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# How the Indonesia Stock Exchange Reacts to Information: A Speed of Adjustment Coefficients Study

Yessy Peranginangin*

*This study applies the ARMA model to estimate the speed of adjustment coefficients, as suggested by Theobald and Yallup (2004), in the IDX. There is not sufficient evidence to conclude that the IDX overreacts to information. However, the findings suggest that the market either underreacts or fully adjusts to information. The IDX displays significant underreactions at weekly intervals that occur after the full adjustment. Investors' reaction is not sensitive to the size and liquidity of the indices. Size alone could not provide sufficient explanation for the different adjustment pattern across sector indices.*

**Keywords:** *speed of adjustment, underreaction, overreaction, emerging markets, market efficiency*

## Introduction

In an efficient capital market, security prices should reflect their intrinsic values and the market should be able to rationally translate new information into prices. Several attempts have been made to investigate how security prices adjust to information. For instance, Fama (1970, 1991) argues that in an efficient market, security prices fully reflect all available information. Furthermore, he defines three types of market efficiency on the basis of information availability (i.e. an efficient market in weak, semi-strong and strong form).

However, recent studies have found that security prices adjust to information irrationally, and thus investors can predict the return on the security. For example, DeBondt and Thaler (1985; 1987) found that in the US the stock market overreacts to information. In addition, it was found that the US stock market underreacts to earnings information (Bernard and Thomas, 1989) and dividends (Michaely *et al.*, 1995). Furthermore, a distinction has been made between underreaction in the short term and overreaction in the long term (Jegadeesh and Titman, 1993; 2001).

The finance literature seems to have come to an agreement on the definition of efficient market. The Fama (1970, 1991) event study approach provides a formal test that aims to determine how fast security prices react to recently published information. However, this method has several weaknesses. Chan and Ariff (2002) argue that the event study

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methodology requires identification of bad/good news as well as of the time when the information is truly new to the market (i.e. no information leakage). Furthermore, the event study methodology only concerns the systematic information and promotes a joint test of market efficiency and the estimated parameters of the market model to estimate the expected returns. Fortunately, a recent study by Theobald and Yallup (2004) developed a method to estimate the speed of adjustment coefficients. These coefficients would measure the speed of adjustment of security prices towards their intrinsic values.

Numerous studies have been conducted in the developed markets to investigate how prices react to information, but only a small fraction of similar research has been conducted in the emerging markets. In particular, little is known about how security prices react to information in the Indonesia Stock Exchange. The present study attempts to estimate the security speed of adjustment coefficients using the ARMA model (Theobald and Yallup, 2004) in Indonesia. However, differently from Theobald and Yallup (2004), this research uses sector indices due to infrequent trading. Preliminary study on the stocks that were included in the LQ45 index on August 2004 revealed that several stocks were frequently traded. In some cases the non-trading days could last more than five days. The zero returns from the non-trading days would create an artificial positive autocorrelation in the return series (Campbell et al., 1997, pp. 84-85). This artificial positive autocorrelation could generate biased standard errors and leading to invalid inferences of the estimated coefficients (Griffiths *et al*., 1993, pp. 521).

This study aims to examine how the IDX reacts to information by estimating the speed of adjustment of two more-diversified indices (Jakarta Composite Index and LQ45) and nine sector indices (less-diversified) in the IDX. Moreover, intervalling analysis would be conducted on each index to estimate number of days required by each index to achieve full reaction towards all information.

Contributions of this study are as follows. Firstly, the study will generate empirical evidence on investors' reactions in the Indonesian market using more recent data and a more robust method of estimation than Roll (1995). Secondly, the study will perform an examination on sector indices further to the one conducted by Chan and Ariff (2002). Lastly, this study provides additional study on under/over reaction in emerging markets. The study would benefit market participants in the IDX. Regulators would benefit by the application of possible improvements in the stock market regulations to minimize the possibilities of under/over reaction occurring in the IDX. Regulators could impose regulations (e.g. on information disclosure) to promote efficiency in the inefficient sectors, so that the efficiency of the market on average would be improved. The enhanced efficiency of the IDX would attract potential investors to the IDX. Investors would be assured that they are trading on the basis of information instead of noise, and thus potential investors would rest sure that they can compete fairly with the local investors in the IDX. Moreover, momentum (contrarian) strategy requires the market to under (over) react to information so that the strategy could yield abnormal returns. If the IDX is proven to under/over react to information, then this irrational reaction would lead to return predictability, hence investors who have better information could benefit from this inefficiency.

The paper is organized as follows. The next section summarises the literature. Section Three discusses the data and the methodology employed in the study. The results and analysis are detailed in Section Four. Finally, Section Five contains the

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conclusion of the paper, its limitations and further research opportunities.

