREGINDEX	LNGOLD	LNOIL
1	-0.002	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000
10	-0.003	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000
20	-0.002	0.000	0.006	0.000	0.000	0.000	-0.001	0.000	0.000
30	-0.002	0.000	0.006	0.000	0.000	0.000	-0.001	0.000	0.000

Table 15. Effect of Cholesky one S.D REGINDEX innovation

Period	LNJSX	BIRATE	LNER	LNIB-RP	ON	LNIB-FOREX	LNREGINDEX	LNGOLD	LNOIL
1	0.012	0.001	-0.002	0.001	0.000	0.000	0.014	0.000	0.000
10	0.012	0.000	-0.002	0.002	-0.003	0.001	0.014	0.001	0.002
20	0.012	0.000	-0.002	0.002	-0.003	0.001	0.014	0.001	0.001
30	0.011	0.000	-0.002	0.002	-0.003	0.001	0.015	0.001	0.000

Figure 2. Response of JSX to Cholesky one S.D. BIRATE innovation

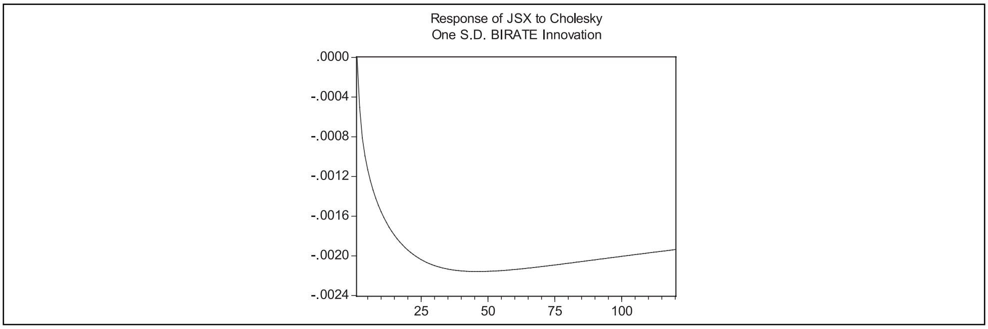
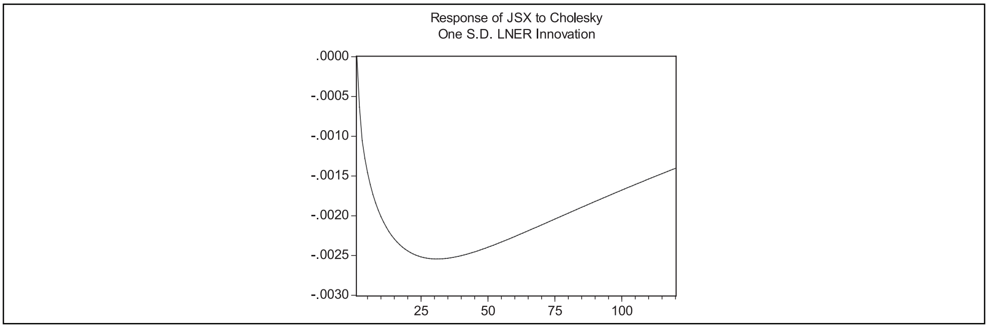


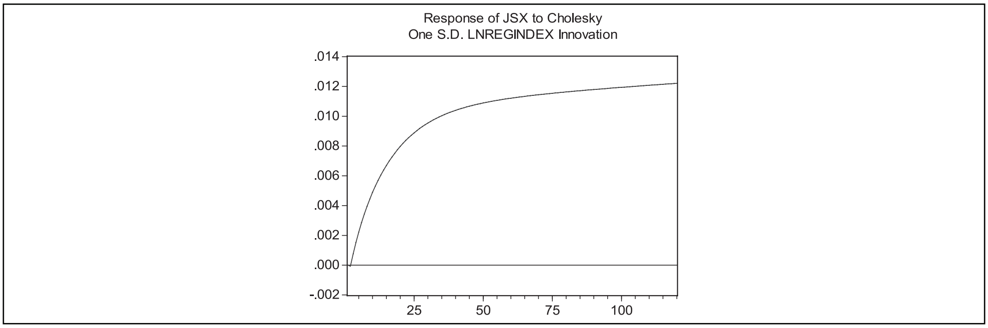
Figure 3. Response of JSX to Cholesky one S.D. BIRATE innovation



hand, in case of exchange rate depreciation shock (LNER) by 1%, JSX growth would decrease by -0.4%. This suggests that monetary policy movement across the JSX is not sensitive, while the exchange rate effect is relatively more sensitive. Above all, shock in regional index (LNREGINDEX) has a strong pass through effect on the JSX growth at around 0.76%.

