

Lead-Lag Effects in Stock Returns: Evidence from Indonesia

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ABSTRACT

The main purpose of this research is to determine the existence of lead-lag effects in stock returns in the Indonesia Stock Exchange. Fifty-eight companies were taken as samples, selected through industrial classification and selection criteria of leader and follower stocks. The data is analysed using Vector Auto Regression method to extrapolate and investigate the existence of lead-lag effects in Indonesian capital market. This study finds that returns to stocks with relatively high market capitalizations lead returns to stocks with relatively low market capitalizations in Indonesian industry portfolios. However, out of ten industries, there are only six who contribute significant result. This research concludes that lead-lag effects do exist in certain industries and it may assist investors in managing the trading strategy. Indonesian capital market is not efficient since lead-lag effects is one of the phenomenon, which against the EMH.

Keywords: Lead-lag effects, Stock Returns, Cross-correlation, Indonesia Stock Exchange

INTRODUCTION

The emergent economic situation in Indonesia, particularly in stock markets, has over the ten years provided greater investment opportunities in the capital market. Investors expect returns in the forms of price appreciations and dividends. Investors often try to estimate the true share prices of the companies they have invested in or of prospective investments, and wonder whether these investments are worth the price currently quoted in the stock market. Since investment is a complex activity strategies in implementation and practices are required.

Many researchers have investigated phenomena opposing the efficient market hypothesis. Market over and under reaction (Fama, 1991), seasonal trends

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or January effect (Gultekin & Gultekin, 1983), Lead-Lag Effects have been tested by researchers. Lead-Lag effect in the point of view of economics has the definition of describing a situation where one (leading) variable is correlated with the values of another variable (lagging) at presently period. In this case the leading variable is determined by the high of a firm market capitalization whereas the lagging variable is verified by the low market capitalization of particular firm. Based on Lo & MacKinlay (1990) the lead-lag relationship refer to a form of return predictability in equity markets whereby current returns to some stocks, known as leader stocks, can predict future returns to other stocks, or follower stocks but not *vice versa* which made this effect is classified as asymmetric.

The Indonesian Stock Market was established before the Independence of Indonesia. The first stock exchange was recognized on 1912 in Batavia, now known as Jakarta, during the Dutch colonial era. The capital market grew gradually and became inactive during World War I and II, and when Indonesia passed from Dutch control. In 1977 Indonesian government reactivated its capital market, and thereafter the support of incentives and regulations rapidly grew. The growth of trading activities in Indonesia Stock Exchange supports that there is improvement and trust in new regulations, which BAPEPAM-LK (Badan Pengawas Pasar Modal dan Lembaga Keuangan) released in 1998. The examples of enhancement of capital market

regulations, in 1999 BAPEPAM-LK made revisions on several rules and released one new rule in order to encourage securities companies to enhance their performance.

The purpose of this study therefore is to analyse the existing lead and lag pattern on stocks that are listed in Indonesia Stock Exchange. Those companies are categorized according to their industry then classified into high or low market capitalization based on their outstanding shares times the share price at the given date.

The aim of this research is to investigate whether Lead-Lag effects exists in the practice of Indonesian capital market. It particularly focuses on daily and weekly returns on leader and follower stocks in the same industry. The primary benefits that can be received from the significant result of this research are: (i) to assist and improve the trading strategy in Indonesian capital market, (ii) to improve forecasting power, particularly in stock market (iii) the result of this thesis may lead to better understanding in lead-lag effects in Indonesian portfolios so that may enhance the knowledge regarding the matter. And the last purpose, (iv) to help the decision-making in companies that has beneficial effects through this thesis result.

LITERATURE REVIEW

Capital market has the main role of allocating the ownerships of an economy's capital stock. According to Eugene Fama (1988), the ideal market is when the prices provide accurate signals meant for resource

allocation, in which the market with the aim of firms can make production decision investment and investors are able to choose among securities that represent ownership of the firm's activities. Fama also stated the general term of market that considered being efficient is at what times the prices are always fully reflect the available information. Additionally, random walk theory confirmed by Bachelier in 1964 is consistent with EMH. The empirical study about this theory was verified in 1960s and many times since. Presently after the empirical evidence appeared, the EMH was projected based on the overwhelming logic by means if returns were forecast able, many investors would use them to produce unlimited profits.