## Literature Review

### Speed of Adjustment Coefficient

The method to estimate the speed of adjustment coefficients is derived from the partial price adjustment model with noise (Amihud and Mendelson, 1987). The model specifies stochastic processes between the logarithmic observed price series and its intrinsic value series. The model assumes that a security's price incompletely adjusts to its fundamental/intrinsic value and the coefficient of price adjustment captures the speed of price adjustment to information. The intrinsic value series follows a random walk process with drift, and the value of the series would respond efficiently to the unexpected information (information shocks). The observed price and the intrinsic value series would follow the specification below;

$$\Delta P(t)=\pi\{V(t)-P(t-1)\}+u(t) \quad (1)$$

$$\Delta V(t)=\mu+e(t) \quad (2)$$

The Δs are the change operators. $P$ and $V$ are the price and the intrinsic value series expressed in logarithms, respectively. Given that the observed return and the value are stationary, the speed of adjustment coefficient ($\pi$) reflects the adjustment of security price towards its value when new information arrives. This coefficient's value should be between zero and two (Black, 1986) to avoid an explosive price series. $u(t)$ is a white noise term, $\mu$ is the mean of the random walk process in intrinsic value and $e(t)$ is the innovation/shocks in logarithmic intrinsic values and this error term should not display serial correlation in efficient markets. The speed of adjustment coefficient ($\pi$) would be equal to unity if prices fully and unbiasedly adjust to information (i.e. the situation when the market is efficient). When $\pi$ is greater (lesser) than unity then market participants over (under) react to information, and when $\pi$ is equal to zero this would be an extreme case when there is no price reaction.

Previously, several studies in the finance literature have attempted to estimate the speed of adjustment coefficients using the Amihud and Mendelson (1987) model. They are Amihud and Mendelson (1989), Damodaran (1993), Brisley and Theobald (1996) and Theobald and Yallup (1998). Theobald and Yallup (2004), however, argue that these earlier methods suffer the following deficiencies.

Firstly, Amihud and Mendelson (1989) and Theobald and Yallup (1998) estimation method captured only the systematic information. Secondly, Damodaran (1993) and Brisley and Theobald (1996) did not provide a readily derived sampling distribution for the estimated adjustment coefficients. Thirdly, Amihud and Mendelson (1989), Damodaran (1993) and Brisley and Theobald (1996) derived the speed of adjustment coefficients from the cross-covariances and cross-correlations of the samples, and thus the estimated coefficients will be subject to non-trading problems. Lastly, Damodaran (1993) and Brisley and Theobald (1996) required that price should fully adjust to information at 20 day intervals. This interval limit could have the result that the potential under/over reaction at a longer time interval could not be captured by the estimated coefficients.

Theobald and Yallup (2004) propose two new estimation methods that could overcome the deficiencies of the pre-existing estimation methods. The first method is the autocovariance ratio estimator (ARE) and the second is the autoregressive (AR) coefficient in the ARMA(1,1) model. These two techniques can overcome the first deficiency of the earlier estimation methods, failure to capture all information, by deriving the speed of adjustment coefficients from the autocovariances and the autocorrelations of the returns instead of from the cross covariances/correlations. Next, the ARE does not require a derived sampling distribution, because of its instrumental variable characteristic (Theobald and Yallup, 2004). Meanwhile the ARMA model has a readily derived sampling distribution from the ARMA regressions. The third deficiency, is remedied by including the longest lag in the intrinsic values returns that affects today's returns in ARE method and increasing the MA order for the ARMA model. Lastly, these estimators do not require any assumption on how long the full reaction should take place, so the estimated speed of adjustment coefficients could capture the under/over reaction that occur across longer time intervals using different return interval (i.e. daily, weekly, etc.). The next section discusses only the analytic structure of the ARMA model since this study will only use the ARMA model to estimate the speed of adjustment coefficients. The reasons are as follow. Firstly, Theobald and Yallup (2004) suggest that the ARMA method performs better than the ARE method in sample because of its wider applicability and its stability in the inter-temporal analysis. Secondly, Roll (1995) supports Theobald and Yallup (2004) by suggesting that the regression-based estimation method performs better in sample Moreover, He estimated the speed of adjustment coefficients from the combination of variances for one and two period return process and found that the estimated speed of adjustment coefficients would have big tail distributions and an infinite mean and variances. He further argues that using autocovariances or a combination of autocorrelations and multiple-period variances would not eliminate the distribution problem mentioned earlier. Lastly, preliminary study on this estimation method yields more estimated speed of adjustment coefficients greater than the absolute value of two.