The impulse response in the case of shock in the monetary policy (BIRATE) and exchange rate (LNER) incline to have a declining effect in JSX at the beginning of the period, as illustrated in the above graphs. Nonetheless, the impact of changes in the monetary policy to JSX tends to rebound after the period of day 45; while the impact of changes in exchange rate to

Figure 4. Response of JSX to Cholesky one S.D. LNREGINDEX innovation



JSX tends to rebound after the period of day 30. The impulse response in case of shock in regional index (LNREGINDEX) has an increasing effect on JSX growth and flattening after the period of day 25. This indicates the impact of the shock changes in these variables has temporary effect in the short term. Therefore, the second hypothesis in this study is accepted that the movement of JSX growth is determined by several variables, including lag of itself and regional index.

Conclusion

This study proves that the stock market index does not follow random walk. Therefore, certain variables in the financial market determine the movement of stock market index. ECM testing confirms that in the long term regional index and exchange rate strongly affect the JSX movement compare to gold, oil and monetary policy; albeit, they are all significant. On the other hand, in the short term only lag of JSX and exchange rate significantly affect JSX movement. Almost similar to ECM testing result, variance decomposition of VECM shows the movement of the JSX formed mainly by its lags, but it tends to diminish and replaced by regional index role over the period. Pass through effect on Cholesky designates monetary policy has a weak sensitivity over JSX movement, despite it is significant. Implicitly, this study reveals that monetary policy transmission through the stock market channel is still weak. On the other hand, exchange rate has a relatively higher sensitivity than monetary policy. Both variables have opposite direction impact on the JSX movement. In contrast, regional index of stock market in ASEAN and Hongkong has a strong sensitivity and unidirectional over the JSX movement. This indicates a strong contagious effect of stock market in ASEAN and Hongkong on domestic stock market, despite that the macroeconomic fundamental and the economic structure of each country is certainly different. Unsurprisingly, the financial crises since a few decades ago unlikely based on macroeconomic fundamental of a country but rather because of contagious effect. This is the time for each country to revitalize the financial market function to match the fundamental aspect rather than the speculative aspect. Every country should not let this condition makes it powerless in dealing with hot money attack.

Short-term capital flows or hot money has direct impact on stock market index movement, supporting by contagious effect. Inevitably, this steers exchange rate stability. For that reason, there is a reciprocal relationship between exchange rate and regional index. As it outreached the authority to control regional stock market, the policy implication of this study suggests authority to maintain exchange rate stability. As massive capital inflows might also transform into sudden capital reversal, the authorities should aim the policy to control speculative transaction of foreigners and redirect the capital flows to a more productive and fundamental transactions. There is no freedom for the speculators to abuse financial market and destroy economic stability of every country. It is the time for every country to take control of its own financial market to be more effective and efficient as financial intermediation. Policy to develop initial public offering (IPO) in securities market is urgently required, for instance by creating a regulation in initial public offering in securities market.

References

Anaraki, N.K. (2009), *The European Stock Market Impulse to the US Financial Crisis*, Science and Research Branch Islamic Azad University, Tehran.

Andersen, T.G., Bollersev, T., Diebold, F.X., and Vega, C. (2005), Real-time Price Discovery in Stock, Bond, and Foreign Exchange Market, *National Bureau of Economic Research Working Paper 11312*.

Batini, N. and Edward N. (2000), *When the Bubble Bursts: Monetary Policy Rules and Foreign Exchange Market Behavior*, Bank of England.