The existence of efficient markets hypothesis predicts that market prices should incorporate all available information at any point in time. Nevertheless, there are different *kinds* of information that influence security values. As a result, financial researchers distinguish among three versions of the Efficient Markets Hypothesis, like Fama (1988) classified the EMH based on the availability of information, which consist of three forms. First is weak form, followed by semi-strong form and the last would be strong form efficiency, however the definition is depending on what is meant by the term "all available information". As mention earlier, both Fama and Malkiel agree that predictability for long-run serial correlation is equal to zero. They suggest that stock price short-run serial correlations

are not zero. Furthermore, they propose in the short-run stock prices are able to gain momentum for investors as they see several consecutive periods of same direction price movement with particular stock. "The dot-com boom" enthusiasm is believed derived from this effect (Shleifer, 2000). This phenomenon occurred derived from four main reasons. The first reason is it caused by time-variation in expected returns for different stocks. Conrad and Kaul (1988) state that the different expected returns may happen from stocks having time-varying and dissimilar sensitivities to common fundamental risk factors. This also supported by Mech (1993) who argues that lead-lag effects have been recognized from stocks with different time-varying expected returns. An alternative of this explanation is that lead-lag relationships arise due to high contemporaneous correlation between leader and follower portfolios and, at the same time, strong auto-correlation in follower portfolios (Boudoukh et al., 1995). The second motivation for lead-lag effects is the existence of non-synchronous or thin trading in some stocks (Boudoukh et al., 1995). Moreover, Hou (2007) noted that thin trading and bid-ask bounce is expected to affect estimated lead-lag effects in daily returns and therefore used weekly returns in his analysis. The third reason for lead-lead effects may come about due to the differential response of some stocks to newly released information.

International studies of lead-lag effects in the markets of various phases of development can help economists gain

important insights that may encourage efficient outcomes. Many authors about this topic mainly come from US and conducted the studies on the US stock markets. For instance, Hou (2007) (as cited in Boudoukh et al., 1995) perform their study on US equity market, they perform the study about industry information transmission and the lead-lag effect in stock returns. He discovers that lead-lag effect between big and small firms in the same industry is driven by the slow-moving adjustment to negative information. Moreover, by conditioning on industry membership to study the lead-lag effect, it describes significant result that the event does exist. In conducting the study, Hou uses weekly returns of stocks from NYSE/Amex/Nasdaq data files for the period beginning in July 1963 and ending in December 2001. The prior study about lead-lag phenomenon in UK stock market also been conducted in 2000 by Mills and Jordanov. They find the similarity of result regarding lead-lag patterns in US stock market with the London Stock Exchange.

Based on the above theoretical background, the hypothesis is created to complete the research process. The efficient market hypothesis, also known as random walk theory, is a dominant theoretical perspective that relates to the existence of lead-lag effects. Lead-lag phenomenon contravenes the basic nature of the EMH. The hypothesis development of this thesis occurs also due to the implementation of EMH into the returns predictability and

trading strategies for long term does not exist. Moreover, the basic assumption in doing this study is triggered by the existence of arguments that opposing the efficient market hypothesis (EMH). Those arguments arose as the result of the growing and changing economic situation compared to previous period when the EMH once developed. The arguments include market over-and under-reaction, January effect or seasonal trends, the effect of value and growth firms, and the focus of this thesis, which is a lead-lag effect in industry portfolios.

The above discussions point out the importance of knowing the presence of lead-lag patterns especially in developing market such as Indonesian stock market and it has never been tested before in Indonesia. Therefore, the author aims to test whether the phenomena does exist and applicable in Indonesia.

