

PRICE LINKAGES IN SELECTED INDONESIAN FINANCIAL MARKETS

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Artikel ini menganalisis dinamika keterkaitan pasar dana (financial markets) di Indonesia dengan mempergunakan data bulanan periode 1991 sampai 1996. Analisis difokuskan pada pasar valuta asing (foreign exchange market), pasar modal (stock exchange market) dan pasar uang (money market). Metode yang dipergunakan adalah kointegrasi (co-integration) dan model GARCH (General Autoregressive Conditional Heteroskedasticity). Kointegrasi mendeteksi seberapa jauh keterkaitan antarpasar dana sedang model GARCH melukiskan variasi keterkaitan pasar dana antarwaktu.

Hasil analisis menunjukkan masih lemahnya keterkaitan antarpasar dana serta masih lemahnya efisiensi informasi (information efficiency) pasar dana di Indonesia. Kondisi ini membuka kesempatan bagi para spekulan di pasar dana untuk memperoleh keuntungan di atas keuntungan normal (abnormal profit) melalui proses arbitrase. Selain itu, diversifikasi assets bisa menurunkan risiko keuangan (financial risks). Kebijakan yang mampu mendorong turunnya biaya perolehan informasi dan meningkatkan laju penyebaran informasi, seperti komputerisasi dan penggunaan internet, dapat mendorong naiknya efisiensi pasar dana.

Keywords: co-integration; diversification; GARCH (general autoregressive conditional heteroskedasticity); Indonesian Financial Market; price linkages

Introduction

It is generally accepted that there are considerable benefits to be gained from diversifying the forms of financial assets held. A risk averse investor can decrease the risk of his portfolio of assets by including a range of assets. Differences in real growth rates, business risks, financial risks, and growth rate of returns may prompt such diversification. Thus, information about relationships among markets and the consistency of such relationships can provide the information necessary to bene-

fit from potential arbitrage opportunities (see Tirupattur, et al., 1994; Ibrahim and Kumah, 1996).

Inter markets linkages can also have important implications for market efficiency and price forecasting. Contemporaneous linkages may imply efficient markets and information flows. Conversely, non-contemporaneous linkages imply that markets hold information about other markets which could be used for forecasting and generating arbitrage profits. However, according to economic theory, certain pairs of economic variables are linked by a

long-run equilibrium relationship. Although these variables may temporarily drift away from equilibrium, economic forces may be expected to act to restore equilibrium. In other words, economic variables share one or more common trends, or are cointegrated. If this is the case, the gains from diversification may be limited.

This article examines the extent of the benefits to be gleaned from diversification of financial assets on the Indonesian financial markets. Analysis focuses on the Jakarta Stock market, the US dollar-rupiah¹ exchange market, and the money market. The nature and magnitude of co-integration between financial prices will be used to gauge the benefits of diversification. Tests of bivariate co-integration indicate weak evidence of co-integration. Thus, there are potential gains to be made from arbitrage in the Indonesian financial markets.

Also, it is well known that variances of financial data are vary over time. So, it is reasonable to argue that covariance and correlation among financial prices also vary over time. If this is true, the benefit to be gained is of a lesser magnitude when compared with the benefits to be gained if this covariance and correlation did not vary over time. The time path of the above correlation will be estimated by using General Autoregressive Conditional Heteroskedasticity (GARCH) model (Baillie and Myers, 1991) is used to estimate the time path of this correlation

Little effort has been devoted to examining the efficiency of the Indonesian financial markets. The majority of research in this area has employed the demand for money theory to examine human behavior in holding assets. This is perhaps due to the slow growth of the Indonesian stock mar-

ket, which continued until the early 1990s when the Indonesian government issued a number of deregulation policies aimed at improving the competitiveness of the Indonesian financial market. Thus, any effort to analyze Indonesian financial markets will provide information for funds managers in Indonesia. Research focuses on how linkages in the Indonesian financial markets will improve understanding of how the markets works.

The following section covers selected literature related to research on the benefit of assets diversification and financial market efficiency. Section three discusses the data and methodology used, which includes a stationary test, co-integration and GARCH. Section four presents the results of estimation and section five presents the summary of this paper.

Selected Literature

Much research on assets diversification has been conducted in the past. These studies focused on the question of whether holding international assets would provide funds manager with a lower risk and a higher potential gain compared to holding domestic assets. The results seem to support international diversification. However, if the correlation among the returns on international financial assets increases, and these returns become more volatile, not much will be gained from international diversification. Many researchers have been employing recent developments in co-integration and GARCH models to examine the above potential gain, and to examine the information efficiency of the financial markets. Evidence of co-integration and increased volatility of the financial returns (as indicated by the GARCH model) implies less potential gain

¹ Rupiah is the Indonesian currency

from arbitrage. Moreover, evidence of co-integration indicates information efficiency of financial markets. On the contrary, evidence from the GARCH may not imply inefficiency.

Solnik (1974) is a 'classic' paper which examined the decrease in the risk of portfolio returns through portfolio diversification. Risk, according to Solnik, was price variability, and diversification meant holding stocks of different industries and in different countries. Seven industrialized countries were sampled and weekly price movements for the period of 1966-1971 were included in the research. Solnik argued that the decrease in the risk of return from assets is great if the correlation between stock returns is small. The paper showed that diversification of domestic stocks provided less risk reduction than diversification of international stocks, and that portfolio diversification by holding international stock means less risk of returns than diversification across industries.