Bernanke, B.S. and Gertler, M. (2001), Should Central Banks Respond to Movements in Asset Prices?, *The American Economic Review*, 91(2), 253-257.

Bernanke, B.S. and Gertler, M. (1999), *Monetary Policy and Asset Price Volatility, Economic Review*, Federal Reserve Bank of Kansas City.

Bordo, M.D., Dueker, M.J., and Wheelock, D.C. (2008), Inflation, Monetary Policy, and Stock Market Condition, *National Bureau on Economic Research Working Paper No.14049*.

Borio, C.E.V., Kennedy, N., and Prowse, S.D. (1994), *Exploring Aggregate Asset Price Fluctuation Across Countries: Measurement, Determinants, and Monetary Policy Implications*, Bank for International Settlement, Monetary and Economy Department.

Cassola, N. and Morana, C. (2002), Monetary Policy and the Stock Market in The Euro Area, *Working Paper No.119*, European Central Bank.

Cecchetti, S.G., Genberg, H., Lipsky, J., and Wadhwani, S.B. (2000), Asset Prices and Central Bank Policy, *Geneva Report on the World Economy No.2*, International Center for Monetary and Banking Studies, and Centre for Economic and Policy Research, Geneva.

Cecchetti, S.G., Genberg, H., and Wadhwani, S.B. (2002), Asset Prices in a Flexible Inflation Targeting Framework, *National Bureau of Economic Research Working Paper 8970*.

Cerrito, P., Olson, D., and Ostaszewski, K. (1998), Non Parametric Statistical Test for the Random Walk in Stock Prices, *Advances in Quantitative Analysis of Finance and Accounting*, 6, 27-36.

Chadha, J.S., Sarno, L., and Valente, G. (2003), *Monetary Policy Rules, Asset Prices, and Exchange Rates*, Center for Dynamic Macroeconomic Analysis.

Chami, R., Cosimano, T.F., and Fullenkamp, C. (1999), The Stock Market Channel of Monetary Policy, *International Monetary Fund Working Paper*, WP/9/22.

Christiano, L., Motto, R., and Rostagno, M. (2006), *Monetary Policy and Stock Market Boom-Bust Cycle*, European Central Bank.

Davig, T. and Gerlach, J.R. (2006), State-Dependent Stock Market Reactions to Monetary Policy, *International Journal of Central Banking*, 2(4).

Dhar, S., Pain, D., and Thomas, R. (2000), *A Small Structural Empirical Model of the UK Monetary Transmission Mechanism*, Bank of England.

De Baudus, D. (2000), *On International Monetary Environment and Stock Returns*, Concordia University, Montreal, Quebec, Canada.

Diebold, F.X. and Kamil, Y. (2008), Macroeconomic Volatility and Stock Market Volatility World Wide, *National Bureau of Economic Research Working Paper 14269*.

Eichengreen, B. and Hui, T. (2003), *Stock Market Volatility and Monetary Policy: What the Historical Record Shows*, RBA Annual Conference.

Fereirra, M.A. and Santa-Clara, P. (2008), Forecasting Stock Market Returns: The Sum of the Part is More than the Whole, *National Bureau of Economic Research Working Paper 14571*.

Filardo, A.J. (2000), *Why the FED Should Ignore the Stock Market*, Federal Reserve Bank of St Louis.

Gertler, M., Goodfriend, M., Issing, O., and Spaventa, L. (1999), *Asset Prices and Monetary Policy: Four Views*, Centre for Economic and Policy Research, London.

Goodhart, C. and Hofmann, B. (2002), *Asset Prices and the Conduct of Monetary Policy*, London School of Economics.

Hayford, M.D. and Malliaris, A.G. (2002), *Monetary Policy and The Stock Market*, Department of Economics Loyola University, Chicago.

Lock, D.B. (2007), The Taiwan Stock Market Does Follow a Random Walk, *Economics Bulletin, Feng Chia University*.

Patelis, A.D. (1997), Stock Returns Predictability and the Role of Monetary Policy, *The Journal of Finance*, 52, 1951-72.

