2 THE DYNAMIC RELATIONSHIP BETWEEN STOCK PRICES AND EXCHANGE RATES: EVIDENCE FROM INDONESIA

(Case Study in Indonesian Stock Exchange from July 2001 – April 2008)

Leonardus Jayadi Nugroho
Wisnu Mawardi
Fakultas Ekonomi Universitas Diponegoro

Abstract

The aim of this study is to examine the dynamic relationship between stock prices and exchange rates by using high-frequency data of exchange rates and composite index of stock prices (IHSG) of Indonesia for the period July 2001 to April 2008. Applying Johansen's cointegration analysis, the study identifies a long-run relationship between stock price and exchange rate. Furthermore, using Granger Causality Test, this study proceed to test for short-run causal relationships between stock prices and exchanges rates and found one unidirectional relationship from stock prices to exchange rates. Analysis of vector error correction (VEC) model reveals that the Rupiah exchange rate is affected by both the past exchange rate and the stock price (ceteris paribus). On the other hand, the stock price is apparently only affected by its past movement. These results are supported by innovative accounting (impulse response function and variance decomposition). The conclusion can be drawn in this study is the stock price seems to be a leading indicator of the relationship between stock price and exchange rate, which is following the Portfolio Balance Approach. The results have implications for investors, policy makers and researchers.

Keywords: *Stock price, exchange rate, dynamic relationship, Indonesia*

1 INTRODUCTION

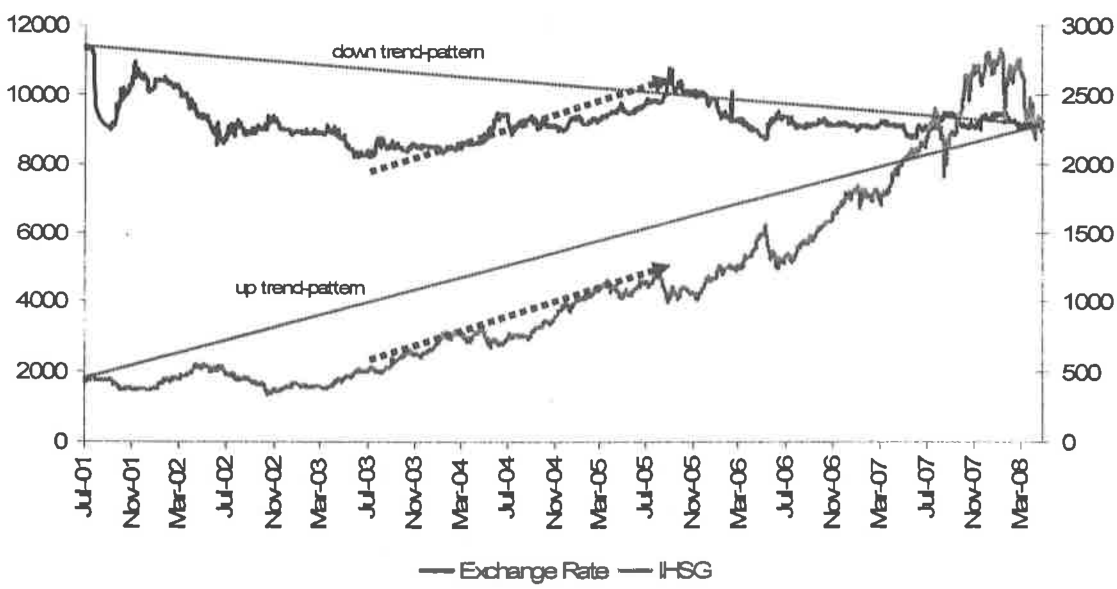
Emerging markets have recently been of great importance to the worldwide investment community. The market capitalization, volatility, and returns have increased dramatically in these markets. While emerging markets are more volatile than developed markets, they tend to be relatively uncorrelated with each other and with developed markets. Many global investors choose to diversify their funds across these markets to reduce portfolio risk. Unfortunately, financial crisis characterized by dramatic fluctuations in stock and foreign exchange markets has been a common phenomenon in recent years in emerging countries.

The phenomenon of currency crisis has become a worldwide problem with serious economic, political, and social implications for both developing countries and developed countries. The currency crisis in Indonesia, which started in July 1997, poses a gigantic menace to the development process in the form of constraining economic growth, eliminating job opportunities, reducing standard of living, and rising inflation level. Moreover, it can also push the country into a tremendous recession due to the dramatic collapse of the financial system and sudden reversal of foreign capital inflows.

