The Role of Speculative Factor in the Indonesian Stock Price Determination[☆]

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Abstract

This study observes the speculative element in the price determination and its mean reverting pattern. The existence of speculative element in the Indonesian stock market price determination was proven. Exponential Generalized Auto Regressive Conditional Heteroscedasticity (EGARCH) method indicates the non-stationary process of the residuals. There are systematic as well as unsystematic component embedded in the speculative behavior. Vector Error Correction Model (VECM) concludes that prices contain volatilities in the short run, but, it will revert to the mean in the long run. Investors' behavior are neutral toward expected gain vis a vis losses in a stock trading.
Keywords: Speculative; Capital Market; Shares Pricing; Demand for Shares; Investment Decision

Abstrak

Penelitian ini mengamati elemen spekulatif dalam penentuan harga yang memiliki pola mean reverting. Adanya pengaruh elemen spekulatif dalam penentuan harga saham telah terbukti. Metode Exponential Generalized Auto Regressive Conditional Heteroscedasticity (EGARCH) *menunjukkan tidak stasionernya proses residu dalam persamaan. Perilaku spekulatif mencakup unsur sistematik maupun non sistematik. Metode* Vector Error Correction Model (VECM) *menyimpulkan bahwa harga saham mengalami volatilitas dalam jangka pendek, tetapi akan kembali ke rata-ratanya dalam jangka panjang. Perilaku investor netral terhadap ekspektasi keuntungan/ kerugian dari suatu transaksi saham.*
Kata kunci: *Spekulasi; Pasar Modal; Penentuan Harga Saham; Permintaan Saham; Keputusan Investasi*

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1. Introduction

The global crisis, started by the US financial meltdown in 2007, has, immediately, creates a big question: "How could a deep crisis, which then spread over to the whole world, took place in a such big country with an established economic infrastructure?" Several studies, among others Min-sky (2008), Malkiel (2010) citing Shiller (2000) concluded that the root causes were mainly due to: (1) The speculative behavior of the economic agent; (2) the weaknesses and ineffectiveness of the regulation (economic infrastructure) and; (3) the inadequacy of risk management.

The three factors mentioned above have the consequences of mispricing or mis-valuation of a product or an asset. In the case of share (stock), the mispricing or mis-valuation has been indicated by the existence of a price bubble, defined by the financial economist, for example Tirole (1985), as a positive deviation from the fundamental or intrinsic value. The market crash will probably take place if the real economic capacity can no longer support the bubble.

The existence of speculative element in the stock

market may not only create inefficiency in that market but, it may also affect the optimality of the resources allocation in the whole economy. Price determination in the stock market, however, is always a mistery. It fluctuates significantly from time to time and no one has an exact answer to this. Fundamentally, price of a stock should represent value of the firm. In an efficient condition, there should be no such big movements in the market, producing a zero sum game situation. However, the fact does not necessarily run on this way. Shiller (1981) in his study, concluded that the movement of stock price cannot be explained by changes in dividend or earning flows only.

In his further study, Shiller (2005) mentioned that other factors identified as structural, cultural, and psychological also influence, significantly, the price fluctuation. The internet era and baby boom and ponzi scheme were considered as structural factors affecting the stock price determination. The cultural factors were mainly due to media development and new economic paradigm. They create a price bubble in the stock market. Investor overconfidence, herding behavior and speculative motive, among others, are the psychological factors affecting price.

Factors mentioned above seem to happen also in Indonesia, although there is no such specific study yet on that matter. Price fluctuation and market crash were happened in the Indonesian stock market. Indonesia has experienced two big stock market crash during the period of 1992 to 2011, i.e., 1998 and 2008. In 1998, the Jakarta Composite Index (Index) dropped from its highest level of 718 in August 1997 to the lowest 256 in the fourth quarter of 1998. In 2008, the Global Crisis, has caused the Index to fall from 2.830 in January 2008 to only 1.111 in October 2008. The Index had recovered to 4.193 on August 1st, 2011 but drop again to 3.763 at November 2011.

Many argue that the 1998 stock market crash was mainly due to lack of confidence to Indonesian market. The economic crisis in Indonesia was the main reason for this lack of confidence. The 2008 market crash, however, was analyzed as the consequences of capital outflow due to the fund needed in the original countries. At any time, the Indonesia stock market index is always fluctuating which creates question on the efficiency of the market.

Study on market efficiency in the Indonesia Stock Market was made, among others, by Nikita and Soekarno (2012), Sula (2004), and Ayuningtyas (2007). Using efficient market hypothesis as their model, the studies revealed a different finding. Nikita and Soekarno concluded that during 2008–2011, the Indonesia Stock Market was not efficient in a weak form. Sula, using daily return data during 1999–2004, also concluded that the weak form of efficient market hypothesis does not exist in Jakarta Stock Exchange (renamed to Indonesia Stock Exchange later on). Ayuningtyas provides evidence that future stock price can be predicted by using Jakarta composite (IHSG) and LQ45 indices during the period 2005–2006.

Other method to detect the efficiency of the stock market is through the analyses of the existence of speculative element in the stock price formation. This paper aims to study this matter. However, it will not cover factors affecting the speculative behavior as mentioned by Shiller (2005) above. The main purpose of the study is to indicate that: (1) the speculative behavior of the investor has the influence to the price determination in the Indonesian stock market and; (2) the price movement (and hence the speculative behavior) has the pattern of mean reverting.

The existence of speculative element and it's mean reverting process will be detected through the stationarity of the residual variances process in the equation between price and the value of market fundamental as well as the demand shock. Reference was made to the study of De Long et al. (1989, 1990) with respect to noise trader risk pricing model and positive feedback demand function.