Prastowo, N.J. dan Tevvy, C. (2008), Peningkatan Aktivitas Pasar Modal, Konsumsi Masyarakat dan Potensi Tekanan Inflasi: Pendekatan *Wealth Effect*, *Kertas Kerja DKM, Bank Indonesia*.

Prastowo, N.J. (2008), Mengapa Pasar Indonesia Terkoreksi Lebih Dalam dan Lebih Sensitif Terhadap Sentimen Eksternal?, *Catatan Riset Direktorat Kebijakan Moneter, Bank Indonesia.*

Thorbecke, W. (1997), On Stock Market Returns and Monetary Policy, *The Journal of Finance*, 76, 635-54.

Untoro and Widodo, P.R. (2008), Mengkaji Perubahan Nilai Tukar Rupiah dan Pasar Saham, *Buletin Ekonomi Moneter dan Perbankan Bank Indonesia*, 10(4).

Yang, J.W. and Parwada, J. (2006), *Predicting Stock Price Movements: An Ordered Probit Analysis on the ASX*.

Zainuddin, R., Tri Y., Clarita L., and Darsono (2002), *Asset Price Channel of Monetary Transmission in Indonesia*, DKM, Bank Indonesia.

Appendix 1

VECM model

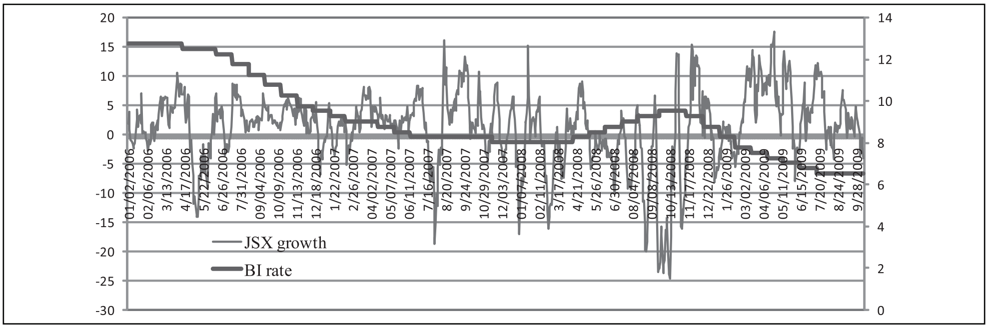
Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5
LNJSX(-1)	1.00	0.00	0.00	0.00	0.00
BIRATE(-1)	0.00	1.00	0.00	0.00	0.00
LNER(-1)	0.00	0.00	1.00	0.00	0.00
LNIB-RP(-1)	0.00	0.00	0.00	1.00	0.00
ON(-1)	0.00	0.00	0.00	0.00	1.00
LNIB-FOREX(-1)	-1.324	23.933	0.626	-0.256	21.315
	-0.760	-12.156	-0.697	-0.173	-11.541
	[-1.742]	[1.968]	[0.898]	[-1.480]	[1.846]
LNREGINDEX(-1)	-1.734	13.703	1.085	-1.630	19.122
	-1.111	-17.770	-1.018	-0.253	-16.871
	[-1.560]	[0.771]	[1.066]	[-6.443]	[1.133]
LNGOLD(-1)	0.477	-9.232	-1.146	-0.122	-14.256
	-1.185	-18.958	-1.086	-0.270	-17.999
	[0.402]	[-0.486]	[-1.055]	[-0.450]	[-0.792]
LNOIL(-1)	5.872	-97.678	-4.880	1.396	-93.769
	-1.125	-17.999	-1.031	-0.256	-17.088
	[5.218]	[-5.426]	[-4.732]	[5.450]	[-5.487]