**Analytic Structure of the ARMA Estimator**

Theobald and Yallup (2004) argue that speed of adjustment coefficients would be part of the AR coefficient in an ARMA model. The derivation starts from differencing and re-arranging equation (1) to create a time-series estimation method.

$$R(t)=(1-\pi)R(t-1)+\pi\Delta V(t)+\Delta u(t) \tag{3}$$

Substituting $\Delta V(t)$ from equation (2) into equation (3) yields the following

$$R(t)=\pi\mu+(1-\pi)R(t-1)+\pi e(t)+u(t)-u(t-1) \tag{4}$$

Note that the speed of adjustment coefficients ($\pi$) would be part of the AR coefficient in the ARMA specification. The AR process in the equation would be a stationary process given that $|1-\pi|<1$ and this restriction also confirms the restriction imposed in the Amihud and Mendelson (1987) model, which suggests that the speed of adjustment coefficients ($\pi$) should be between zero and two, to ensure that prices are finite. In the presence of non-trading/synchronicities, equation (4) is modified to

$$\begin{aligned} R(m,t) = {} & \pi\mu + (1-\pi)R(m,t-1) + \\ & \sum_{i=0}^{q} w(i)L^{i}\{\pi e(t-1)+u(t-1)-u(t-1-i)\} \\ & + (1-(1-\pi)L)r(t), \end{aligned} \tag{5}$$

where $L$ is the lag operator and the ARMA structure would be an ARMA(1,$q$+1) and $q$ is the longest lag in the intrinsic value returns that impacts $R(m,t)$.


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**Empirical Results of the Speed of Adjustment Coefficients**

Theobald and Yallup (2004) compare the performance and the properties of the Damodaran (1993) method to the ARE and AR methods. In general, they confirm Damodaran's (1993) finding that the US market underreacts to information. The stocks underreact to information at shorter differencing intervals and the estimated speed of adjustment coefficients gets to unity when the differencing intervals are increased. They also investigated whether the speed of adjustment coefficients across size-sorted portfolios would support the lead/lag effects which are reported and established in Lo and MacKinlay (1990) and Jegadeesh and Titman (1995). The lagged reactions of the small capitalisation stocks could be due to the slow price adjustment and to thin trading effects. Theobald and Yallup (2004) argue that the lagged reactions of the small capitalisation stocks were indeed because of the slow adjustment to information. After taking into account thin trading effects, the small capitalisation stocks display speed of adjustment coefficients which are closer to unity than the unadjusted. However, the adjusted coefficients of the small capitalisation stocks are still smaller than the estimated coefficients of the big capitalisation stocks.

Amihud and Mendelson (1989) extended the Amihud and Mendelson (1987) partial adjustment model and proposed that the speed of adjustment coefficients of future contracts should be closer to unity than those of the underlying spots ($\pi_s < \pi_f < 1$) since the future market impounds information quicker than its underlying spots market. They found that the estimated coefficients of the future market in the US market are closer to unity than of the underlying spot. In addition, Theobald and Yallup (1998) found that the UK stock market data confirmed Amihud and Mendelson's (1989) findings. These empirical studies suggest that the faster a portfolio/stock adjusts to information the closer is the speed of adjustment coefficients to unity.

Roll (1995), in his survey paper on the Indonesian equity market, finds that the average speed of adjustment coefficients is significant and equal to 1.045. The standard deviation of the cross-sectional average is 0.0651. Furthermore, he adjusts the OLS estimated coefficients using Stein's (1955) method to get more robust estimated coefficients. He finds a similar overreaction pattern in the average speed of adjustment coefficients. However, individual stocks do not react uniformly to information. Out of 126 stocks in the sample, ten stocks underreact and 19(14) stocks overreact under the OLS(Stein) methodology. Trabelsi and Oueslati (2004) apply the Damodaran (1993) estimation method and find that the Tunisian market overreacted during 1990s. They use the Tunisian Stock Exchange Index (TSEI), Tunindex and individual stock prices to estimate how fast the Tunisian market reacts to information. At index level, they find that the TSEI and the Tunindex display similar characteristics; the speed of adjustment coefficients remains close to two for the first six daily intervals. Furthermore, individual stock analysis leads to a similar conclusion as for the index. The average speed of adjustment coefficients stabilizes at two for one to six differencing days. They noted that the full reaction took longer than 20 days to achieve full adjustment ($\pi=1$). Chan and Ariff (2002) find that, similar to the New York market, the Hong Kong market needs two days to fully adjust to information. In addition, the Hong Kong market adjusts to information faster than the Tokyo market. They conducted sector indices analysis and found that different sectors react differently to information. They argued that these differences were due to the representativeness and trading activities of the indices constituents rather than to the number of constituents. The landscape of the industry and the trading activities of the constituents also determine how fast a sector index adjusts to information.