2. Literature Review

The word "speculative" in this paper refers to the behavior of certain individual during his/her investment decision in a stock trading. A speculative decision does not necessarily deviate from the objective of maximizing utilities. Description and analysis of the speculative decision will be made through the concept of demand and pricing of stock.

2.1. Demand for Stock

The demand for stock, represented by volume of transaction (v), is derived from the investor's utility function with the objective of maximizing wealth. Utility function is a representation of preferences. As in other goods and services, demand for shares is a function of its price, although, Aiyagari (1988) concludes that the demand for stock is not only determined by the current, but also the future price. De Long et al. (1989) studied the effect of positive feedback strategy in the noise trader demand for stock. In his study, De Long et al. classified the investors into three different categories with different demand patterns. Those are: (1) noise trader (also called positive feedback or speculative investors); (2) sophisticated or rational or real investor and; (3) passive investor. Following Black (1986), De long et al. defined the noise traders as investors who act on noise during stock trading and base their decision on believe of future price and market.

Noise trader, based on his/her belief toward non fundamental information, drives price to increase. Their demand is an exponential function of price with the positive feedback coefficient as the exponent variable. The later reflects the implication of the positive feedback strategy. The noise trader decision, however, contains a misperception risk, which, in this study, will be viewed as part of the speculative element. The sophisticated investors, on the other hand, try to maximize their utility reflected in their consumption function at the end of the investment period. Their investment decision will be based on the rational expectation of the return. The passive investors follow the market.

De Long et al divided investment process into four periods (0, 1, 2, 3). Period 0, is a starting point where there is no trading and the stock's price equal to the fundamental value stated at zero (0). During period 1, an information on price shock in period 2 were received by the sophisticated investor. The noise trader creates demand shock in period 2. In period 3, all investors liquidate the shares, received a fixed dividend and the price is back to the fundamental value. The sophisticated investor, being the arbitrator, is doing the arbitrage transaction only with the passive investor. Total demand in the market, therefore, will not change.

The study conclude that, instead of acting as an arbitrator and bring the share's price back to the

fundamental value, sophisticated investors, during a price increase, have actually been doing the other way around. They follow the positive feedback strategy, therefore, shifting the demand function up-ward, and then, out from the market when price is going to fall. This phenomena, whereby, in the short run, the share's price has a positive serial correlation, and followed by a reversion to its mean in the long run, has been indicated in many empirical studies such as Fama and French (1988), Poterba and Summer (1988), and Lo and Mackinslay (1988), see De Long et al. (1989). The pattern of the mean reverting process will be dependent upon the existence of noise trader. Note that this pattern is basically due to the different demand function between noise trader and sophisticated investor. There also should be enough passive investor, the demand of which could be manipulated by noise trader or sophisticated investor.

2.2. Pricing for Stock

There are two important schools of thought in the theory of stock's pricing. Practitioners in the capital market, usually, use the firm foundation theory or castle in the air theory. They use fundamental or technical analysis as a tool to analyze the price. The academic researchers at the same time, develop pricing models which among others could be classified as efficient market hypothesis, capital asset pricing model and noise trader risk model. The firm foundation theory, originally developed by William (1938), said that the price of a share is determined by its intrinsic or fundamental value. The intrinsic value, viewed from the performance of the firm, could be calculated as the discounted dividend flow. Picerno (2010) call this as Dividend Discount Model (DDM).

Other method of determining the intrinsic value was developed by Tobin (1969) with his q theory. Under this theory, the intrinsic value of firm could be obtained through the discount process of marginal revenue product (earning) flowing in the future. The efficient market hypothesis, formerly created by Samuelson in 1965 (Picerno 2010) then developed by Fama (1970), defined price on the basis of its correlation with the collected information. This theory mentioned that the price of a share has reflected all information about the firm. Therefore, the securities, with certain category of

risk, has always been fairly priced. Depending on the nature of information, the efficient market hypothesis could be categorized into weak, semi strong and strong. The efficient market hypothesis, however, is still using dividend discounted model in formulating the price (Shiller 1981).

The capital assets pricing model (CAPM) was founded by Markowitz (1952) and developed by Sharpe (1965). This is the first model which accommodate the element of risk in the price formulation, although, the risk being associated, was only market or systematic risk. The capital assets pricing model was still using the efficient market condition as a ground. This model, was basically, searched the efficient mean-variance combination for the optimal investment in securities. With regard to the pricing of a risky asset (including shares) the capital assets pricing model states that price will comprise of the price of risk free assets plus the market risk premium adjusted by market beta coefficient. This coefficient represents the correlation between the variances of respective assets and the market variances. It indicates the responsiveness of the individual (combination of) assets to the total market.

The effect of risk in the formulation of price is reflected in risk premium which defined by Moix (2001) as: $\pi = \frac{1}{2}\text{var}(\varepsilon)\left[\frac{u''(w)}{u'(w)}\right]$. In the formula, var($\varepsilon$) represents variances of random variable with $E(\varepsilon) = 0$ and var(ε) > 0. The individual utility is assumed to be a function of wealth (w). Therefore, the $u''(w)$ and $u'(w)$ are second and first derivatives of this function respectively. From this formula, it can be concluded that the risk premium depends on two factors, i.e., the risk of the game (transaction) represented by variances ε and individual aversion toward risk reflected in $\frac{u''(w)}{u'(w)}$ (CARA). The risk of transaction could be interpreted as market driven risk, while the degree of risk aversion is the result of individual behavior.