Oldier and Solnik (1993) showed that investing internationally offers a greater reduction in risk, but whether these benefits will continue in the future depends cross-country correlation, market volatility, and currency risk. Yet, since the domestic monetary policy of each country is less correlated with other countries, even if the correlation of stock returns is increasing, there is still some rooms to reduce risk and increase an opportunity to obtain profit from international assets diversification.

Levy and Sarnat (1970) examined how diversification reduces risk by using Markowitz's and Tobin's rules of portfolio diversification. They employed 28 countries stock indexes within the period 1951 to 1967. The results showed that risks could be reduced through diversification if correlation among the security

returns was low. In addition, diversification using domestic asset may not result in much gain (in the form of decreased risk) because correlation among domestic assets returns may be high. Also, Kaplanis (1988) showed that the potential benefits of international diversification may be reduced if the comovement structure of international equity is non stationary than if the converse is true.

Meric and Meric (1989) examined potential gain from asset diversification in the international stock market using national stock and industry stock. Seventeen countries and seventeen industries were included in their study. The observation period ran from 1973 to 1987. The methods used were index of dependency, volatility of returns, principal components, intertemporal stability and seasonality in international stock. They concluded that in the short run, the correlation matrix among the stocks was unstable, but that this was not the case in the long run. Between May and September, the correlation showed a seasonal pattern. International stock market relationships indicated a significant change from month to month. They concluded that more gains were to be obtained from diversification across countries than across industries. Moreover, diversification through international stock reduced risk to a greater extent than diversification of domestic stock.

Alexakis and Apergis (1996) applied the efficiency test on the foreign exchange market using Deutschmark to US dollar, French franc to US dollar, and Japanese yen to US dollar rates. Quarterly data for the period 1978 to 1992 was used in their study. The methods used were co-integration and new co-integration, which included ARCH. They hypothesized that if co-integration exists between spot and futures prices of the foreign exchange, then

the spot price can be predicted perfectly through futures prices. This means no trading strategy which provides economic gain exists between spot and future prices. The study also showed that a modified co-integration model (co-integration with ARCH) provides conclusive results which differ from the results obtained from the pure co-integration model.

Schwaiger (1995) noted that the evidence of GARCH in the stock market does not necessarily imply inefficiency in the stock market. The presence of GARCH implies that stock market returns are the result of rational and efficient equilibrium pricing. He tested this hypothesis by using S&P indices from 1971 to 1988 and the quarterly GDP for the US at 1985 prices, for the years 1971 (1) to 1993 (3). An equilibrium rate of return from an economy with single assets was derived, and an individual with time additive logarithmic utility function and infinite horizon modeled. By examining the auto-correlation behavior of this equilibrium of return Schwaiger found evidence of a GARCH process. This result confirmed that GARCH do not necessarily imply inefficiency.

Lee (1992) used a multivariate VAR approach to examine causal relations and dynamic interactions among asset returns, real activity, and inflation in the postwar United States (January 1947 to December 1987). He showed that inflation did not appear to be explained by real stock returns, in line with the argument that weak (negative) relationships between stock returns and inflation are proxy for other positive relationships between stock returns and economic activity. These two findings are compatible with Fama's hypothesis that the negative correlation between stock returns and inflation is not a causal relation, but a proxy for a positive relationship

between stock returns and real activity, and is induced by a negative relationship between real activity and inflation.

Ely and Robinson (1997) examined the relationship between stock price and inflation in sixteen industrialized countries using quarterly logarithmic data for the time period 1957:1 to 1992:3. The analysis focused on whether stocks offer a good hedge against inflation. By using co-integration and vector error correction (VEC), they concluded that only limited evidence exists of such long run equilibrium between stock and inflation. This implies that stock do maintain their value relative to movements in overall price indexes, and serve as a hedge against inflation.

One example of testing financial market efficiency in the developing countries is provided by Balaban and Kunter (1997). The financial market in Turkey is used to test information efficiency. Observation of daily security exchange composite indexes, interest rates, foreign currency exchange baskets, and currency in circulation was carried out during the period January 1989 to July 1995. The method used is a Granger causality test i.e. if the two variables (markets) do not Granger-Cause, it implies that markets are not information efficient. The result shows no information efficiency for stock, foreign exchange, and interbank money markets with respect to the financial market (currency in circulation). In other words, development in the stock market, the foreign exchange market, and the interbank money market in Turkey do not fully reflect publicly available information on liquidity.

In the past, research on the Indonesian financial market focussed on the theory of the demand for money (Nasution, 1983; Boediono, 1985, among others). Later, this approach was improved, for example,

by the inclusion of the stock market (Sugiyanto, 1991), and short run and long run factors affecting the market (Insukindro, 1990). A recent contribution has been made by Husnan (1992), who examined the information efficiency of the Indonesian stock market (the Jakarta Stock Exchange), looking at both weak and moderate forms of efficiency. The weak efficiency test measures stock market efficiency based on its past price. Using coefficient of correlation, Husnan showed that there was some improvement of efficiency in the Indonesian stock market in 1990 (compared to 1984-1987, and 1989). But, when he tested using the moderate form of test, the stock market remained inefficient. In other words, using proper trading strategies will reap some abnormal profit (return) for traders.

The Indonesian stock market is open to foreign funds managers. Thus, holding of the Indonesian stock is one alternative form of international assets diversification for those managers. However, Husnan and Pudjiastuti (1994) noted that the Indonesian stock market is not integrated with markets in the Asia-Pacific region. In other words, it may be assumed that foreign managers still do not consider holding Indonesian stock in their portfolio, or the Indonesian funds managers consider only domestic assets when allocating funds. However this may no longer be the case since recent development shows an increasing share of foreign funds managers in the Indonesian stock market, Husnan (1994), and Suwandi (1997).