On October 7, 1997, the rupiah had lost 55% of its value against the US dollar, as compared to other Asian currencies which fell comparatively less (within the range of 11 - 41%) (Usmanto, 1997 in Khusaini, 1999). The fall of Indonesian rupiah has caused 20% domestic inflation, which quickly absorbed the foreign reserves further affecting the economic crisis. Facing this reality one could no longer say that the Indonesian economy was fundamentally firm. The Indonesian economy which had been built for 30 years collapsed in just a few months.

The phenomenon gap was occurred between 2003 and 2005 which reflected the inconsistent relationship between the movement of stock prices and exchange rates. Hence it is interesting to give further attention in this study in order to have better understanding for the relationship between stock price and exchange rate in Indonesia. From the figure below, we can see that there is a trend-pattern both for the movement of stock price and exchange rate which an up-trend pattern occurred for the movement of stock prices and a down-trend pattern occurred for the movement of exchange rates in Indonesia. Even tough, from 2003 to 2005 there was a down-trend pattern occurred in exchange rate movement. It showed some short-inconsistent pattern occurred in long pattern. As a result, we can not be sure about the relationship between stock price and exchange rate in Indonesia.

Figure 1
The Movement of Stock Prices and Exchange Rates in Indonesia



Most of the empirical literature that has examined the stock prices-exchange rate relationship has focused on examining this relationship for the developed countries with very little attention on the developing countries. The results of these studies are, however, inconclusive. Some studies have found a significant positive relationship between stock prices and exchange rates (for instance Smith (1992), Solnik

(1987), and Aggarwal (1981) in Muhammad, N. (2002)) while others have reported a significant negative relationship between the two (e.g., Soenen and Hennigar (1998) in Muhammad, N. (2002)). On the other hand, there are some studies that have found very weak or no association between stock prices and exchange rates (for instance, Franck and Young (1972), Eli Bartov and Gordon M.Bodnor (1994) in Muhammad, N. (2002)).

Based on the background above, the research question in this study could be formulated as follows: "What is the dynamic relationship between stock prices and exchange rates in Indonesia?"

The rest of the paper is organized as follows. In the next section we review the underlying theories and some empirical studies. Section three present the data and discuses empirical methodology, while section four present empirical results. In section five sets forth the conclusions.

2. UNDERLYING THEORIES AND PREVIOUS EMPIRICAL STUDIES

UNDERLYING THEORIES

Flow Oriented Models (The Goods Market Approach)

Mishra and Paul (2005) explained that "Flow Oriented" models [Dornbusch & Fisher (1980)] of exchange rate determination focus on the current account or the trade balance. This model posits that currency movements affect International competitiveness and balance of trade positions, and, consequently, the real output of the country, which in turn affects the current and future expected cash flows of firms and their stock prices.

The detailed logical deduction of this relationship is like this. Changes in exchange rates affect the competitiveness of a firm as fluctuations in exchange rates affect the value of the earnings and cost of its funds because many companies borrow in foreign currencies to fund their operations and hence its stock prices. But this will affect in either way depending upon whether that firm is an exporting unit or a heavy user of imported inputs. In the case of an exporting firm, a depreciation of the local currency makes exporting goods more attractive and this leads to an increase in foreign demand for export of goods and services. As a result, the revenue of the firm and its value will increase which will in turn increase stock prices. On the other hand, an appreciation of local currency decreases profits of an exporting firm because of decrease in foreign demand of its products. Hence the stock price will decrease. This is exactly opposite to the case of an importing firm as exchange rate changes.

Stock Oriented Model (Portfolio Balance Approach)

The Portfolio Balance Approach stressed the role of capital account transactions where the capital market can influence the exchange rate through money demand or supply, as, like other commodities, the exchange rate is determined by market mechanisms dependent on supply and demand. The development of the capital market attracts capital inflows from foreign investors and hence increases domestic demand of money. On the other hand, when stock prices decline, capital will shift from the stock market to other forms of investment. According to this approach, declining stock prices reduce the wealth of local investors. This leads to a decreased demand for money, and, thus, a falling interest rate. The decline in interest rate tends to support capital outflows (ceteris paribus), and, finally, causes a depreciation of the exchange rate. Thus, this approach states that there is a positive relationship between stock prices and the exchange rates, in contrast to the Goods Market Approach. The Portfolio Balance Approach argues that stock price fluctuations impact exchange rate fluctuations (Novita and Nachrowi, 2005).