The castle in the air theory could be traced back to the book written by John Maynard Keynes (1936). He mentioned that instead of relying on the intrinsic value, the investor is more focusing on the trend of the crowd's behavior. This herding behavior heavily participates in the forming of expectation and price. The practitioners of the capital market, usually, implement this theory through technical analysis. Two concepts, have generally been used in the

analysis. First, all information about earning, dividend and future performance, will automatically be reflected in the past price and second, price tend to move following the trend. There are several methods to apply this analysis (Malkiel 1990). Among others are: (1) filter system; (2) dow theory; (3) relative strength system and; (4) price value volume system.

De Long et al. (1990) accommodated the misperception risk in the price formulation. The price of a risky assets will comprise of its fundamental value plus the premium associated with the noise trader misperception toward risk. The asset price fluctuates due to this misperception. The deviation from the mean of variances need additional premium to hold the assets. They elaborated the speculative element through the idiosyncratic variances (De Long et al. 1988). Price comprises of the fundamental value plus the risk premium. The speculative element is reflected in idiosyncratic variances which is a random variable η with parameter τ. This parameter describes the noise trader's opinion about the deviation's standard (variances) of the return of j assets. If $\tau \neq 1$, the noise trader has a misperception toward idiosyncratic variances. Since the investor's decision was based on this misperception, $\tau \neq 1$ means that variances are not constant and consequently, the price include risk, which, in this paper, is identified as speculative risk.

2.3. Speculation in the Capital Market

Investment decision is a process involving the investor's attitude toward risk, their paradigm, method of analysis and information use. Noise traders use positive feedback strategy in the stock trading (Shleifer and Summer 1990). This strategy tend to extrapolate and follow the trend. Shleifer (2000) denoted that the belief, manifested by over/under reaction toward information they received, is used as a basis for price formulation. Such misperception based decision making creates a new type of risk called sentiment based risk (Shleifer 2000) or noise trader risk (De Long et al. 1990). In this paper it will be considered as speculative risk.

The misperception risk will create a bubble, defined as a deviation from the intrinsic value (Ti-

role 1985). As mentioned by West (1988) there are rational as well as speculative bubble. The positive feedback strategy adopted by the noise trader has caused the bubble price tend to leverage up. Malkiel (2010) refers those situations as feedback loop. Price increase tends to motivate investors to push their demand. In turn, the increase in demand will push the price up again. Continuously, the price will always be moving upward with more and more bubble content in it. In this paper the bubble will be considered as a manifestation of misperception risk.

The bubble price fluctuates and could only be maintained if the real economy is still be able to support it. The real economic support could be represented by the growth of the gross domestic product (Tirole 1985). The financial economists spell out those support by the fundamental value of the firm. If real economic foundation can no longer support the bubble, then, a boom bust may be happened. In the capital market, a market crash, is a manifestation of a boom bust situation.

The probability of market crash occurrence could be evaluated using De Long et al. (1989) model on noise trader's demand function. If sophisticated investors are dominant in the market, the mean reverting process will take place gradually because of their objective to maximize utility in an efficient market condition. On the other hand, ife noise traders dominate the market, price will not revert to the mean, although the maximum threshold allowed by the growth of the fundamental value has already been exceeded. In this speculative bubble situation, the mean reverting process will last longer or, alternatively, a market crash will take place, i.e., when the noise trader's economic capacity can, no longer, support the price increase.

2.4. The Model

The following model is summarized from De Long et al. (1990). In their model, it is assumed that noise trader (symbolized as n), based on his belief on non-fundamental information, which is not true, choose his portfolio combination. The sophisticated investor (i) exploit the noise trader misperception and acts as an arbitrator. Two type of assets are traded, risk free assets (s) and risky assets (μ). The risk free assets have a perfect elastic

supply and provide fixed dividend r. The risky assets also give a fixed dividend r, but the supply is inelastic. This supply is normalized at 1. The price of μ at period t is stated at P_t. The two types of investor choose their portfolio when they were young with the objective of maximizing their perceived expected utility based on ex ante mean of price distribution μ at $t + 1$.

The distribution of P_t is normal with the mean of $\rho*$ and variance of $\sigma_p^2 (P \sim N(\rho*, \sigma_p^2))$. The mean of misperception $\rho*$ measure the average noise trader bullishness and σ_p^2 represent the variances of misperception on the risky assets expected return. (Detail of the model can be seen in the Appendix).

The De Long et al. model assumes differences in the demand function of sophisticated investors *vis a vis* noise trader. The sophisticated investor has λ_t^i risky assets μ to maximize their utility function. The demand for risky assets μ of the sophisticated investor is:

$$\lambda_t^i = \frac{r +_t P_{t+1} - (1+r)P_t}{2\gamma\left\{_t\sigma_{P_{t+1}}^2\right\}} \qquad (1)$$

The demand of noise trader is as follows:

$$\lambda_t^n = \frac{r + P_{t+1} - (1+r)P_t}{2\gamma\left\{_t\sigma_{P_{t+1}}^2\right\}} + \frac{\rho_t}{2\gamma\left\{_t\sigma_{P_{t+1}}^2\right\}} \qquad (2)$$

The symbol γ represent the coefficient of constant absolute risk aversion.

The additional variable in the demand equation of the noise trader $\left[\frac{\rho_t}{2\gamma\left\{_t\sigma_{P_{t+1}}^2\right\}}\right]$ is due to misperception of the expected return. When the noise trader overestimate the expected return, their demand will increase and the demand of sophisticated investor decrease. The reverse situation will apply if the noise trader under-estimate the expected return.