Theobald and Yallup (2004) study provides a robust speed of adjustment coefficient. This coefficient can act as a measure of the under/over reaction when the coefficient is significantly different from unity. Additionally, this coefficient can measure securites' speed of adjusting to information by calculating the absolute difference among the estimated coefficients to unity. The closer the estimated coefficients value to unity the faster the securities react to information. Moreover, when under/over reaction occurs in daily differencing interval, the coefficient can provide length of time required by securities to achieve full reaction towards information through intervalling analysis. Given the latest development of speed of adjustment estimation techniques, this study will apply Theobald and Yallup (2004) method to estimate the speed of adjustment coefficient in the IDX. The first hypothesis of this study is the IDX does not fully react to information in two types of indices, the more-diversified and less-diversified. In addition, the second hypothesis is full-reaction in IDX can be achieved in five days. The third hypothesis aims to examine factors that would affect the speed of adjustment across different indices. The hypothesis is big capitalization indices react faster to information than the small capitalization indices. This is to examine whether the lead/lag effect appears on the estimated speed of adjustment coefficients.

# Methodology

The data for this study were obtained from the IDX Statistic starting from 1999 to May, 2009. The data used in this study are daily price index and the capitalisation of the indices, from January 4, 1999 to May 29, 2009. The study uses Jakata Composite Index (JCI), LQ45 index and sector indices data.

The speed of adjustment coefficient manifests itself in the estimated AR coefficient of an ARMA regression. However, the partial adjustment model (Amihud and Mendelson, 1987) requires that the AR order should be held equal to one while the MA order could vary (from zero to five in this study) to model the thin-trading effects. The upper bound for the MA order is set to be no higher than five so that the estimated model will not lose its degree of freedom and have greater stability over the sample period. In order to obtain a robust speed of adjustment estimate, six ARMA models (holding AR order equal 1 while the MA order ranging from zero to six) were estimated.

Each speed of adjustment estimate in this study comes from the AR coefficient of the six ARMA models that minimizes the Akaike Information Criterion (AIC). This is to ensure that the selected ARMA model used to estimate the speed of adjustment coefficients will be the best-fit model for the return series (Enders, 2004, pp. 69). When the AR coefficient is significantly different from zero one can calculate the estimated speed of adjustment. However, if the AR coefficient is not significant therefore one can conclude that the estimated speed of adjustment is equal to unity.

To increase the robustness of the estimated AR coefficients, the possibility of having an unknown form of heteroskedasticity and autocorrelation in each regression residuals is considered. The inferences of the estimated coefficients in all ARMA models in this study will be based on the Newey-West adjustment to the standard errors (Newey and West, 1987).

This study examines IDX's reaction towards information by estimating the speed of adjustment coefficients of the JCI and LQ45 indices. Moreover, sector analysis would investigate how each sector in the IDX reacts to information. In addition, similarly to Theobald and Yallup (2004), each sector's estimated speed of adjustment coefficients will be sorted based on the sector's market capitalisation to examine the existence of lead/lag effects among sector indices in the IDX. Intervalling analysis will be conducted by generating different return series, from which the ARMA models are estimated, starting from daily return to two weeks return. Different differencing days will be applied to see the time needed by each index to reach full reaction and to examine the existence of significant under/overreaction in longer return intervals. Finally, this study will estimate the speed of adjustment coefficients in two sub-sample periods to test the inter-temporal stability of the estimated coefficients in the whole sample.

## Result and Discussion

### More-Diversified Indices

The estimated speed of adjustment coefficients in Table 1 were estimated using the JCI and LQ45 index data in three sample periods. The first period covers the whole sample from 1999 to 2009. The second period covers the less recent data from 1999 to 2004 and the third covers the more recent data from 2005 to 2009. While these two indices consist of stocks from different industries, the LQ45 consists of 45 most liquid stocks in the IDX.

Table 1. Speed of Adjustment Coefficients Estimates of the JCI and LQ45 (1999 to May, 2009)

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The speed of adjustment coefficients are estimated from the ARMA model of each differencing/return series and index. Various MA orders are used (order zero to five) to obtain the ARMA model of each return series while holding the AR order equal to one. Each speed of adjustment estimate comes from the ARMA model that minimizes the Akaike Information Criterion (AIC).