H_A: There is lead-lag relation between returns of big cap stocks and small cap stocks in the same industry

RESEARCH METHODOLOGY

The data for this study are taken from the period starts from 1 January 2008 until 31 December 2010. Those data consist of daily and weekly returns which each comprises of raw and market adjusted returns of the selected companies. There are two processes need to be conducted in selecting the appropriate sample for this research which will be discussed as follows.

Selection of Industry/ Sector for This Study

This study examines ten industry groups whose stocks make highest contribution to the total market capitalization of the Indonesian Stock Exchange. On the further condition that each industry must comprises a minimum of 4 stocks. This ensures the process or set of rules to be followed in choosing the leader stocks and follower stocks that will be discussed in the next section. Each sector must consist of at least two leader stocks and two follower stocks to be able to be selected as samples that represent the industry. The small number of stocks in the leader and follower portfolios of some industries is a natural consequence of studying lead-lag effects within the industries covered on a relatively small stock exchange. Nevertheless, some industries in Indonesian market contain of the leader and follower portfolios up to eight stocks each. Consequently, the results for those industries with a larger number of leader and follower stocks will be more reliable.

In order to test lead-lag effects required two categories of samples, which include leader and follower stocks in each industry. The terms of leader stocks are those who classified as big market capitalization firms. Big market capitalization is determined from share price times the total number of shares traded in IDX, then the author ranks them orderly started from the biggest to the smallest. Based on the orderly ranking will be selected approximately 50 percent of them as leader stocks and the rest that lesser

than 50 percent are considered as follower stocks. This selection method differs from the previous studies performed by Hou (2007) and Haque (2010) that choose leader and follower stocks for a given industry using largest 30% of stocks, by market capitalization, for a given industry as the industry's leader stocks. They also classify the middle 40% of stocks to be the mid-cap stocks and the bottom 30% are the small-cap or follower stocks for that industry. The differentiation arises due to the process in obtaining the adequate samples from Indonesian market to be tested in this research needs to be adjusted based on the situation in the market. Furthermore, Indonesian market is different with those of developed markets, as a result in choosing the samples need to be modified. Another important criterion for both leader and follower stocks is liquidity.

The author uses formal empirical methodology for this thesis that involves estimating vector autoregressive models (VAR). The vector auto-regression (VAR) model is one of the most successful, flexible, and easy to use models for the analysis of multivariate time series. In addition, since this study uses multivariate time series of data therefore autocorrelation and cross correlation tests are needed to be preliminary performed before the VAR test. To test lead-lag effects in Indonesian stock market, it defines first the 2 X 1 vector i_t as follows

$$i_t = \begin{pmatrix} R_{X, Lead} \\ R_{X, Foll, t} \end{pmatrix} = \text{equation 1}$$

And estimate

$$i_t = c + \Phi_1 i_{t-1} + \Phi_2 i_{t-2} + \dots + \Phi_p i_{t-p} + \varepsilon_t$$

equation 2

with $\varepsilon_t \sim \text{i.i.d } N(0, \Omega)$. The dimensions of c are 2×1 while $\Omega, \Phi_1, \Phi_2, \dots, \Phi_p$ are all 2×2 matrices. The author uses $p = 5$ in the regressions for daily raw and market-adjusted and weekly raw and market-adjusted returns. Furthermore, it is expected that lead-lag effects will most clearly be observed in the five periods following a shock to leader stocks.

The criteria of the existence of lead-lag effects that states and industry X shows the phenomenon based on Hou (2007), if the equation (3) and (4) below are both satisfied:

$$\Sigma g_k > 0 \quad \text{equation 3}$$

$$\Sigma g_k > \Sigma c_k \quad \text{equation 4}$$

$$k = 1$$

The equation (3) is the basic premise of the lead-lag hypothesis. It tests whether a shock to a leader stock of an industry has the significant result statistically to the corresponding follower stocks. Nevertheless, the entire stocks contained by given industry have some common characteristics. Thus a shock to the follower stocks of an industry may also be expected to have some flow-on effect to the leader stock of the same industry. For that reason, it is necessary to estimate equation (4) in order to obtain the lead-lag hypothesis to be true. The impact of a shock to follower stocks on leader stocks must be statistically less than the impact of a shock to leader stocks on the parallel follower stocks. If these two equations are not met, then the distinction between leader and follower stocks cannot be determined therefore the lead-lag effect does not exist.