The price of a share at period t (P_t) could be obtained through rearranging the demand equation as follows:

$$P_t = \frac{1}{1+r}\left\{r +_t P_{t+1} - 2\gamma(_t\sigma_{P_{t+1}}^2) + \mu\rho_t\right\} \qquad (3)$$

From the equation above, it could be interpreted that the price of risky assets at period t is a function of the same period noise trader misperception (ρ_t), the technology factor r, the behavior factor (γ)

and one moment ahead of the distribution of price (P_{t+1}). The final form of the price equation is as follows:

$$P_t = 1 + \frac{\mu(\rho_t - \rho^*)}{1 + r} + \frac{\mu\rho^*}{r} - \frac{(2y)\mu^2\sigma_\rho^2}{r(1 + r)^2} \quad (4)$$

The last three variables in the equation represent the effect of noise trader risk to the risky assets price formation μ. If the distribution of P_t is approaching to zero, the equilibrium price will be nearly equal to the fundamental value stated at one. The last three variables could be explained as the effects of:

1. Fluctuation of the risky assets μ due to the misperception variances of the noise trader $\left\{\frac{\mu(\rho_t - \rho^*)}{(1+r)}\right\}$.
2. Deviation of from the fundamental value due to the fact that the noise trader average misperception is not equals to zero $\left(\frac{\mu\rho^*}{r}\right)$.
3. Additional risk due to the misperception of the noise trader $\left\{\frac{2\gamma\mu^2\sigma_p^2}{r(1+r)^2}\right\}$.

In summary, the De Long et al. (1990) model stated that the price of a risky asset will be comprised of its fundamental value, which is normalized at one (1) plus the effect of misperception risk of the noise traders toward the future price or market. This misperception risk is due to a belief on non-fundamental information during their investment decision. Therefore, the misperception risk is, basically, a noise trader's behavioral aspect in the price formulation. In this paper it is considered as the speculative element during stock trading.

2.5. Identification of Misperception Risk

De Long et al. (1990) concluded that there was an effect of misperception risk to the formation of price. Since component of price could be simplified into its fundamental value and the misperception risk (speculative element) factors then, the empirical testing could be done through the regression of the above variables. The problem, however, is to identify the variable for misperception risk. As Wu and Xiao (2008) mentioned in their stud that the most popular approach used in testing the existence of price bubble is to examine the stationarity

of residual variable in the equation between price of the assets and the market fundamental. As has been explained above, price bubble could be interpreted as a manifestation of misperception risk. See Appendix for the explanation of Wu and Xiao model.

The method for regression may use Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH) which, later on, is developed into Exponential Generalized Auto-Regressive Conditional Heteroscedasticity (EGARCH) (Agus 2007). Singleton (2006) stated that this method is widely used in a discrete time volatility model. See Appendix for the explanation of the EGARCH method.

3. Method

The De Long et al. model (1989, 1990) with respect to noise trader risk pricing and positive feedback demand function will be used in this paper as the basis for modeling. Referring to Wu and Xiao (2008) and by using the EGARCH method the De Long et al. model could be modified as follows:

$$\ln P_t = a_0 + a_1 \ln d_t + a_2 \ln V_t + e_t \quad (5)$$

And

$$\ln \sigma_t^2 = \sigma^2 + j_i\left|\frac{e_{t-1}}{\sigma_{t-1}}\right| + k_1\frac{e_{t-1}}{\sigma_{t-1}} + q_1 \ln \sigma_{t-1}^2 \quad (6)$$

Equation 5 regress the price (P) with selected observable variables i.e., the fundamental value (d) represented by Earning to Price Ratio (ERP) and volume of transaction (V). In the De Long et al. model (1990) the fundamental value is normalized at one (1). Additional variable V was put in to the model to represent the demand shock. This variable accommodates the changes in the supply of shares traded in the market, the capital inflow from foreign investors and other external factors affecting the market. The variances equation uses lag period of 1. The hypothesis is that all coefficients must be zero.

The error term (e) contains the residuals variances of which will be considered as idiosyncratic in nature. This is what De Long et al. said as the representation of misperception's risk. The error term represents: (1) the misperception variances $\left(\frac{\mu(\rho_t - \rho^*)}{1+r}\right)$; (2) the deviation of misperception to

the average $\left(\frac{\mu\rho^*}{r}\right)$ and; (3) additional misperception risk $\left(\frac{2\gamma y\sigma_\rho^2}{r(1+r)}\right)$.

The speculative element, which is not observable, will be represented by these residuals. The process of its variances will (Equation 6) indicate the stationary of these variables. The equation is trying to prove that the residuals process will be affected by: (1) the previous residuals; (2) the previous variances and to explain; (3) the symmetrical nature of positive *vis a vis* negative stock. The hypothesis is that coefficient $j = k = q = 0$.

The mean reverting process and the period needed to come back to the mean will be tested using Error Correction Model (ECM). Referring to Agus (2007), the error correction model of the above equation is as follows:

$$\Delta \ln P_t = h_0 + h_1 \Delta \ln d_t + h_2 \Delta \ln V_t$$
$$+ h_3 EC_t + \varepsilon_t \tag{7}$$

The hypothesis is that the coefficient of h_3 must be equals to zero. If not, then, this coefficient will be used to calculate the period of mean reverting.

Two methods will be used during the empirical testing i.e. Vector Auto Regression (VAR) and EGARCH. The VAR method is, basically, used to detect the nature and direction of the relationship among variables, and the stability of the equation. VAR method comprises three step, i.e.: (1) stationarity testing; (2) cointegration testing and; (3) estimation.

The stationarity testing was made to indicate the existence of unit root in the data. If the stationarity does not exist, then, the variances are constant at σ^2 and the data could be used for further testing.