Error Correction:	D(LNJSX)	D(BIRATE)	D(LNER)	D(LNIB-RP)	D(ON)	D(LNIB-FOREX)	D(LNREGINDEX)	D(LNGOLD)	D(LNOIL
CointEq1	-0.071	-0.040	0.003	0.325	-1.982	0.316	-0.016	0.030	0.000
	-0.014	-0.048	-0.006	-0.353	-1.214	-0.261	-0.016	-0.012	-0.016
	[-4.938]	[-0.827]	[0.590]	[0.919]	[-1.631]	[1.208]	[-1.002]	[2.477]	[-0.027]
CointEq2	-0.003	-0.003	0.000	0.014	0.171	-0.024	0.000	0.001	0.000
	-0.001	-0.002	0.000	-0.018	-0.061	-0.013	-0.001	-0.001	-0.001
	[-4.142]	[-1.310]	[0.418]	[0.768]	[2.786]	[-1.792]	[-0.242]	[1.613]	[0.255]
CointEq3	-0.012	-0.027	0.001	-0.059	0.148	0.786	-0.001	0.012	0.002
	-0.004	-0.014	-0.002	-0.100	-0.345	-0.074	-0.004	-0.003	-0.005
	[-2.893]	[-1.984]	[0.579]	[-0.589]	[0.429]	[10.594]	[-0.215]	[3.374]	[0.461]
CointEq4	0.003	-0.003	0.000	-0.373	0.071	0.075	0.002	-0.001	0.003
	-0.001	-0.004	-0.001	-0.031	-0.106	-0.023	-0.001	-0.001	-0.001
	[2.692]	[-0.616]	[0.449]	[-12.09]	[0.672]	[3.280]	[1.333]	[-0.655]	[1.954]
CointEq5	-0.001	0.002	0.000	0.007	-0.321	-0.001	-0.001	0.000	0.000
	0.000	-0.001	0.000	-0.008	-0.026	-0.006	0.000	0.000	0.000
	[-2.229]	[1.882]	[0.308]	[0.853]	[-12.234]	[-0.211]	[-2.084]	[1.027]	[-0.886]
D(LNJSX(-1))	0.151	-0.016	-0.045	-1.021	-0.075	-1.652	0.127	-0.080	-0.054
	-0.043	-0.143	-0.017	-1.044	-3.594	-0.774	-0.046	-0.036	-0.047
	[3.549]	[-0.109]	[-2.586]	[-0.977]	[-0.020]	[-2.135]	[2.736]	[-2.209]	[-1.149]
D(BIRATE(-1))	-0.004	-0.032	0.007	-0.028	0.660	0.106	0.006	-0.002	-0.005
	-0.010	-0.032	-0.004	-0.233	-0.803	-0.173	-0.010	-0.008	-0.011
	[-0.418]	[-1.010]	[1.764]	[-0.118]	[0.821]	[0.615]	[0.560]	[-0.301]	[-0.518]
D(LNER(-1))	-0.078	0.096	-0.111	-2.561	-6.200	0.126	0.118	-0.156	-0.102
	-0.085	-0.284	-0.034	-2.072	-7.129	-1.535	-0.092	-0.072	-0.093
	[-0.918]	[0.337]	[-3.213]	[-1.236]	[-0.869]	[0.081]	[1.280]	[-2.183]	[-1.095]
D(LNIB-RP(-1))	-0.001	0.005	0.000	-0.150	0.263	-0.009	-0.002	0.000	-0.002
	-0.001	-0.004	-0.001	-0.033	-0.112	-0.024	-0.001	-0.001	-0.001
	[-0.778]	[1.071]	[-0.207]	[-4.605]	[2.341]	[-0.378]	[-1.086]	[0.032]	[-1.636]
D(ON(-1))	0.000	-0.001	0.000	0.007	0.037	-0.009	0.000	0.000	0.001
	0.000	-0.001	0.000	-0.009	-0.033	-0.007	0.000	0.000	0.000
	[1.018]	[-0.760]	[-0.393]	[0.691]	[1.135]	[-1.270]	[0.577]	[0.954]	[1.514]
D(LNIB-FOREX(-1))	-0.001	-0.001	0.000	-0.094	-0.064	0.096	-0.001	0.002	0.002
	-0.002	-0.006	-0.001	-0.042	-0.146	-0.031	-0.002	-0.001	-0.002
	[-0.572]	[-0.248]	[0.499]	[-2.215]	[-0.436]	[3.051]	[-0.299]	[1.502]	[0.890]
D(LNREGINDEX(-1))	-0.066	0.005	0.006	0.458	-2.577	0.547	-0.105	0.062	0.034
	-0.041	-0.137	-0.017	-0.996	-3.426	-0.738	-0.044	-0.034	-0.045
	[-1.632]	[0.038]	[0.358]	[0.460]	[-0.752]	[0.741]	[-2.387]	[1.789]	[0.750]
D(LNGOLD(-1))	0.044	-0.073	-0.003	-1.179	-4.799	-0.588	0.038	0.010	0.050
	-0.039	-0.133	-0.016	-0.966	-3.323	-0.715	-0.043	-0.033	-0.043
	[1.105]	[-0.552]	[-0.163]	[-1.220]	[-1.444]	[-0.821]	[0.894]	[0.314]	[1.155]
D(LNOIL(-1))	0.056	-0.082	-0.007	0.969	-0.708	1.239	0.082	0.047	0.251
	-0.031	-0.105	-0.013	-0.767	-2.637	-0.568	-0.034	-0.026	-0.035
	[1.788]	[-0.781]	[-0.514]	[1.264]	[-0.268]	[2.181]	[2.410]	[1.767]	[7.268]
R-squared	0.068	0.026	0.022	0.236	0.165	0.264	0.030	0.029	0.084
Adj. R-squared	0.055	0.013	0.009	0.226	0.154	0.254	0.018	0.016	0.072
Sum sq. resids	0.282	3.189	0.047	169.261	2003.827	92.866	0.332	0.202	0.343
Akaike AIC	-5.302	-2.878	-7.102	1.094	3.565	0.493	-5.140	-5.638	-5.107
Schwarz SC	-5.233	-2.809	-7.033	1.163	3.634	0.562	-5.071	-5.569	-5.038