PREVIOUS EMPIRICAL STUDIES

Issam S.A. Abdalla and Victor Murinde (1997) applied cointegration approach to examine the long-run relation between stock price index and the real effective exchange rate for Pakistan, Korea, India and Philippines. They use month data from January 1985 to July 1994. Their study found no long-run relationship for Pakistan and Korea but did find a long-run relationship for India and Philippines. They also examine the issue of causation between stock prices and exchange rates. Using standard Granger causality tests they found a unidirectional causality from exchange rates to stock prices for both Pakistan and Korea. Since a long- run association was found for India and Philippines they uses an error correction modeling approach to examine the causality for these countries. The results show a unidirectional causality from exchange rate to stock prices for India but for Philippines the reverse causation from stock prices to exchange rates was found.

Clive W.J Granger, Bwo-Nung Huang and Chin Wei Yang (1998) examine the causality issue using Granger causality tests and Impulse response function for nine Asian countries. They use daily data for the period January 3, 1986 to November 14, 1997. The countries included in their study are: Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan. For Japan and Thailand they found that exchange rates leads stock prices with positive correlation. The data from Taiwan suggests stock prices leads exchange rates with negative correlation. No relationship was found for Singapore and bi-directional causality was discovered for the remaining countries.

Ajayi et al (1998) used daily data and reported that causality runs from the stock market to the currency market in Indonesia and Philippines, while in Korea it runs in the opposite direction. No significant causal relation is observed in Hong Kong, Singapore, Thailand, or Malaysia. However, in Taiwan, they detected bi-directional causality or feedback. Furthermore, contemporaneous adjustments are significant in only three of these eight countries. In developed countries, they found significant unidirectional causality from stock to currency markets and significant contemporaneous effects.

Nieh and Lee (2001) found no significant long-run relationship between stock prices and exchange rates in G-7 countries, using both the Engle-Granger and Johansen's cointregration test. Furthermore, they found ambiguous, and significant, short-run relationships for these countries. Nonetheless, in some countries, both stock indexes and exchange rates may serve to forecast the future paths of these variables. For example, they found that currency depreciation stimulates Canadian and UK stock markets with a one-day lag, and that increases in stock prices cause currency depreciation in Italy and Japan, again with a one-day lag.

Kasman, Saadet (2003) examined the relationship between stock prices and exchange rates by using the daily data from 1990 to 2002 of exchange rates and aggregate stock indices of Turkey. By employing Johansen's cointegration test and Granger causality test, the study found a long-run stable relationship between stock indices and exchange rates. The study also concluded that causality relationship exists only from exchange rate to industry sector index.

3. DATA AND METHODOLOGY

DATA

The data is considered as a secondary data. The stock prices were indicated by Composite Index of Stock Prices (IHSG). The exchange rates are spot rates from International Monetary Market (IMM), which are indices in the form of units of Indonesian rupiah per US dollar. The sample which used in this research consists of 1.641 observations, for the sample period from July 2, 2001 to April 28, 2008, of daily closing stock market indices and foreign exchange rates in Indonesia. The use of lower frequency data such as weekly or monthly observations may not be adequate to capture fast-moving exchange rates and stock prices. The significant interaction between the two series may be diluted in data of lower frequency. The data was obtained from *datastream*.

METHODOLOGY

The research methodology used was a multiple step testing procedure employing stationary test (Unit Root Test), lag length determination, the cointegration test, Granger Causality Test and the VEC model. Each is explained in more detail below.

Unit Root Test

The unit root tests are meant to help avoid the problem of spurious regressions; this has become standard in econometric practice. Both the Augmented Dickey-Fuller (ADF) 1 and Phillips Perron (PP) unit-root tests were employed to examine the stationary property of the data series.

The Augmented Dickey-Fuller (ADF) test is developed by Dickey and Fuller (1979) in the following equation:

$$\Delta y_t = a + b * t + c * y_{t-1} + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + \varepsilon_t$$

Where y_t denotes the stock price at time period t; t is the trend variable, and ε_t is standard normal distributed.