Cointegration testing is intended to detect the nature of relationship. If there is a long term equilibrium among variables then the cointegration exists and Vector Error Correction Model (VECM) will be used to estimate the model. Conversely, if there is no cointegration, the Vector Auto Regression (VAR) method should be applied. Analysis of the significance and direction of the relationship could be made during estimation. The Granger Causality test is used for this purpose. The stability of the model will be tested during the empirical testing. The VECM method can also be used to test the existence of mean reverting process and it's convergence period. The EGARCH method tests the

existence of speculative element in the price formulation.

The model was empirically tested using LQ45 companies listed in the Indonesia Stock Exchange as a sample. This purposive selection was made due to the fact that LQ45 represent the most sizeable and liquid shares traded in the Exchange. During 2007 to 2010 the average transaction value of LQ45 shares represented 77% of the total market. The average volume of transaction during the same period was 51%. Trading in the Indonesia stock market was, definitely, dominated by LQ45 shares. In term of frequencies, LQ45 shares represented 53% of the total market on average during 2007–2010. The market capitalization represents 69% on average of the total market. Although, in term of size, the sample selected may already representative to the population, however, the method of sample selection, for sure, will create bias to the result of the testing. Therefore, it should be considered as limitation to the study.

Data used are: (1) LQ45 index (index), to represent price; (2) volume of transaction (volume or V) for demand and; (3) earning to price ratio (EPR) to represent fundamental value. EPR is the ratio between earning to price, which represent return on investment of the stock. Earning is usually used to calculate the fundamental value of the firm. Monthly data during February 1997 to December 2010 will be used for the testing. Included in the data was the trend of the index during the market crisis in 1988 and 2008. The inclusion was purposely made to tap the speculative effect during that period. All data was converted into logarithmic form. The average EPR was obtained by inversing the average Price to Earnings Ratio (PER). The average PER was obtained through simple averaging the PER of all companies included in the LQ45 index. All of the statistical regression was processed using Eview 7. The trend of the variables used in the testing could be graphically illustrated as shown in **Figure 1**.

4. Result and Analysis

The first objective of the study is tested using the equation of the variances of the residuals (Equation 6). Before doing this, however, other independent variables included in the model (Equation 5)

(d and V) affecting the price (P) should have been proven as significant and have long term equilibrium with the dependent variables. This long term equilibrium will be proven using cointegration and causality test. Moreover, the data used in the equation should be stationary. The unit root test for each independent variables will be done to determine the level of data used. If the independent variables have a significant impact to the dependent one and they have a long term equilibrium, the residuals will cover other variables not included in the model. The speculative element will be part of term and, even, this paper assumes that the residuals are representative of this element. The probability that the residuals may contain independent variables other than speculative element should be considered as limitation of this study.

The unit root test for index, volume and EPR indicates that at logarithmic format, these variables do not have a unit root at first difference. It means that the data is stationary. The cointegration test between logarithmic data of index, volume and EPR indicates that there is a cointegration between these variables. Therefore the Vector Error Correction Model (VECM) could be used to estimate the model. The relationship among these variables will tend to reach an equilibrium in the long run. Short run variations will, ultimately, be corrected to the long run equilibrium. There is a mean reverting pattern on it. Test on the lag period resulted a minimum Schwarz Information Criterion (SIC) at one period while Akaike Information Criterion (AIC) test indicates a lag of 4 period. The lag of 4 is chosen in the estimation.

Result of the regression using VECM and lag period of 4 is shown in **Table 1**. The cointegration equation, representing the long run equilibrium relationship, could be obtained from the table as follows:

$$\text{Log Index}(-1) = -0.923602\{\text{Log Vol}(-1)\} \\ -0.190232\{\text{Log EPR}(-1)\} \\ +16.36538 \qquad (8)$$

The t statistics for volume and EPR are significant, meaning that this equation tend to reach an equilibrium in the long run. The sign of the coefficients indicates that index is negatively influenced by volume and EPR. Increase in volume and EPR will result a decrease in index. The rationale of this type of relationship was due to lag effect of information.

The regression result between index, volume and EPR using the EGARCH method is shown in **Table 2**. As can be seen from the table, at confidence level of 99%, volume of transaction has a significant impact to index. The significant statistical result indicates that the demand shock, represented by changes in volume of transaction, has significant impact to the changes in price. The sign of the coefficient indicates the positive relationship of these variables. On the other hand, EPR does not have a significant impact to index. The fundamental value does not have a significant impact to the price formation. In the long run, however, the above result is not consistent with the result of regression using Vector Error Correction Model (VECM). Under VECM, the relationship between EPR and index tend to converge to long run equilibrium. The statistical result of these two methods has no difference in the short run.

Analysis of the variance equation reveals that the role of this variable is significant. The R-Squared (R2) number was 0,41 meaning that 59% of the model was explained by the residual. Meanwhile, analysis of the variances concludes that there is a serial correlation within this variable. The coefficient of C6, which represents the previous variances, is statistically significant at $\alpha = 1\%$. The coefficient of C4 indicates the effect of volatility or previous residuals toward the residual variances. This variable is significant at confidence level of 95%. The serial correlation between the present residual's variances with the previous residuals and variances indicates the non-stationary process of the variable. Since the residuals represent the speculative element, this statistical result proves that the speculative behavior of the investor has the influence to the price determination. The existence of the speculative component in stock's price indicates the inefficiency of the market, since the price will deviates from the fundamental.