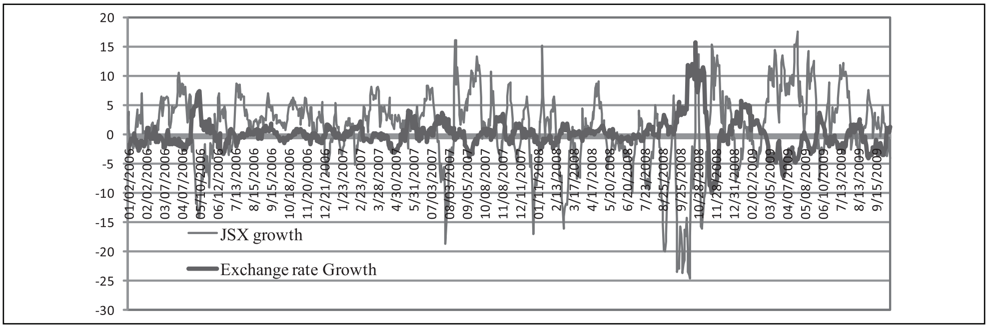
Standard errors in ( ) & t-statistics in [ ]

Appendix 2

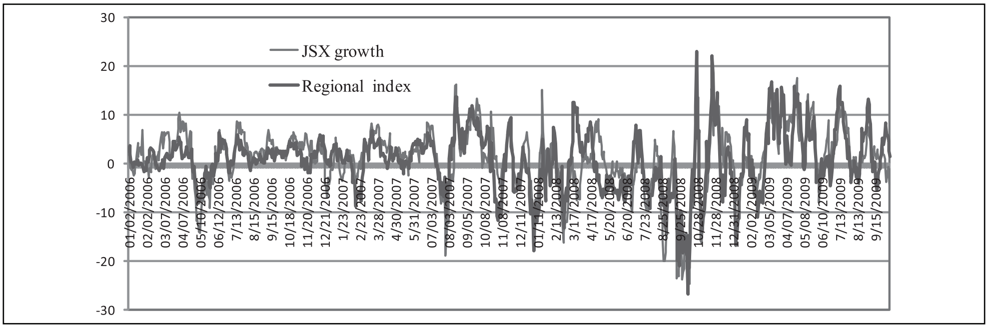
Growth of JSX and BI rate



Growth of JSX and exchange rate



Growth of JSX and regional index



Foreign investor share in Indonesia stock market