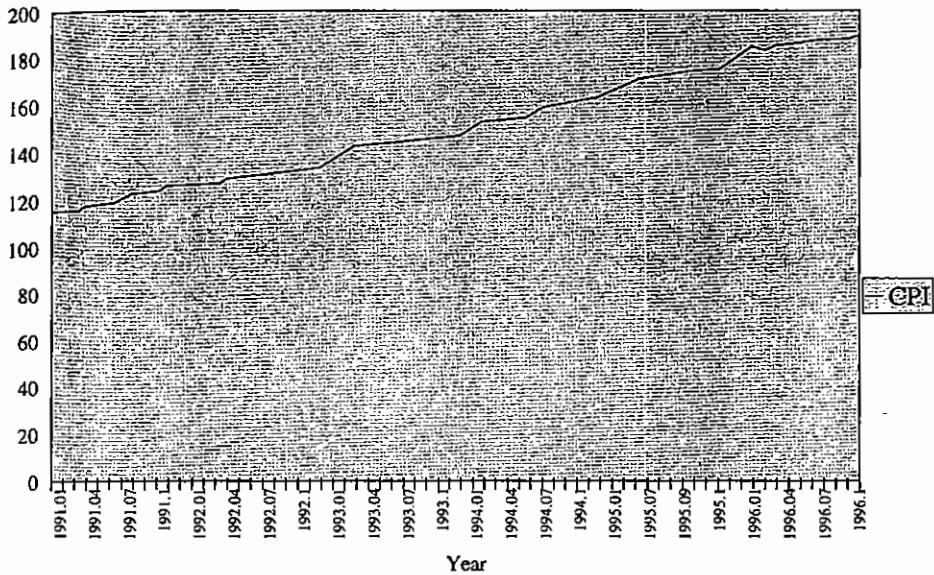
Data and Methodology

Data

This study focuses on the following financial markets: the Rupiah - US Dollar exchange market, the Indonesian Stock Market (Jakarta Stock Exchange), and the money market. The variables observed are: the Rupiah-US dollar exchange rates (EX), the Jakarta Stock Index (JSX), the Consumer Price Index (CPI), and inflation rates (INFLA). Monthly data for these variables for the period of 1991(1) to 1996(12) are used in this study.

In Indonesia people could allocate their wealth to real estate, gold, money, deposits, foreign exchange, or stock and bonds. People may have deposits and savings in the form of foreign currency. Moreover, the Indonesian government abolished the fixed exchange rates system and moved toward flexible exchange (the managed float exchange rate) in the 1970s. However, since Indonesian exports depend greatly on exports of oil, and were affected by the decrease in the world oil price, the rupiah was devaluated in 1983 and 1986. Since the beginning of the 1990s the government has maintained the managed floating system and kept the rate of depreciation of the rupiah between 5 and 6 percent per year. In addition, the Central Bank has intervened in the foreign exchange market to maintain the spread (the difference between selling and buying of foreign exchange at the Central Bank) at 8 percent. These developments opened up speculative activities on the foreign exchange market.

Figure 1. The Consumers Price Index (CPI), 1991 (1) - 1996(11)



In June 1983, the Indonesian government released a financial deregulation package. This deregulation package basically freed the state banks from setting their interest rates, abolished credits ceilings, and reduces the reserve requirement from 30 percent to 15 percent. The next deregulation package was announced in October 1988, simplifying the requirements for the private sector to open banks, and allowing foreign banks to open branches in 6 major cities outside Jakarta, and thereby stimulating competition in the financial market. In addition, the reserve requirement was decreased to 2 percent. This new regulation provided private and state owned banks with greater opportunities to compete in the market, and financial markets became more competitive.

The Jakarta Stock Exchange (JSX) was in the past operated by a government agency. But since December 4, 1991, it has been owned and operated by a private enterprise (The Jakarta Stock Exchange

Incorporated). The roots of its establishment can be traced back to the year 1912, when Indonesia was under the Dutch colonial rule. The first Indonesian stock exchange was set up in Batavia, the colonial capital and future site of Jakarta. Closed during World War II, and the Independence war in 1945, the exchange was reopened in 1977 under the management of the Capital Market Executive Agency, an institution operating under the auspices of the Ministry of Finance.

In 1995 the JSX launched the Jakarta Automated Trading System that will allow up to 50,000 transactions daily as opposed to 3,800 daily transactions under the manual trading system. Since then, both market capitalization and JSX index have increased. In December 1995, market capitalization increased 46.62 percent to Rp 152 trillion (Rp 103 trillion in 1994), and the JSX composite Index closed at 513.847, an increase of 9.41 percent over the figure for the end of 1994. In addition,

Figure 2. The US\$-Rupiah Exchange Rates (EX), 1991(1) - 1996(11)