| Differencing (days) | 1999- May, 2009 (whole sample) | | 1999-2004 (first sub-sample) | | 2005-May, 2009 (second sub-sample) | |
|---|---|---|---|---|---|---|
| | JCI | LQ45 | JCI | LQ45 | JCI | LQ45 |
| 1 | 0.4573* | 0.4425 | 0.4412 | 0.4373 | 0.8454* | 0.8482* |
| 2 | 0.9014* | 0.8676* | 0.8905* | 0.9003* | 0.8583* | 0.8623* |
| 3 | 0.8688* | 0.8711* | 0.8956* | 0.8990* | 0.8433* | 0.8502* |
| 4 | 0.4180* | 0.4147* | 0.8261* | 0.9534 | 0.8285* | 0.3411* |
| 5 | 0.0718* | 0.8569* | 0.1062* | 0.8909* | 0.9036 | 0.6100 |
| 6 | 0.8468* | 0.8436* | 0.8118* | 0.8454* | 0.8451* | 0.8446* |
| 7 | 0.3924* | 0.3709* | 0.3885* | 0.4144* | 0.3994* | 0.3728* |
| 8 | 0.2590* | 0.3106* | 0.3043* | 0.3009* | 0.2657* | 0.2859* |
| 9 | 0.2512* | 0.2528* | 0.2281* | 0.2349* | 0.1757* | 0.2212* |
| 10 | 0.1977* | 0.2044* | 0.1909* | 0.2009* | 0.1887* | 0.1964* |

*significantly different from **one** at 95% level.

The speed of adjustment coefficients are estimated from the ARMA model of each differencing/return series and index. Various MA orders are used (order zero to five) to obtain the ARMA model of each return series while holding the AR order equal to one. Each speed of adjustment estimate comes from the ARMA model that minimizes the Akaike Information Criterion (AIC).

Whole sample analysis on Table 1 suggests that, when the speed of adjustment coefficients were estimated using daily differencing interval, the JCI significantly underreacts while LQ45 fully reacts to new information in one day. In other words, LQ45 adjusts to information faster than the JCI. When return intervals were increased from two days to two weeks, it is found that the JCI underreacts to information up to two weeks interval. It seems that the JCI never fully adjusts to information since the estimated speed of adjustment coefficients are significantly different from unity throughout the different return intervals. However, the JCI's speed of adjustment coefficient decreased significantly in weekly return interval. The estimated speed of adjustment for the five days return is equal to 0.0718. The low value of speed of adjustment coefficient can be translated as trivial reaction to information (i.e. no further adjustment to information). Moreover, the fullest reaction of the JCI may be achieved in two days since the estimated speed adjustment in two days interval is the closest to unity. Both indices display small but significant underreaction in two weeks intervals. This might indicates that investors' underreaction in the IDX lasts at least up to two weeks time.

The first sub-sample, the less recent data, shows that the JCI and LQ45 both fully adjusts to information in its daily intervals. In other words, both indices fully adjust to information in one day. However, similar to the whole sample finding, significant underreaction occur in longer differencing intervals. Furthermore, the more recent data, suggests that the JCI and LQ45 fully react to information in weekly return interval. The JCI adjusts faster to information than LQ45 in four, six and seven days return intervals.

Whole sample data suggests that liquid stocks impound information quicker than the whole market (Amihud and Mendelson, 1989). However, this finding is not supported in both sub-samples, where the JCI reacts as fast as LQ45. Even though the JCI's and LQ45's reaction are mixed between underreaction and fully reacts but similarities exist on the way these indices react to information. The whole and sub-sample analysis confirm that both the JCI and LQ45 underreact to information from one week to two weeks return intervals. These findings are different to that of Roll's (1995). He suggests that Indonesia's market overreacts. Furthermore, the findings in Indonesia's market are different to that of Theobald and Yallup's (2004). Their results suggest that the US market processes information logically. The market would display incremental decrease (increase) in its speed of adjustment coefficients when the market initially overreacts (underreacts) to information. In addition, the process of adjusting to information finishes when the speed of adjustment coefficients is equal to unity.

**Sector Analysis**

Better understanding of the IDX's reaction to information can be obtained by investigating how different sectors in the IDX react to information. Table 2 shows the sector indices' estimated speed of adjustment coefficients. Note that BIND, MISC and CGDS indices make up the MANF index. The MANF index measures the performance of the processing/ manufacturing industry; hence the sector

Table 2. The Sector Indices' Speed of Adjustment Coefficients Estimates in the IDX from 1999 to May, 2009

The speed of adjustment coefficients are estimated from the ARMA model of each differencing return series and sector index. Each speed of adjustment estimate comes from the ARMA model that minimizes the AIC with the AR order equal to one and the MA order ranging from one to five. The MANF index measures the performance of the processing/manufacturing industry and consists of BIND, MISC and CGDS indices.