Phillips and Perron (1988) propose an alternative (nonparametric) method of controlling for serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test equation, and modifies the t-ratio of the á coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the statistic:

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0} \right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{1/2} s}$$

Where $\hat{\alpha}$ is the estimate, and t_α the t-ratio of α, $se(\hat{\alpha})$ is coefficient standard error, and s is the standard error of the test regression. In addition, γ_0 is a consistent estimate of the error variance in (calculated as $(T-k)\, s^2 / T$, where k is the number of regressors). The remaining term, f_0, is an estimator of the residual spectrum at frequency zero.

Lag Length Determination

The analysis of the cointegration, Granger Causality Test and VEC models are sensitive to lag length. Therefore, the determination of optimal lag length is important in the development of the model. There are general parameters used to determine optimal lag. Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Likelihood Ratio (LR). Based on Enders (1995:88), AIC, SIC, LR is defined as follows:

$$AIC(k) = T \ln\left(\frac{SSR(k)}{T} \right) + 2q$$

$$SIC(k) = T \ln\left(\frac{SSR(k)}{T} \right) + q \ln(T)$$

$$LR = -2(l_r - l_u)$$

T = number of observations
SSR = Sum Square Residuals
k = lag length
q = number of regressor = k + 1 = number of estimated parameters
l = log likelihood
r = restrictive regression
u = unrestrictive regression

Cointegration Test

This study adopts Johansen (1991, 1995) cointegration tests. The Johansen's multivarite cointegration test is based on the following vector autoregression equation:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t$$

Where y_t and x_t are, respectively, a k-vector of non-stationary $I(1)$ variables and a vector of deterministic variables and $\mathring{a}_t$ is a vector of innovations.

In making inferences about the number of cointegrating relations, two statistics known as the trace statistic and the maximal eigenvalue statistic are used. The trace statistic is determined using the following formula:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \log(1 - \hat{\lambda}_i) \quad r = 0,1,2,\ldots,n-1$$

Where T is the number of observations and $\hat{\lambda}_i$ is the ith eigenvalue.

The maximum eigenvalue statistic is determined using the following formula:

$$\lambda_{\max} = -T \log(1 - \hat{\lambda}_{r+1}) \quad r = 0,1,2,\ldots n-2, n-1$$

To make inferences regarding the number of cointegrating relationships, the trace and maximum eigenvalue statistics are compared with the critical values tabulated in Osterwald-Lenum (1992).

Granger Causality Test

Granger's causality [proposed by Granger (1969) and popularized by Sims (1982)] may be defined as the forecasting relationship between two variables. In short, Granger causality test states that if S & E are two time series variables and, if past values of a variable S significantly contribute to forecast the value of the other variable E, then S is said to be Granger causing E and vice versa. The test involves the following two regression equations:

$$S_t = \gamma_0 + \sum_{i=1}^{n} \alpha_i E_{t-1} + \sum_{j=1}^{n} \beta_j S_{t-j} + u_{1t} \qquad (1)$$

$$E_t = \gamma_1 + \sum_{i=1}^{m} \lambda_i E_{t-1} + \sum_{j=1}^{m} \delta_j S_{t-j} + u_{2t} \qquad (2)$$

Where S_t and E_t are the stock price and exchange rate to be tested, and u_{1t} and u_{2t} are mutually uncorrelated white noise errors, and *t* denotes the time period. Equation 1 postulates that current S is related to past values of S as well as of past E. Similarly, Equation 2 postulates that E is related to past values of E as well as related to past values of S. Three possible conclusions can be adduced from such analysis, *viz,* unidirectional causality, bi-directional causality and that they are independent of each other.

1. Unidirectional causality from E to S is indicated if the estimated coefficients on the lagged E in Equation 1 are statistically different from zero as a group (i.e., $\sum_{i=1}^{n} \alpha_i \neq 0$) and the set of estimated coefficients on the lagged S in Equation 2 is not statistically different from zero (i.e., $\sum_{j=1}^{m} \delta_i = 0$).

2. Unidirectional causality from S to E exists if the set of lagged E coefficients in Equation 1 is not statistically different from zero (i.e., $\sum_{i=1}^{n} \alpha_i = 0$) and the set of the lagged S coefficients in Equation 2 is statistically different from zero (i.e., $\sum_{j=1}^{m} \delta_i \neq 0$).?

3. Feedback or bilateral causality is suggested when the sets of E are statistically and significantly different from zero in?and S coefficients both regressions.

4. Finally, independence is suggested when the sets of E and S coefficients are not statistically significant in both the regressions.