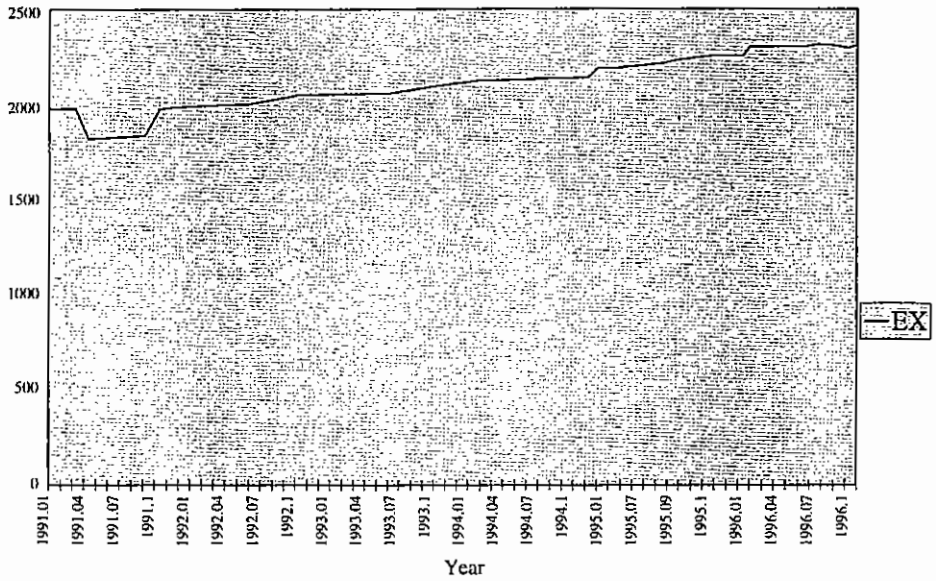


Figure 3. The Jakarta Stock Index (JSX), 1991(1) - 1996(11)

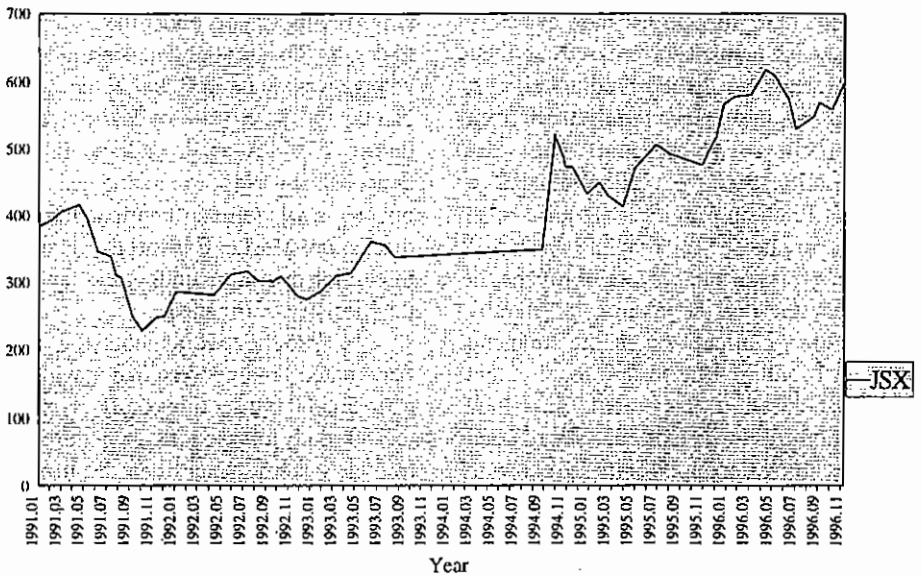


Figure 4. The Jakarta Stock Index (JSX) and the US\$-Rupiah Exchange Rates (EX), 1991(1) - 1996(11)

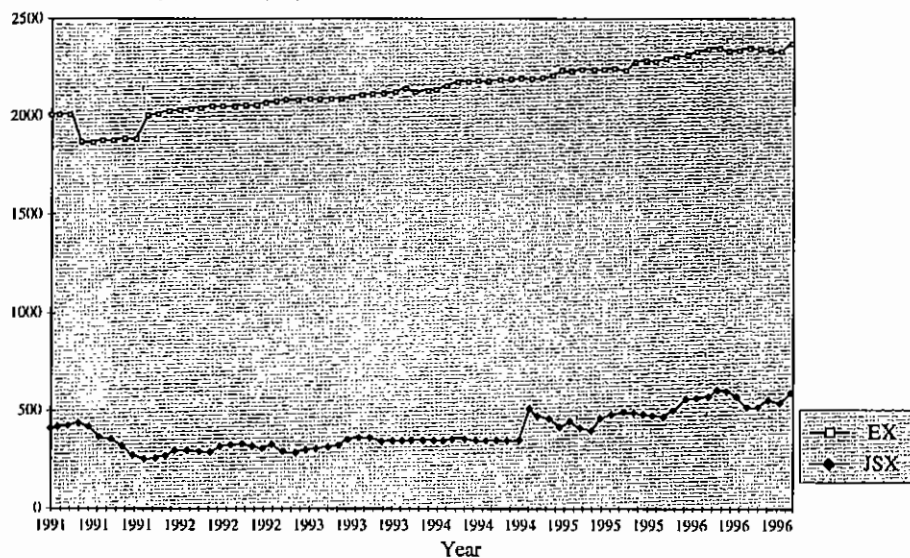


Figure 5. The US\$-Rupiah Exchange Rates (EX) and the Consumers Price Index (CPI), 1991(1) - 1996(11)