The constant (indicated by C3) is significant at 90% confidence level. The constant indicates the systematic component of the misperception risk. The investors are always aware about the existence of risk in any stock trading. Any investment decision, therefore, is always been made on a rational basis, even, by noise traders. This is a risk associated with individual behavior. The serial correlation of the residual variances represents the unsystematic element of the risk. This could be interpreted as market driven risk due to crowd's behavior and,

Table 1: Result of Estimation–VECM
Index, Volume, and EPR

Variable, Method and Lag	Estimation Result					
Total (VECM, Lag 4) Cointegration Eq	Coef.	t-Stat				
Log Indeks (-1)	1.000000					
Log Vol (-1)	-0.923602	-16.2598				
Log EPR (-1)	-0.190232	-3.00228				
C	16.36538					
Error Correction	D Log Index		D Log Vol		D Log EPR	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Coint Eq 1	-0.055877	-2.01303	0.492083	4.85945	0.535516	2.13540
D Log Index (-1)	0.182372	2.14446				
D Log Index (-4)			0.796666	2.58975		
D Log Vol (-2)					0.581603	2.68121
D Log Vol (-4)			-0.164413	-2.08941		
D Log EPR (-1)			0.099304	2.88144	-0.208244	-2.43990
D Log EPR (-2)			0.089342	2.60725		
D Log EPR (-3)					-0.194082	-2.29370
D Log EPR (-4)			0.059463	1.79547	-0.185501	-2.26170

probably, other external factors affecting the market.

The regression also indicates that the coefficient of C5 is not statistically significant. Therefore, the effect of positive shock is symmetrical to the negative shock in forming the price. There is no difference in the responses of the investors on positive *vis a vis* negative shock. They are neutral toward expected gain or loss.

The second objective of the study is tested using Error Correction Model (Equation 7) together with cointegration and causality test. In the short run, changes in index (D Log Index) are influenced by the cointegrating equation and lag 1 of its own variable. The type of relationship between current changes and its lag 1 is positive meaning that an increase in the previous index will also increase the current one. The result of the regression also shows that changes in volume and EPR have no effect to index. This kind of relationship could be interpreted as the implementation of positive feedback strategy in the short run stock trading, since price (index) is affected positively by its previous trend.

The cointegrating equation which is also significant, acts as a correction of the short run to reach long run equilibrium. The convergence period could be calculated as 17.9 period (month).

The Granger causality test indicates that there is a significant cause-effect relationship only if volume is a dependent and index and EPR are independent variables. If index is treated as dependent variable then, there is no causality relationship between index and volume as well as EPR. The stability test indicates that the model will be stable with lag 2, 6 and 10. In conclusion, the model is stable with different lag period.

5. Conclusion

Result indicates that the residual process is not stationary during the regression of the variables used in the empirical testing. There is a serial correlation during the process. It reveals, therefore, the existence of misperception risk in the price formulation. In other words, the speculative behavior of the investor has the influence to the price determination in the Indonesia stock market (first objective of the study).

There are systematic as well as unsystematic components within the risk. The systematic risk indicates that the investors are aware about the risk in any stock trading. Even for noise trader, any investment decision was made on the basis of rational thinking about the possible variances with what

Table 2: Result of Regression Using EGARCH
Variable: Index, Volume, and EPR

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LOGVOL	0.211679	0.002831	7.477.120	0.0000
LOGEPR	-0.025540	0.021064	-1.212.484	0.2253
Variance Equation				
C(3)	-1.522.835	0.730288	-2.085.251	0.0370
C(4)	1.287.267	0.591606	2.175.884	0.0296
C(5)	0.076709	0.254773	0.301089	0.7633
C(6)	0.815806	0.119810	6.809.172	0.0000

he/she expected. This is the risk associated with individual behavior. The unsystematic component of the risk could be interpreted as market driven risk. This is the risk due to the crowd's behavior and, probably, other external factors affecting the market. There is no significant differences between positive *vis a vis* negative shock in price formulation which indicate that the investor is neutral toward expected gain or losses.

Short run price fluctuation will revert to the mean in the long run. The reverting process, however, does not necessarily, revert back to the fundamental value. Since positive feedback strategy is widely used in the short run trading, the mean reverting process tend to go back to the average price of the stock. The convergence period is 17.9 period (month). The price movement (and hence the speculative behavior) has the pattern of mean reverting (second objective of the study).

The existence of speculative element in a price determination of stock and the fact that the speculative behavior has the reverting process has the implication of the importance of symmetrical information during investment decision. Any asymmetric condition will cause noise traders to misinterpret their own information which creates mispricing or misvaluation of asset including misperception of risk in it. The over valuation of risk embedded in price together with the speculative behavior of the investor tend to form an inefficient pricing formulation.

To mitigate the market inefficiency due to asymmetrical information, policies on transparency, proper valuation and enhancement of knowledge on risk management should be encouraged. The value of the firm should be constantly communicated to the investor from time to time. The capital market needs to have an early warning system to indicate, from time to time, the possibility of market swing. Knowledge of risk management should be spread over to investor as well as the management of the issuers. The knowledge will improve the rationale pricing process and reduce the speculative behavior. The policy to push the real investor, which is less speculative, should be maintained.

As a limitation, it should be noted when reading this paper that the speculative behavior analyzed in this study is basically relevant only to the LQ45 market. The conclusion of the study may not apply for the individual company's market. Therefore, it could not be used to analyze the existence and size of the speculative element for the individual share price formation.

6. Appendix

6.1. De Long et al. (1990)

Two types of investors choose their portfolio with the objective of maximizing their perceived expected utility based on ex ante mean of price distribution ν at $t+1$. The distribution of P_t is normal with the mean of ρ^* and variance of $\sigma_p^2 (P \sim N(\rho^*, \sigma_p^2)$. The mean of misperception ρ^* measures the average noise trader bullishness and σ_p^2 represent the variances of misperception on the risky assets expected return.