Vector Error Correction (VEC) Analysis

A vector error correction model is a restricted VAR designed for use with nonstationary series that are known to be cointegrated. The VEC has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics.

According to Engle and Granger (1987), if two variables are cointegrated, there exists an error-correction model of the following form:

$$\Delta x_t = a_1 + b_1 ect_{t-1} + \sum_{i=1}^{m} c_1 \Delta x_{t-i} + \sum_{i=1}^{n} d_1 \Delta y_{t-i} + e_{1t}$$

$$\Delta y_t = a_2 + b_2 ect_{t-1} + \sum_{i=1}^{m} c_2 \Delta y_{t-i} + \sum_{i=1}^{n} d_2 \Delta x_{t-i} + e_{2t}$$

Where x_t and y_t are the variables which are cointegrated, Δ is the difference operator, *m* and *n* are the lag lengths of the variables, ect_t denotes the residuals from the cointegrating equation and e_{1t} and e_{2t} are the white-noise residuals.

Granger causality test results can be interpreted as within-sample causality tests and can be used to make inferences about causal relationships within the sample period only. Therefore, to make inferences on causal relationships beyond the sample period, variance decomposition analysis is used. In variance decomposition analysis, variance of the forecast error of a particular variable is partitioned into proportions attributable to innovations (or shocks) in each variable in the system, including its own. If a variable can be optimally forecast from its own lags, then it will have all its forecast variance accounted for by its own disturbances (Sims, 1972).

4. EMPIRICAL RESULTS

Unit Root Test

As a first step, it is necessary to determine the degree of integration of stock prices and exchange rates. The augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests are two commonly used procedures in the empirical literature. In both tests, the null hypothesis is that a unit root exists in the autoregressive representation of the time series.

In this study, the determination whether a variable has a unit root, it would used a comparative value between ADF (PP) and the table value of ADF (PP). If the absolute value of ADF (PP) have smaller value than the critical absolute value (the table value of ADF (PP) at a certain significant level), then that variable can be said to contain a unit root (be non-stationary). The unit root test can be summarized as follows:

Table 1
The Result of Unit Root Test

Variables	ADF		PP	
	Constant	Constant & Trend	Constant	Constant & Trend
	Level		*Level*	
IHSG	-0.360279	-1.788031	-0.233543	-2.135975
EX	-2.721787	-2.668982	-2.582412	-2.534138
	First Difference		*First Difference*	
IHSG	-19.69268	-19.68235	-34.72678	-34.70851
EX	-33.27112	-33.27568	-44.26270	-44.26176

Note: The critical values for ADF and PP test with constant at 1%, 5% and 10% are -3.43, -2.86, and -2.56 while for ADF and PP test with constant and trend are -3.96, -3.41, and -3.12 respectively. The numbers in parenthesis for ADF indicate appropriate lag lengths selected by Schwartz Information Criteria and for the PP by the Bartlett kernel of Newey and West (1994). The Eviews programme automatically selected the appropriate lag length.

The results of unit root tests reported in Table 1 indicate that the level of each series is non-stationary. Using the ADF and PP test with and without a deterministic trend, the hypothesis of level non-stationary cannot be rejected for all series. However, results for the first-difference clearly show that the hypothesis of non-stationarity can be rejected. Thus, like most financial time series, the stock price and exchange rates require differencing to achieve stationarity or they are I(1).

Lag Length Determination

There are some procedures used to determine an appropriate leg length such as the Akaike information criteria (AIC), the Schwartz information criteria (SIC) and the likelihood ratio (LR) test.

In this study, the lag length used to estimate VAR/VEC model is based on LR. Calculations showed that the direct determination by minimum AIC and SIC criteria did not give the optimal value as the AIC and SIC values tended to decrease. It is following the recommended procedure in Novita and Nachrowi (2005). Therefore, the sequential modified likelihood ratio (LR) test is carried out. The next step is to compare the modified LR statistics to the 5% critical values starting from the maximum lag, and decreasing the lag one at a time until we first get a rejection. The alternative lag order from the first rejected test is marked with an asterisk (if no test rejects, the minimum lag will be marked with an asterisk "*").