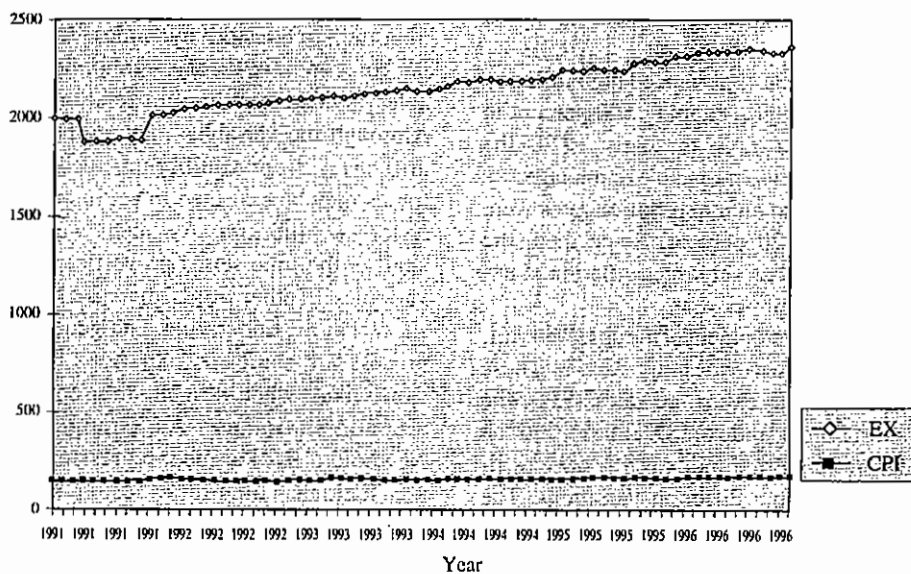
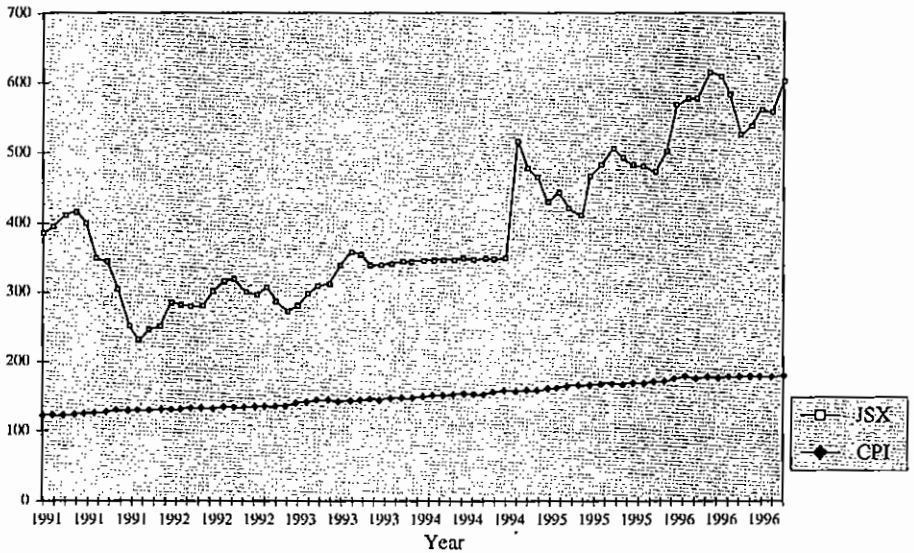


Figure 6. The Consumers Price Index (CPI) and the Jakarta Stock Index, 1991(1) - 1996(11)



foreign funds managers were invited to trade on the JSX. This boosted trading on the market, and created opportunities for the people to reallocate their wealth to attain optimum allocation.

Indonesia experienced high inflation in the mid 1960s, topping 500 percent in 1965. However, in the early 1970s the government was more able to managed its economy, and annual inflation rates were kept below 20 percent. Since then, the government has set target inflation at under 10 percent per year.

The development of the observed variables are shown in the graphs above. These variables- the exchange rates (EX), the Jakarta Stock Index (JSX Index), and the Consumers Price Index (CPI) have positive trends, but different variations. The JSX index fluctuates more sharply than the other two variables. This may indicate that a lesser degree of government intervention to stabilize the stock market. These different variations indicate a potential gain from arbitrage in the financial markets.

Methodology

Stationary

In constructing economic models it is important to consider dynamics. According to economic theory, economic variables indicate equilibrium relationships. Although the variables may temporarily drift away from equilibrium, economic forces may be expected to act in order to restore equilibrium. As such, we must analyze the time series properties of our variables. In other words, there is a need to show that the underlying data generating process are stationary. Spurious regression is likely when variables in an equation are non-stationary. As Granger and Newbold (1974) argued, regression with non-stationary time series results in high R^2 and a low Durbin-Watson statistic, arising from stochastic correlated trends in the variables being observed.

Testing stationary processes is similar to testing the presence of a unit root in an auto-regressive time series model. For

auto-regressive process to be stationary, the roots of the polynomial must exceed one, or lie outside the unit circle. Roots near the value of one imply a non-stationary process. In this paper, the Dickey-Fuller and Phillips-Perron methods are used to test the stationary. The former captures lags of the auto-regression, while the Phillips-Perron method is used to account for serial correlation of the different data (Hamilton, 1994, p. 475). Let X_t be the variable to be tested. We can write AR(1) process as

$$X_t = \beta_0 + \beta_1 X_{t-1} + \varepsilon_t$$

Subtracting X_{t-1} from both sides of this equation gives,

$$(1-L)X_t = \beta_0 + (\beta_1 - 1)X_{t-1} + \varepsilon_t$$

Then, X_t will be non stationary or has a unit-root, if $b_1 = 1$ or $b_1 - 1 = 0$ is not rejected. In that case, X_t has a degree of integration of order 1, $I(1)$. The stationary can be tested by testing the null hypothesis, $\beta_1 - 1 = 0$. The critical value of the Dickey-Fuller t -statistic (which is equivalent to the Phillips-Perron t -statistic) is -3.58 at $\alpha = 0.01$.