| 1999-May, 2009 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Differencing (days) | AGRI | BIND | PROP | CGDS | FINC | MANF | MINE | MISC | TRAD | UTIL |
| 1 | 0.5906* | 0.5432* | 1.3145 | 0.4172* | 0.2895* | 0.8426* | 0.9630 | 0.8998* | 0.4191* | 0.4433* |
| 2 | 0.9166* | 0.2934* | 0.9785 | 0.8818* | 0.8797* | 0.8633* | 0.9601 | 0.4784* | 0.9728* | 0.9703 |
| 3 | 0.5997 | 0.9134* | 0.0354* | 0.8674* | 0.8685* | 0.8450* | 0.0157* | 0.9011* | 0.1429* | 0.6832 |
| 4 | 0.9177* | 0.1183* | 0.4722 | 0.4439 | 0.9081* | 0.3559 | 0.1921* | 0.3737 | 0.1099* | 0.4204* |
| 5 | 0.9196* | 0.9012* | 0.4813 | 0.8544* | 0.8670* | 0.8263* | 0.2900 | 0.9087 | 0.9360 | 0.4298* |
| 1999-2004 (first sub-sample) | | | | | | | | | | |
| 1 | 0.6357* | 0.5472 | 1.3694 | 0.439 | 0.2918* | 0.8661* | 1.0329 | 0.9966 | 0.9725 | 0.4319* |
| 2 | 0.5765* | 0.2692* | 1.0134 | 0.8940* | 0.9088 | 0.8965* | 1.0428 | 0.9943 | 0.9833 | 0.9899 |
| 3 | 0.6921 | 1.3758* | 0.7671 | 1.3824 | 0.4559* | 1.7497* | 0.0833* | 0.4666 | 0.0632* | 1.0424 |
| 4 | 0.6069* | 0.2618* | 0.725 | 0.8238* | 0.8935* | 0.1520* | 0.4501* | 0.9915 | 0.0433* | 0.3216* |
| 5 | 0.5836* | 0.2315* | 1.0202 | 0.2166* | 0.8615* | 0.0438* | 0.0993* | 1.0068 | 0.9599 | 0.3031* |
| 2005-May, 2009 (second sub-sample) | | | | | | | | | | |
| | AGRI | BIND | PROP | CGDS | FINC | MANF | MINE | MISC | TRAD | UTIL |
| 1 | 0.4857* | 0.4521* | 0.0150* | 0.2421* | 0.8491* | 0.3145* | 0.4962* | 0.3731* | 0.4606* | 0.2348* |
| 2 | 0.4395* | 0.9046* | 0.9003* | 0.9184 | 0.8613* | 0.8299* | 0.0164* | 0.9888* | 0.4747* | 0.9159* |
| 3 | 0.3907 | 0.4182* | 0.3544* | 0.8907 | 0.8482* | 0.8122* | 1.6980* | 0.8295* | 0.8905* | 0.3647* |
| 4 | 0.3129 | 0.3561 | 0.3610* | 0.3082 | 0.8481* | 0.0090* | 0.8310* | 0.8278* | 0.8967* | 0.3649* |
| 5 | 0.8091* | 0.8737* | 0.8507* | 0.8829 | 0.8199* | 0.8085* | 0.8799* | 0.8290* | 0.8776* | 0.8865* |

*significantly different from **one** at 95% level.

comparison will exclude MANF, since it is not appropriate to compare sector indices to a combination of three sectors index.

Whole sample analysis suggests that most of the sector indices display significant underreaction. Using daily return, it was found that PROP and MINE fully react to information in one day. In addition, within the same daily return interval it is found that AGRI, BIND, CGDS, FINC, MANF, MISC, TRAD and UTIL significantly underreact to information. Intervalling analysis on the whole sample period suggests that UTIL fully adjusts to information in two days while AGRI and BIND fully adjust to information in three days; the speed of adjustment for BIND is the closest to unity in three days return interval. Moreover, full adjustment to information for CGDS, FINC, MANF and MISC is achieved in four days. Lastly, TRAD requires five days to achieve full reaction to information.

Comparison of speed of adjustment is conducted at daily differencing. This comparison aims to examine how fast one sector adjusts to information relative to others. The closer the estimated coefficient to unity the faster the sector adjusts to information. The order of the adjustment speed at daily return is as follows: PROP, MINE, UTIL, AGRI, BIND, CGDS, FINC, MISC, and TRAD. The first two sector indices are considered as adjust fully to information in one day hence the order of these indices do not reflect anything meaningful. Similar interpretation should be given for sectors that adjust to full information in similar return interval. In addition, MANF is excluded from comparison analysis since it comprises of three sectors.