Relevant results are presented in Table 2 as follows:

Table 2

Lag	LR
0	NA
1	6986.663
2	39.08258
3	45.88177
4	21.53702
5	0.931525
6	4.866355
7	1.051445
8	2.409707
9	5.357455
10	2.175676
11	6.109501
12	2.205871
13	0.353741
14	11.52561*
15	3.082343
16	2.731810
17	0.655467
18	8.483363
19	3.199638
20	3.538137

Source: own calculations based on data

Note :* indicates lag order selected by the criterion. LR is the sequential modified LR test statistic (each test at 5% level).

As we can see in table 2, the optimum lag length has been found out to be 14 for stock prices and exchange rates, based on, the sequential modified likelihood ratio (LR) criteria.

Cointegration Test

On the basis of the above unit root tests, now we have to define whether time series are cointegrated or not. In this study it would performed the Johansen's cointegration test to see whether any combinations of the variables are cointegrated. According to Johansen (1997) the selection of variables to be included in cointegration test should be based on economic reasoning, i.e. stationary variables should be included only if reasonable. However, at least two variables need to be non-stationary to perform a cointegration test. Since this study employ two variables only in tests, the results of test must show one cointegrating equations to be relevant and significant.The lag length is chosen by applying the sequential modified likelihood ratio (LR) criteria.

Relevant results are presented in Table 3 as follows:

Table 3
The Result of Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value
None *	0.022106	18.51208	15.41
At most 1	0.000990	0.785637	3.76

* denotes rejection of the hypothesis at the 5% level

Trace test indicates 1 cointegrating equation(s) at the 5% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value
None *	0.022106	17.72644	14.07
At most 1	0.000990	0.785637	3.76

* denotes rejection of the hypothesis at the 5% level

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level

Source: own calculations based on data

When the Johansen co-integration test was applied (assuming an intercept and a linear deterministic trend in the data), it was found that the test null hypothesis of zero cointegration could be rejected. For the test of zero co-integrating relations, the trace statistic (18.51208) and maximum eigenvalue statistic (17.72644) were each greater than the 5 per cent critical values. The trace and maximum eigenvalue statistics for the test shows that there is one co-integrating relation between stock prices and exchange rate since its values is greater than the critical values.

Granger Causality Test

The short-run dynamics of the system may be examined by performing Granger causality tests. We apply the tests with the aim to seek a presence of short-run relationship where no long-run causality appeared, and to confirm the VECM results where the cointegration between stock prices and exchange rates exists. Granger causality test requires that all data series involved are stationary. Otherwise the inference from the F-statistics might be spurious because the test statistics will have nonstandard distributions. Accordingly, we employed the first differences of all series. The test results of Granger causality are given in Table 4.

Table 4
Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Probability
EX does not Granger Cause IHSG	830	0.30709	0.99321
IHSG does not Granger Cause EX		4.16154	4.5E-07

Source: own calculations based on data

As we can see in Table 4, we cannot reject the Null Hypothesis that the exchange rate does not Granger cause stock price with probability not significant on alpha 5 percent. On the other hand, we can reject the Null Hypothesis that the stock price does Granger cause exchange rate with significant probability on alpha 5 percent. From this analysis, it is evident that a significant uni-directional causal relationship exists between the variables, with stock price changes found to Granger cause changes in the Indonesian rupiah exchange rate during the sample period. This demonstrates a relationship consistent with the Portfolio Balance Approach.

Vector Error Correction (VEC) Analysis

Based on Enders (1995), if there is cointegration, the appropriate model to use is the Vector Error Correction because the VAR estimation does not account for data co-movement and has potential misspecification errors. The estimation of the VECM for each data series are given in Appendix.

It may be noted that the coefficients obtained from the estimation of VEC model can't be interpreted directly. To overcome this problem, Litterman (1979) in Mishra (2004) had suggested the use of Innovation Accounting Techniques, which consists of both Impulse response functions (IRFS) and Variance Decompositions (VDS).

Impulse response function is being used to trace out the dynamic interaction among variables. It shows how the dynamic response of all the variables in the system to a shock or innovation in each variable. Variance decomposition is used to detect the causal relations among the variables. It explains the extent at which a variable is explained by the shocks in all the variables in the system. The forecast error variance decomposition explains the proportion of the movements in a sequence due to its own shocks verses shocks to the other variables.