Co-integration

Co-integration is a feature of the relationship between time series. It is important to establish if variables move together in the long-run, even though they do not do so in the short run. Data series may be non stationary, and taking first differences may fail to detect long-run relationships. The existence of co-integration may suggest that the model shows a first differences, lead-lag relationship, and VAR may be incorrectly specified or give misleading results.

Co-integration relies on testing for unit roots. Existence of unit roots implies a non-stationary data series. If X_{1t} and X_{2t} are $I(1)$, and there exists a linear combination

$$Z_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t}$$

which is $I(0)$ and mean zero, then X_{1t} and X_{2t} are cointegrated, see Engle-Granger (1987) for more formal definition of co-integration.

In this paper, the Dickey-Fuller method is used. Let the co-integration regression be

$$z_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t}$$

then the Dickey-Fuller regression is

$$(1-L)z_t = -\phi Lz_t + \varepsilon_t$$

where L is a lag operator. Testing the hypothesis of no co-integration implies that $H_0: \phi = 0$. The Dickey-Fuller statistic is given by the t -ratio of f , with critical values of 4.07 at $\alpha = .01$, 3.37 at $\alpha = .05$, and 3.03 at $\alpha = 1$

If co-integration is confirmed, then the model can be written in an Error Correction (ECM) form

$$(1-L)X_{1t} = \delta(1-L)X_{2t} - \lambda Lz_t + v_t$$

where v_t = white noise,

δ = measures the short-run impact on X_{1t} of the changes in X_{2t}

β = measures the long-run equilibrium relationship between X_{1t} and X_{2t} ,

z_t = the ECM variable obtained from the co-integration regression.

General Autoregressive Conditional Heteroskedasticity (GARCH)

As mentioned above, if correlation between a pair of returns is high, there may nothing to gain from portfolio diversification, even if prices are not co-integrated. It is hypothesized that the conditional covariance of returns is time-varying. Following is the bivariate GARCH approach to model the time-varying process.

Let ε_{it} are drawn from a time varying distribution from equation (1).

$$X_t = \beta_0 + \beta_1 X_{t-1} + \dots + \beta_p X_{t-p} + \varepsilon_t \dots (1)$$

In the multivariate GARCH model, the M-element residual vector ε_t is specified as $\varepsilon_t | \Omega_{t-1} \sim N(0, H_t)$, where $\Omega_{t-1} = \{\varepsilon_{t-1}, \varepsilon_{t-2}, \dots\}$ and H_t : ($M \times M$) is the time varying conditional covariance matrix which may be formulated as a diagonal vech GARCH form, a positive definite GARCH form, or a generalized positive definite GARCH form (see for example Engle and Kroner, 1995). Bera and Higgins (1993) noted that there are two main problems concerning the specification of H_t : it should be positive definite for all possible realizations, and some exclusion restriction should be imposed so that the number of parameters to be estimated is not very large. One possibility is to employ the generalized positive definite form, as used by Engle and Kroner (1995). In the generalized positive definite form, the conditional covariance matrix for a GARCH (p, q) process is given by:

$$H_t = C^* + \sum_{k=1}^K \sum_{i=1}^q A_{ik} \varepsilon_{t-i} \varepsilon_{t-i}' A_{ik}' + \sum_{k=1}^K \sum_{i=1}^p G_{ik} H_{t-i} G_{ik}' \dots (2)$$

the choice of K determines the generality of the process. A form of generalized positive definite GARCH model that sets $K = M$ and imposes restrictions on A_{ik} and G_{ik} is used in this paper. Consider the GARCH (1,1) with $M=2$ (a bivariate case). The model can be rewritten as:

$$Y_t = \beta_0 + \beta_1 X_{t-1} + \varepsilon_t \dots (3)$$

where: $\varepsilon_t \sim N(0, h_t)$, and $h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \phi h_{t-1}$

Testing the existence of GARCH (p, q) is identical to testing the null hypothesis

$$H_0: \alpha_0 = \alpha_1 = \alpha_2 \dots = \alpha_q = 0$$

from the following model (Bera and Higgins, 1993).

$$\varepsilon_t | \psi_{t-1} \sim N(0, h_t) \text{ and } h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2$$

The LM statistic is equal to TR^2 and is distributed as $\chi^2_{(q)}$, where T is the number of observations and R^2 is the coefficient of multiple determination from the regression of ε_t^2 on a constant and $\varepsilon_{t-1}^2, \dots, \varepsilon_{t-q}^2$ and ε_t 's the OLS residuals from equation (1).

Results and Discussions

Results of the stationary tests

Two methods of testing the null hypothesis of a unit root (i.e. non-stationary) are used: the Dickey-Fuller and the Phillip-Perron tests. Both methods are applied on the nominal and logarithmic values of the variables. The results show that the null hypothesis of a unit root is not rejected in all variables using both methods.

These results indicate that these variables can move freely. Any fluctuation can happen to these variables. The only concern that the Indonesian government has is the inflation rates, which are shown by the stationary tests to be stationary. This may reflect the government's effort to keep the inflation rates at under 10 percent per year. As the co-integration test is carried out on the premise of non stationary process, the following three variables were used: the Jakarta Stock Index (JSX), the US dollar - Rupiah exchange rates (EX), and the Consumer Price Index (CPI).

Results of co-integration tests

Both co-integration models, with and without trends, are employed in this analysis. However, since space is limited, only

those models without trends are reported. The conclusion from these models are similar. Table 2 reports the co-integration test results: all pairs of variables are not co-integrated. This applies to both nominal and logarithmic models. These results are in line with those of Ely and Robinson (1997), among others, demonstrating a very limited long run equilibrium between the stock and the inflation. In this paper, there is no evidence of long run equilibrium in the financial markets under study.