The utility function of each agent is as follows:

$$U = -e^{-(2\gamma)w}$$

The symbol γ represents the coefficient of constant absolute risk aversion. With the normal distribution of return, maximizing the expected U equals to

maximizing $(\bar{w} - \gamma\sigma_w^2)$ where w is the final expected value of wealth and σ_w^2 is the next one period variance of the wealth.

The sophisticated investor has λ_t^i risky assets μ to maximize:

$$
\begin{aligned}
E(U) &= \bar{w} - \gamma\sigma_w^2 \\
&= C_0 + \lambda_t^i \left[r +_t P_{t+1} - P_t(1+r)\right] \\
&\quad -\gamma(\lambda_t^i)^2\{_t\sigma_{P_{t+1}}^2\}
\end{aligned} \quad (9)
$$

The C_0 is a function of income from labor at the first period. The subscript sign in front of the symbol indicates time when the expectation is made.

One period variance P_{t+1} or $_t\sigma_{P_{t+1}}^2$ as follows:

$$
_t\sigma_{P_{t+1}}^2 = E_t\{[P_{t+1} - E_t(P_{t+1})]^2\} \quad (10)
$$

With λ_t^n risky assets, the noise traders maximize:

$$
\begin{aligned}
E(U) &= \bar{w} - \gamma\sigma_w^2 \\
&= C_0 + \lambda_t^n \left[r +_t P_{t+1} - P_t(1+r)\right] \\
&\quad -\gamma(\lambda_t^n)^2\{_t\sigma_{P_{t+1}}^2\} + \lambda_t^n(\rho_t)
\end{aligned} \quad (11)
$$

The only difference between those two equations is the existence of misperception factor in the noise trader $[\lambda_t^n(\rho_t)]$.

The demand for risky assets μ of the sophisticated investor is:

$$
\lambda_t^i = \frac{r +_t P_{t+1} - (1+r)P_t}{2\gamma\{_t\sigma_{P_{t+1}}^2\}} \quad (12)
$$

And the demand of noise trader:

$$
\lambda_t^n = \frac{r + P_{t+1} - (1+r)P_t}{2\gamma\{_t\sigma_{P_{t+1}}^2\}} + \frac{\rho_t}{2\gamma\{_t\sigma_{P_{t+1}}^2\}} \quad (13)
$$

The demand for risky assets could be negative. Even if the demand is positive, due to unbounded return, the wealth may, eventually, negative. Based on the assumption on preferences and distribution of return, the demand of the investor for the risky asset (both noise traders and sophisticated) will be a direct proportion to the perception of excess return and inversely proportional to the variances of perception.

The additional variable in the demand equation of the noise trader $\left(\frac{\rho_t}{2\gamma\{_t\sigma_{t+1}^2\}}\right)$ is due to misperception of the expected return. When the noise traders overestimate the expected return, their demand will

increase and the demand of sophisticated investor decrease. The reverse situation will apply if the noise trader under-estimate the expected return.

The price of a share at period t (P_t) could be obtained through rearranging the demand equation as follows:

$$
P_t + \frac{1}{(1+r)}\{r +_t P_{t+1} - 2\gamma(_t\sigma_{P_{t+1}}^2) + \mu\rho_t\} \quad (14)
$$

From the equation above it could be interpreted that the price of risky assets at period t is a function of the same period noise trader misperception (ρ_t), the technology factor r, the behavior factor (γ) and one moment ahead of the distribution of price (P_{t+1}).

Focusing only on the steady state equilibrium, and by assuming that the unconditional distribution of P_{t+1} equals to the distribution of P_t, the endogenous variable of the one period ahead of the price μ could be eliminated. Therefore:

$$
P_t = 1 + \frac{\mu(\rho_t - \rho^*)}{1+r} + \frac{\mu\rho^*}{r} + \frac{2\gamma}{r}(_t\sigma_{\rho_{t+1}}^2) \quad (15)
$$

The one period ahead of variance of ρ_t is a fixed function of the generation of the noise trader misperception variance ρ_t which is constant, then:

$$
_t\sigma_{\rho_{t+1}}^2 = \sigma_{\rho_{t+1}}^2 = \frac{\mu^2\sigma_\rho^2}{(1+r)} \quad (16)
$$

The final form of the equation as follows:

$$
P_t = 1 + \frac{\mu(\rho_t - \rho^*)}{1+r} + \frac{\mu\rho^*}{r} - \frac{(2y)\mu^2\sigma_\rho^2}{r(1+r)^2} \quad (17)
$$

6.2. Wu and Xiao Model

Wu and Xiao wrote the basic model as follows:

$$
p_t + q = \kappa + \delta E_t p_{t+1} + (1-\delta)E_t d_{t+1} \quad (18)
$$

In the above equation p_t and dt are the logarithmic format of price at time t (P_t) and dividend (D_t) paid during the period t to $t+1$, respectively. The logarithmic form of return is symbolized by q an δ is the average ratio of price and the sum of price and dividend ($0 < \delta < 1$), κ is a function of δ. Based on the transversality condition: $\lim_{k\to\infty} \delta^k E_t p_{t+k} = 0$ the

solution for forward looking market fundamental is:

$$f_t = \eta + (1 + \delta) \sum_{j=0}^{\infty} \delta^{\gamma} E_t d_{t+1+j} \qquad (19)$$

However, if the transversality condition does not apply, the general solution would be:

$$p_t = f_t + b_t \qquad (20)$$

The equation above refers f_t as the fundamental value and b_t is the rational speculative bubble or rational bubble. The rational bubble follows the condition:

$$E_t b_{t+1} = \frac{1}{\delta} b_t \qquad (21)$$

This bubble will eventually collapse to make the model plausible.