Table 5
Impulse Response Functions

Response of IHSG:

Period	IHSG	EX
1	17.89873	0.000000
2	20.60023	0.131475
3	20.21764	-0.194796
4	24.21614	0.143289
5	26.04390	0.372323
6	25.40424	0.158934
7	26.42498	0.534239
8	27.76371	0.721661
9	28.30371	-0.282898
10	28.87042	-0.245864

Response of EX:

Period	IHSG	EX
1	0.000000	62.89582
2	-9.821250	49.75619
3	-18.18958	39.84446
4	-18.42966	41.03539
5	-18.99852	43.10658
6	-20.61540	39.07510
7	-24.52768	38.98166
8	-22.84709	39.05473
9	-23.60020	40.91493
10	-24.63629	41.32083

Source: own calculations based on data

From Table 5, as we could see, that one standard deviation from the stock price index 17.89873 doesn't bring any effect to variable exchange rate (its standard deviation equal to null). After two periods, the standard deviation of stock price index becomes 20.60023 above its averages, brings influence to the downdraft of exchange rate's standard deviation from 0.194796 below its averages.

On the other hand, after one period, standard deviation of exchange rate 49.75619 causing negative effect to variable stock price index 9.821250. At the periods 3, standard deviation of exchange rate 39.84446 above its averages, causing downdraft on standard deviation of stock price index that becomes 18.18958 below its averages.

Table 6

Variance Decomposition of IHSG:

Period	S.E.	IHSG	EX
1	17.89873	100.0000	0.000000
2	27.28682	99.99768	0.002319
3	33.96505	99.99522	0.004782
4	41.71133	99.99565	0.004350
5	49.16921	99.99114	0.008858
6	55.34205	99.99218	0.007816
7	61.32182	99.98605	0.013947
8	67.30806	99.97694	0.023060
9	73.02115	99.97891	0.021092
10	78.52467	99.98078	0.019218

Variance Decomposition of EX:

Period	S.E.	IHSG	EX
1	62.89582	0.111185	99.88881
2	80.99758	2.075976	97.92402
3	92.34383	6.064646	93.93535
4	102.9630	8.575446	91.42455
5	113.4685	10.30469	89.69531
6	121.9864	12.14429	87.85571
7	130.6355	14.49823	85.50177
8	138.4644	15.94691	84.05309
9	146.5189	17.14490	82.85510
10	154.4346	18.26984	81.73016

Cholesky Ordering: IHSG EX

Source: own calculations based on data

From Table 6, as we can seen, the variance decomposition of stock price index at step one, errors variance estimation could entirely (100 percent) explained by variable stock price index itself. But, at step two, exchange rate has had influence on stock price index's errors variance estimation, even though it was only around 0.002 percent. At step 10, variable exchange rate only influenced stock price index's errors variance around 0.01 percent. On the contrary, as seen in the table, the variance decomposition for exchange rate, stock price index has had an effect on exchange rate's errors variance equal to 0.111185 percent. At step two, the influence increases 2.075976 percent and 18.26984 percent at step 10.

5. CONCLUSIONS

This paper investigated the dynamic relations between stock prices and the exchange rates in Indonesia. The empirical evidence presented in this paper suggests several conclusions as follows:

1. Based on cumulative return value, the IHSG is more volatile than the exchange rate. In fact, the IHSG tends to increase more than the exchange rate.
2. The unit root test used to determine whether the data series were stationary or not. From the results, it shows that both series, stock price and exchange rate, were non-stationary at level and will be stationary at its first difference.
3. The Cointegration Test, Granger Causality Test, and VAR/VEC were sensitive to lag length. By using likelihood ratio (LR) test, it can be concluded that the optimal lag for this models are 14. In other words, 14 days is needed to make an adjustment between stock price and exchange rate in Indonesia.
4. With paying careful attention to the selection of lags, the Johansen cointegration test identified a long-run equilibrium relationship between stock price and exchange rate. In other words, a long-run stable relationship between stock indices and exchange rates exist. That means stock index and exchange rates move together in the long-run. This result is similar to the results of the previous empirical studies related to the study such as Abdalla and Murinde (1997), Baharumshah et al. (2002), Kasman (2003), and Stavarek (2004).
5. The empirical finding above prompted this study to investigate whether there are any short-run causal relationships between stock prices and exchange rate in Indonesia using Granger-causality tests. From this analysis, it is evident that a significant uni-directional causal relationship exists between the variables, with stock price changes found to Granger cause changes in the Indonesian rupiah exchange rate during the sample period. This demonstrates a relationship consistent with the Portfolio Balance Approach. This result is similar to the study by Granger et. al (1998), Ajayi et. al (1998), and Stavarek (2004).
6. The VEC model shows that the exchange rate is not only affected by its dynamic movement, but also by stock price index dynamic movement. On the other hand, the stock price is likely affected by its own dynamic movement. Thus, it can be concluded that the stock price index is a leading indicator for exchange rate as suggested by the Portfolio Balance Approach.