Consider the variables observed from returns of holding financial assets. Exchange rates (EX) represents returns from holding US dollars, the Jakarta Stock Index (JSX) represents returns from holding stock, and the consumers price index (CPI)

represents the negative returns from holding rupiah (cash and demand deposits). The co-integration tests show no long run equilibrium among these returns on financial assets. Since they do not move together in the long run, traders (funds managers) may speculate in these markets and realize abnormal gains.

Moreover, holding a combination of these assets will be less risky for funds managers. As indicated by the different patterns of fluctuation of the variables over time, holding different forms of assets may be used to hedge against an adverse fluctuation. Low values of the coefficient of determination (R^2) from the models that relates CPI with JSX, and EX with JSX indicate low relationship (correlation)

Table 1. The Results of the Stationary Tests

Variable	Dickey-Fuller (in logarithmic)	Dickey-Fuller (in nominal)	Phillip-Perron (in logarithmic)	Phillip-Perron (in nominal)
EX	-1.69	-1.28	-.28	-.10
CPI	-1.78	.15	-.75	.23
JSX	-1.92	-1.83	-2.22	-2.22
INFLA	-3.64	-3.64	-6.43	-6.43

Notes: EX : the Rupiah-US dollar exchange rates
 JSX : the Jakarta Stock Index
 CPI : the Consumers Price Index
 INFLA : the inflation rates (INFLA)

Table 2. The Results of Cointegration Tests

Model	R^2	D-F Statistic	Conclusion
In Nominal Values			
CPI - EX	0.933	-2.30	Not Cointegrated
CPI - JSX	0.179	-0.81	Not Cointegrated
EX - JSX	0.153	-1.56	Not Cointegrated
In Logarithmic Values			
LCPI - LEX	0.92	-2.24	Not Cointegrated
LCPI - LJSX	0.188	-2.37	Not Cointegrated
LEX - LJSX	0.164	-2.07	Not Cointegrated

between these pairs of variables. As Oldier and Solnik (1993), Solnik (1974), Levi and Sarnat (1970) noted, this low correlation will ensure that assets diversification reduces risk.

Evidence of no co-integration also implies that markets are not information efficient. As Alexakis and Apergis (1996), and Balaban and Hunter (1997) noted, information efficiency will be gained if markets are co-integrated. Markets that are not efficient means that pricing in these markets do not reflect efficient prices. In other words, reallocation of assets from these markets may improve the welfare of the participants.

Result from GARCH model

The GARCH (1,1) model is used in this analysis. The results from estimation are presented in Table 3. The estimate of the models have high X^2 which implies

that the GARCH models are statistically acceptable to describe financial market behavior. However, only models in logarithmic values are stationary, i.e. have positive coefficients in the variance function, and the sum of these coefficients is less than one

From the Table 3 we observe that the models can be explained by GARCH (1,1). The ARCH coefficients (α_1) are significant in all of the models, but the lag of the variances are weak. The results imply that the variance of the errors are changing overtime. Therefore, these results confirm the above co-integration tests. Evidence of no co-integration also means that the variance of the errors are not constant.

In addition, as Alexakis and Apergis (1996) noted, evidence of GARCH implies that markets are not efficient. As concluded in Husnan's (1992), the Indonesian stock market is not efficient, at least

Table 3. Result of the GARCH (1,1) Models

Model	CPI - EX	EX - JSX	CPI - JSX	LCPI - LEX	LEX - LJXS	LCPI - LJXS
β_0	-200 (-59)	1731.2 (114.5)	95.52 (60.2)	-12.4 (-151.4)	6.52 (386.5)	2.35 (43.7)
β_1	.16 (105.8)	1.04 (28.53)	.15 (40.3)	2.27 (2109)	.195 (67.05)	.45 (50.12)
α_0	1.52 (3.05)	950 (2.96)	9.3 (2.44)	.000 (2.8)	.000 (3.36)	.000 (1.61)
α_1	.87 (3.58)	.82 (3.16)	.84 (3.54)	.867 (3.72)	.88 (3.76)	.71 (3.16)
ϕ	-.0007 (-.09)	-.018 (-.19)	-.13 (-1.29)	-.0055 (-2.71)	-.084 (-3.36)	.19 (1.46)
χ^2	50.8	51.57	49.1	17.37	51.72	.95
LLF	-167.58 NS	-373.12 NS	-235.098 NS	187.416 ST	186.171 ST	128.73 ST

Figures in the brackets are the t values.

LLF stands for Log Likelihood Function, NS for Non Stationary, and ST for Stationary.

in the moderate form. Recent computerization in the Jakarta Stock Exchange, and increase in the use of the internet speed up the spread of information. Decreasing the cost of acquiring information, these developments will increase efficiency in the financial markets in the near future.

Summary

Recent development in the Indonesian financial markets show a movement towards a more competitive market. This development, however, is not statistically significant. The linkage between markets still open up the opportunity to traders and arbitragers to reap potential abnormal profits. But this low correlation among markets provides fund managers with the means to reduce risk through assets diversification.

The Indonesian financial markets are still informationally inefficient, implying that pricing in the markets do not reflect

efficient prices. Reallocation of funds through arbitrage may bring the market towards an efficient price level. This process could be accelerated by the provision of a better and cheaper information. The increase in the use of the internet and increased computerization in the markets, for instance, will speed up the spread of information and trading processes. Thus, policies to support the use of these new technologies will foster the attainment of efficient markets.