6.3. The EGARCH Method of Regression

The general format of the model is (Agus 2007):

$$Y_t = \beta_0 + \beta_1 X_t + e_t \qquad (22)$$

Y = Dependent Variable;
X = Independent Variable;
e = Error term.

The function of the variances of the error term is:

$$
\begin{aligned}
\ln \sigma_t^2 \quad = \quad & \sigma^2 + \alpha_1 \left| \frac{e_{t-1}}{\sigma_{t-1}} \right| + \theta_1 \frac{e_{t-1}}{\sigma_{t-1}} + ... \\
& + \alpha_p \left| \frac{e_{t-p}}{\sigma_{t-p}} \right| + \theta_p \frac{e_{t-q}}{\sigma_{t-q}} + \lambda_1 \ln \sigma_{t-1}^2 \\
& + ... + \lambda_q \ln \sigma_{t-q}^2 \qquad (23)
\end{aligned}
$$

The non stationarity of the residual process, is due to the fact that current residual is affected by previous residual as well as it's previous variances. The effect of previous residuals is indicated by the variable $\left| \frac{e_{t-1}}{\sigma_{t-1}} \right|$. The hypothesis is that $a_1 = a_2 = ...a_p = 0$.

The previous variances, indicated by $\ln \sigma_{t-q}^2$, has the hypothesis that $\lambda_1 = \lambda_2 = ...\lambda_q = 0$. If the hypothesis on the effect of previous residual and variances are proven, then, there will be a stationarity in the residual process and the variances would be constant at a_0. The stationarity of the residual

proves that there is no effect from the misperception risk.

The EGARCH method also measure the symmetrical effect of the nature of the market shock. This effect is represented by $\frac{e_{t-1}}{\sigma_{t-1}}$. If the coefficient $\theta \neq 0$ then there is no difference between positive *vis a vis* negative shock. The hypothesis that there is a-symmetrical effect, therefore, is $\theta_1 = \theta_2 = ...\theta_p = 0$.

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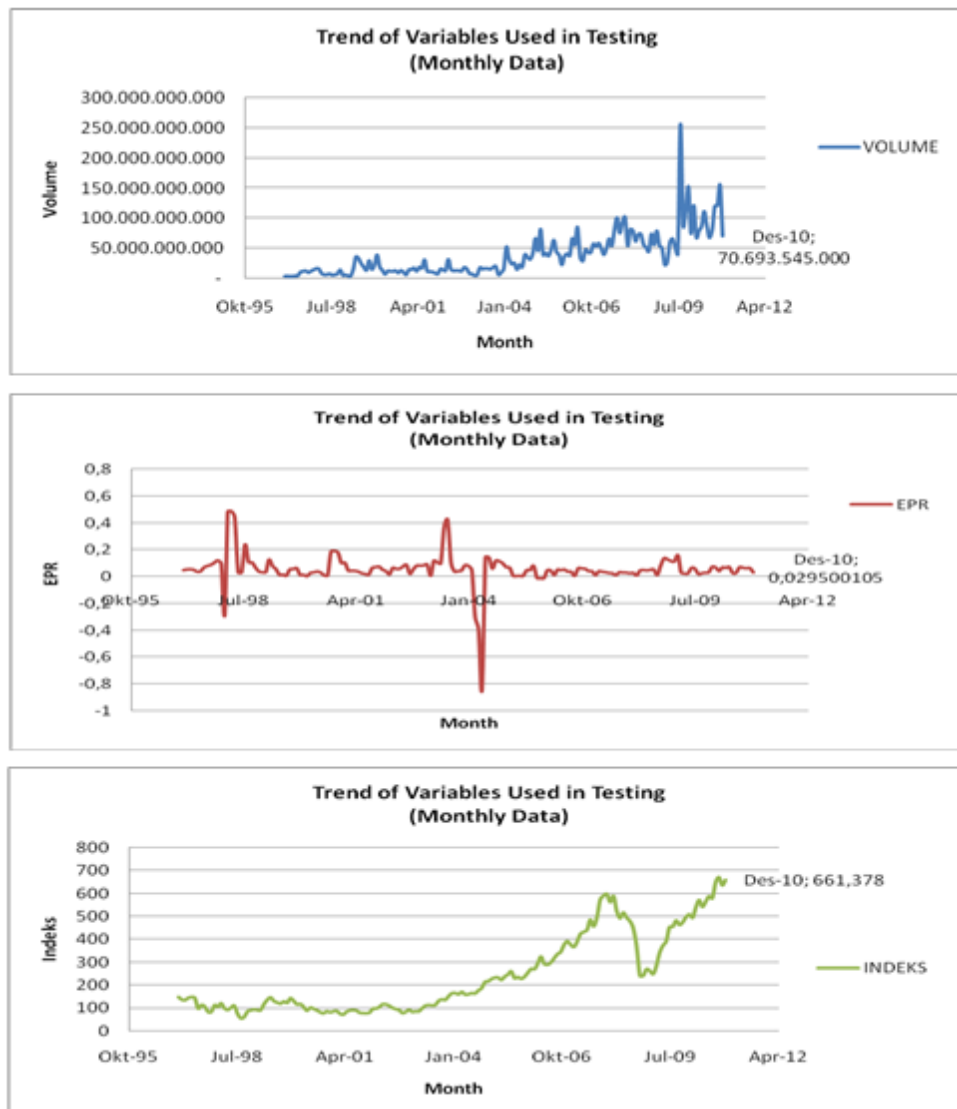
Figure 1: Trend of Variables Used in Testing