REFERENCES

Abdalla, I.S.A., and V. Murinde, 1997. "Exchange Rate and Stock Price Interactions in Emerging Financial Markets: Evidence on India, Korea, Pakistan and the Philippines." *Applied Financial Economics*. 725-735.

Ajayi, A. R, Friedman J. and Mehdian, S. M. 1998. "On the Dynamic Relation Between Stock Prices and Exchange Rates", *Global Finance Journal*, 9(2): 241-251

Babarumshah, A.Z., A.M.M. Mansur, and M. Azali. .2002. "The Stock Market and the Ringgit Exchange Rate: A Note." *Japan and the World Economy*. 14. 471-486.

Bahmani-Oskooee, M., Sohrabian, A. 1992. "Stock Prices and the Effective Exchange Rate of the Dollar", *Applied Economics*, 24, 459-464.

Damodar N. Gujarati .2003. "Basic Econometrics" Fourth Edition, McGraw-Hill Publication.

Dickey, D. A., & Fuller, W. A. 1981. "Likelihood ratio statistics for autoregressive time series with a unit root". *Econometrica*, 49, 1057–1072.

Dornbusch, R and Fischer, S 1980. "Exchange Rates and the Current Account", *AER*, Vol. 70, No. 5, Pp. 960-71.

Granger, C.W.J, Huang, B.N and Yang, C. W 2000. "A Bivariate Causality between Stock Prices and Exchange Rates: Evidence from Recent Asian flu", The *Quarterly Review of Economics and Finance*, Vol. 40, Pp. 337-54.

Ibrahim, M. H .2000. "Cointegration and Granger Causality Tests of Stock Price and Exchange Rate Interactions in Malaysia", *Asian Economic Bulletin*, Vol. 17, No. 1, Pp. 36-46.

Kasman, S. 2003. "The Relationship between Exchange Rates and Stock Prices: A Causality Analysis", Source: www.sbe.dev.edu.er/yayinear/dergi/2003sayi-2pdf/kasman.pdf

Mishra, A.K, .2005. "Stock Price and Exchange Rate Interlinkages in Emerging Financial Markets: The Indian Perspective", *The ICFAI Journal of Applied Finance*, Vol.11, No.4, Pp.31-58.

Muhammad, N & Rasheed A .2002. "Stock Prices and Exchange Rates: Are they Related? Evidence From South Asian Countries", Karachi University, Contact Info: naeem_muhammad_pk@yahoo.com

Nieh, C.C., and C.F. Lee. .2001 "Dynamic Relationship Between Stock Prices and Exchange Rates for G-7 Countries." *The Quarterly Review of Economics and Finance.* 41. 477-490.

Ng, S., & Perron, P. 2001) "Lag length selection and the construction of unit root tests with goof size and power. *Econometrica*, 69, 1519–1554.

Novita M. and Nachrowi D. 2005. Dynamic Analysis of the Stock Price Index and the Exchange Rate Using Vector Autoregression (VAR): An Empirical Study of the Jakarta Stock Exchange, 2001-2004

Osterwald-Lenum, M. 1992. "A Note With Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics", *Oxford Bulletin of Economics and Statistics*, 54: 461-472.

Phylaktis, K. and Ravazzolo, F. 2005. Stock Prices and Exchange Rate Dynamics, *Journal of International Money and Finance*, 24, 1031-1053.

Sims, C. A. 1982. Policy Analysis with Econometric Models, Brookings Papers on Economic Activity, 1, 107-152.

Soenen, L.A., Hennigar, E.S. 1988. "An Analysis of Exchange Rates and Stock Prices: the U.S. Experience between 1980 and 1986", *Akron Business and Economic Review*, 19, 7-16. 32.

Stavarek, D. 2005. "Stock Prices and Exchange Rates in the EU and the United States: Evidence on their Mutual Interactions", *Czech Journal of Economics and Finance*, ISSN: 0015 - 1920,URL:
http://ideas.repec.org/a/fau/fauart/v55y2005i3-4p141-161.html