This paper could be followed up by the inclusion of short term interest rates to complete measures of returns of holding money and short terms deposits. More frequent data, daily or weekly, could be used to test the sensitivity of the conclusions. In addition, the realization of the gains from asset diversification will depend on the transaction costs and other costs related to the arbitrage.

References

- Alexakis, Panayotis and Nicholas Apergis (1996), "ARCH Effects and Co-integration: Is the Foreign Exchange Market Efficient?," *Journal of Banking and Finance*, 20, p. 687-697.
- Baillie, Richard T and Robert J. Myers (1991), "Bivariate GARCH Estimation of the Optimal Commodity Futures Hedge," *Journal of Applied Econometrics*, vol. 6, p.109-124.
- Balaban, Ercan and Kürsat Kunter (1997), "A Note on the Efficiency of Financial Markets in a Developing Country," *Applied Economic Letters*, 4, p. 109-112.
- Bera, Anil K. and Matthew L. Higgins (1993), "ARCH Models: Properties, Estimation and Testing," *Journal of Economic Surveys*, vol. 7, no. 4, p. 305-69.
- Boediono (1985), "The Demand for Money in Indonesia," *Bulletin of Indonesian Economic Studies*.
- Ely, David P. and Kenneth J. Robinson (1997), "Are Stocks a Hedge Against Inflation? International Evidence Using a Long-run Approach," *Journal of International Money and Finance*, Vol. 16, No. 1, p. 141-167.

- Ely, David P. and Kenneth J. Robinson (1992), "Stock Returns and Inflation: Further Tests of the Role of the Central Bank," *Journal of Macroeconomics*, Vol. 14, No. 3, p. 525-543, Summer.
- Engle, R.F and C.W.J. Granger (1987), "Co-Integration and Error Correction: Representation, Estimation and Testing," *Econometrica*, 55, p. 251-276.
- Engle, Robert F. and Kenneth K. Kroner (1995), "Multivariate Simultaneous Generalized ARCH," *Econometric Theory*, 11, p. 122-150.
- Granger, C.W.J and Paul Newbold (1974), "Spurious Regression in Econometrics," *Journal of Econometrics*, 2, p. 111-120.
- Hamilton, James D. (1994), *Time Series Analysis*, Princeton.
- Husnan, Suad (1992), "Efisiensi Pasar Modal Indonesia," *Jurnal Ekonomi Indonesia*, April, p. 24-34.
- Husnan, Suad (1994), "Investasi di Pasar Modal Indonesia: Perkembangan, Kecenderungan, Kebutuhan dan Prospek," *KELOLA Gadjah Mada University Business Review*, No. 7/III/1994, p. 100-113.
- Husnan, Suad and S. Pudjiastuti (1994), "Diversifikasi Internasional: Pengamatan Terhadap Beberapa Bursa di Asia Pasifik," *KELOLA Gadjah Mada University Business Review*, No. 5/III/1994.
- Ibrahim, Salifu Baba and Francis Y. Kumah (1996), "Co-movements in Budget Deficits, Money, Interest Rates, Exchange Rates and the Currents Account Balance: Some Empirical Evidence," *Applied Economics*, 28, p. 117-130.
- Insukindro (1990), "The Short- and Long- term Factors Influencing the Credit Markets in Indonesia," *unpublished, PhD. Thesis*, University of Essex.
- Jakarta Stock Exchange (1996), *The Jakarta Stock Exchange at a Glance*.
- Kaplanis, Evi C. (1988), "Stability and Forecasting of the Co-movement Measures of International Stock Market Returns," *Journal of International Money and Finance*, 7, p. 63-75.
- Lee, Bong Soo (1992), "Causal Relations Among Stock Returns, Interest Rates, Real Activity, and Inflation," *The Journal of Finance*, Vol. XLVII, No. 4, September, p. 1591-1603.
- Levy, Haim and Mashall Sarnat (1970), "International Diversification of Investment Portfolio," *American Economic Review*, Vol. LX, No. 4, September, p. 668-675.
- Meric, Ilhan and Gulser Meric (1989), "Potential Gains from International Portfolio Diversification and Intertemporal Stability and Seasonality in the International Stock Market Relationship," *Journal of Banking and Finance*, 13, p. 627-640.
- Nasution, Anwar (1983), "Financial Institutions and Policies in Indonesia," *Institute of Southeast Asian Studies*, Singapore.

- Oldier, Patrick and Bruno H. Solnik (1993), "Lesson for International Assets Allocation," *Financial Analyst Journal*, March-April.
- Schwaiger, Walter S.A. (1995), "A Note on GARCH Predictable Variances and Stock Market Efficiency," *Journal of Banking and Finance*, 19, p. 949-953.
- Solnik, Bruno H. (1974), "Why Not Diversify Internationally Rather Than Domestically?," *Financial Analysts Journal*, July-August, p. 48-52.
- Sugiyanto, Catur (1991), "Time Series Analysis of the Indonesian Demand for Money," *Unpublished MA Project*, Department of Economics, University of Alberta, Canada.
- Suwandi, Titin (1997), "Kinerja Bursa Efek Jakarta 1988-1996," *KELOLA Gajah Mada University Business Review*, No 14/V/1996.
- Tirupattur, Viswanath, Phillips Garcia, and Raymond M. Leuthold (1994), "Price Linkages in Selected Agricultural, Industrial, Financial and Foreign Exchange Futures Markets Using Daily Data," *OFOR Paper* 94-10.