The first sub-sample suggests that, in daily differencing, the estimated coefficients of the sector indices confirm the significant underreaction found in the JCI. AGRI, FINC, MANF and UTIL significantly underreact to information while BIND, PROP, CGDS, MINE, MISC and TRAD fully adjust to information. AGRI reaches full adjustment in three days, while FINC and UTIL reach full adjustment in two days. Full adjustment to information for MANF cannot be concluded since significant underreactions still occur up to five days return interval. A longer return interval is needed to determine how long MANF need to fully adjust to information. Speed of adjustment comparison across sectors is conducted at daily differencing. The order of the adjustment speed at daily return is as follows: BIND, PROP, CGDS, MINE, MISC, TRAD, AGRI, UTIL, FINC. The first six sector indices are considered as fully adjust to information hence the order of these indices do not reflect anything meaningful.

The second sub-sample suggests that none of the sectors fully react to information in daily interval. All sectors significantly underreact to information in daily interval. Moreover, CGDS, AGRI, and BIND fully adjust to information in two, three and four days, respectively. It seems that PROP, FINC, MANF, MINE, MISC, TRAD and UTIL do not fully adjust to information in one week. Longer return intervals are required to determine the time when these sectors achieve full reaction. The order of speed of adjustment in daily interval is CGDS, AGRI, BIND, PROP, FINC, MINE, MISC, TRAD and UTIL. The last six sectors are not fully react to information up to one week return interval, hence no comparison on the speed of adjustment can be done. Furthermore, most if the index in the second sub-sample require more days to fully adjust to information. This may suggests that the IDX needs more time to process information in the midst of global financial crises that was triggered by the sub-prime mortgage crises in the US. However, further study is required to provide supporting evidence.

The dynamic of the speed of adjustment coefficients can be observed by analyzing the estimated coefficients in the two sub-samples. The speed of adjustment of each sector index can be compared using daily interval data. The closer the estimated coefficients' value to unity the faster the index adjusts to information. Table 2 shows that FINC adjusts faster to information in the second sub-samples compared to the first one. PROP adjusts to information in similar speed in both sub-samples. The near zero underreaction in the second sub-sample (at daily interval) might be interpreted as full reaction. This full reaction is similar to PROP's reaction in the first sub-sample. This might suggest PROP maintains its efficiency in translating information to prices. However, AGRI, BIND, CGDS, MANF, MINE, MISC, TRAD, and UTIL react slower to information in the second sub-sample than in the first. Furthermore, almost all indices require more days to fully adjust to information in the second sub-sample. Only AGRI can maintain the length of days it requires to fully adjust to information. The global financial crises might affect how the IDX processes information.

**Size Sorted Reaction**

Table 3 shows the estimated speed of adjustment coefficients for each index sorted by its average market capitalisation. This study uses market capitalisation as a proxy for size and the estimated speed of adjustment estimates will be sorted based on the yearly average of each sector's market capitalisation.

As mentioned earlier, since MANF is a combination of three sector indices, no meaningful comparison can be made on the basis of this index. At daily differencing, the lead/lag relationship is not supported



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Table 3. The Average Market Capitalisation of the Sector Indices in the IDX (in IDR billions)

The yearly market capitalisation data are taken from the IDX Statistic. The average capitalisation is the simple average of the yearly market capitalisation during the sample period (1999-2009 (May); 1999-2004; 2005-2009 (May)). The sector indices are sorted in descending order based on the average capitalisation of the corresponding sample period.

Panel 1: 1999-May, 2009

| | Differencing (days) | | | | |
|---|---|---|---|---|---|
| Sectors | 1 | 2 | 3 | 4 | 5 |
| UTIL | 0.4433* | 0.9703 | 0.6832 | 0.4204* | 0.4298* |
| TRAD | 0.4191* | 0.9728* | 0.1429* | 0.1099* | 0.9360 |
| PROP | 1.3145 | 0.9785 | 0.0354* | 0.4722 | 0.4813 |
| MANF | 0.8426* | 0.8633* | 0.8450* | 0.3559 | 0.8263* |
| MISC | 0.8998* | 0.4784* | 0.9011* | 0.3737 | 0.9087 |
| MINE | 0.9630 | 0.9601 | 0.0157* | 0.1921* | 0.2900 |
| FINC | 0.2895* | 0.8797* | 0.8685* | 0.9081* | 0.8670* |
| CGDS | 0.4172* | 0.8818* | 0.8674* | 0.4439 | 0.8544* |
| BIND | 0.5432* | 0.2934* | 0.9134* | 0.1183* | 0.9012* |
| AGRI | 0.5906* | 0.9166* | 0.5997 | 0.9177* | 0.9196* |

Panel 2: 1999-2004

| | Differencing (days) | | | | |
|---|---|---|---|---|---|
| Sectors | 1 | 2 | 3 | 4 | 5 |
| MANF | 0.8661* | 0.8965* | 1.7497* | 0.1520* | 0.0438* |
| FINC | 0.2918* | 0.9088 | 0.4559* | 0.8935* | 0.8615* |
| CGDS | 0.439 | 0.8940* | 1.3824 | 0.8238* | 0.2166* |
| UTIL | 0.4319* | 0.9899 | 1.0424 | 0.3216* | 0.3031* |
| BIND | 0.5472 | 0.2692* | 1.3758* | 0.2618* | 0.2315* |
| MISC | 0.9966 | 0.9943 | 0.4666 | 0.9915 | 1.0068 |
| TRAD | 0.9725 | 0.9833 | 0.0632* | 0.0433* | 0.9599 |
| MINE | 1.0329 | 1.0428 | 0.0833* | 0.4501* | 0.0993* |
| PROP | 1.3694 | 1.0134 | 0.7671 | 0.725 | 1.0202 |
| AGRI | 0.6357* | 0.5765* | 0.6921 | 0.6069* | 0.5836* |

Panel 3: 2005-May, 2009

| | Differencing (days) | | | | |
|---|---|---|---|---|---|
| Sectors | 1 | 2 | 3 | 4 | 5 |
| UTIL | 0.2348* | 0.9159* | 0.3647* | 0.3649* | 0.8865* |
| TRAD | 0.4606* | 0.4747* | 0.8905* | 0.8967* | 0.8776* |
| PROP | 0.0150* | 0.9003* | 0.3544* | 0.3610* | 0.8507* |
| MISC | 0.3731* | 0.9888 | 0.8295* | 0.8278* | 0.8290* |
| MINE | 0.4962* | 0.0164* | 1.6980* | 0.8310* | 0.8799* |
| MANF | 0.3145* | 0.8299* | 0.8122* | 0.0090* | 0.8085* |
| FINC | 0.8491* | 0.8613* | 0.8482* | 0.8481* | 0.8199* |
| CGDS | 0.2421* | 0.9184 | 0.8907 | 0.3082 | 0.8829 |
| BIND | 0.4521* | 0.9046* | 0.4182* | 0.3561 | 0.8737* |
| AGRI | 0.4857* | 0.4395* | 0.3907 | 0.3129 | 0.8091* |

across the sector indices. Panel 1 describes that while PROP and MINE do not have the largest capitalization but they adjust faster to information than other indices whose capitalization is larger. In addition, the estimated coefficients of UTIL, TRAD, MANF, MISC, FINC, CGDS, BIND and AGRI suggest that these sectors underreact to information. If the lead/lag effects exist among these sectors, then the estimated coefficient of UTIL should be the closest to unity than that of the other indices. However, Panel 1 shows the contrary, the estimated coefficient of MISC is closer to unity than the estimated coefficient of UTIL.

Similarly, findings Panel 2 and 3 do not confirm the existence of lead/lag relationship among sector indices in the IDX. It seems size does not affect how sector indices respond to information. This finding confirms Chan and Ariff (2002) findings. They argue that differential reaction across sector indices is due to representativeness and trading activities of the indices constituents.

The estimated speed of adjustment coefficients, estimated from the JCI, LQ45 and sector indices, provide evidence that the IDX does not overreact to information. Furthermore, there are mixed evidence on whether the IDX fully reacts or underreacts to information in daily interval. Even though there are evidence that on certain sample range the JCI, LQ45 and several sector indices fully react to information in one day but this efficient reaction is followed by significant underreaction in longer differencing intervals. Therefore, the first hypothesis of this study cannot be fully rejected. However, one can conclude that longer interval underreaction in the IDX is apparent. Lacking of consistent evidence also leads this study to partially rejecting the second hypothesis. The whole sample and sub-sample analysis do not provide evidence that the JCI, LQ45 and sector indices fully reflect to information in less than one week trading. Moreover, it seems that characteristics other than degree of diversification of the index and liquidity can provide explanation of these mixed findings. The third hypothesis of this study can be rejected. The lead/lag effect is not supported by Indonesian data. Larger index does not react faster to information and does not lead information processing in the IDX.

## Conclusion

Applying the ARMA model to estimate the IDX's speed of adjustment, the present study finds evidence that the IDX either underreacts or fully adjusts to information from 1999 to 2008. Not enough evidence could be found to conclude that the IDX overreacts to information. Underreaction exists in weekly return after the full adjustment is achieved. The whole sample and sub-sample analysis reveals that investors' reaction in the IDX is not sensitive to the size of the indices. Thus, there is not enough evidence to support the lead/lag effects in the IDX. A possible extension to this research would be a study to examine the significance of the underreactions that occur after the full adjustment through the application of momentum strategy in the IDX. Further study is also needed to investigate the factors that could provide explanations for the differences in the sector indices' reaction to information.

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