Table 1
Lead-lag Effects in the Indonesian Stock Market

Industry	Positive Effect of leaders on followers			
	Daily Return	Daily Adj	Weekly Return	Weekly Adjusted
Property	0.03897	0.03518	0.09468	0.07985
Wholesale	0.03825	0.03818	0.12842	0.09365
Food		0.033384*		
& Beverages	0.03382	1.84279	0.07855	0.06584
Banking	0.04956	0.04571	0.09983	0.09165
Plantation	0.039092	0.01983	0.13857	0.16262*** 2.75969
Investment		0.03858*		0.065*
Automotive	0.03033	1.6466	0.03033	1.76777
Textile	0.04442	0.03896	0.14226	0.10035
			0.11775*	0.10302*
	0.06359	0.0519	1.80393	1.65418

TABLE 1 (continue)

Industry	Positive Effect of leaders on followers			
	Daily Return	Daily Adj	Weekly Return	Weekly Adjusted
Animal Feed	0.04286	0.04108*	0.11269	0.37814
Coal Mining	0.04211	0.04140*	0.09649	0.08819
Greater Effect of leaders on followers than vice versa				
Industry	Daily Return	Daily Adjusted	Weekly Raw Return	Weekly Market Adjusted
Property	0.0341	0.03528	0.09233	0.07985
Wholesale	0.03825	0.03818	0.14044*	0.09388
Food & Beverages	0.03382	0.033384**	0.08283	0.06318
Banking	0.0497*	0.04584*	0.09919	0.09309
Plantation	0.03059	0.01991	0.13857	0.16426**
Investment	0.03033*	0.03819*	0.03033*	0.06521*
Automotive	0.04483	0.03916	0.14264*	0.10035*
Textile	0.06359	0.0519	0.13438*	0.1037*
Animal Feed	0.04286	0.04109*	0.10711	0.35185
Coal Mining	0.04211	0.04140*	0.09706	0.08912

RESULTS AND ANALYSIS

The leader and follower coefficients come from the result of equation 3 and 4 that already explain in the methodology section. The formula intends to seek coefficients in which contribute the outcomes of returns of leaders and followers' stocks. However, this study focuses on the returns of follower stocks since the objective is to find out whether there is lead-lag relation in Indonesian industry portfolios. There are two important coefficients need to be examine thoroughly in order to achieve findings of the existence of lead-lag effects. They are the leader to follower coefficients and follower to leader coefficients. For

the reason that lead-lag phenomenon is determined by those coefficients therefore the criteria of determining the presence of the lead-lag effects is based on them. The summary of results regarding which sectors are showing significant outcome with the respects of the satisfied criteria. The results, however, need to be convinced with the results of t-statistics of certain lag, which must be positive and greater than 1.645 for 90% confidence level, 1.960 for 95% confidence level and 2.576 for 99% level of confidence. When these requirements are met, it means that the results are being proofs to the existence of lead-lag effects in Indonesian equity portfolios.

A shock to a leader stock has a positive subsequent effect on follower stocks. It also provides results for the explanation of equation (3) that is a shock to leader stocks has a greater subsequent effect on follower stocks than the effect of a similar shock to follower stocks, on leader stocks. Moreover, this table gives the same quantities for daily market-adjusted returns. The t-statistics values are verified with the t-table in order to confirm whether the lead-lag phenomenon is applicable in the tested sectors. Based on the results, in daily returns, the sectors that show significant result are food and beverages, investment, animal feed, and coal mining. The above table shows that in daily market adjusted returns, a positive shock to the leader stocks of most sectors has a positive effect on the subsequent follower stocks, in the following five days. Meanwhile, in the raw returns show none of significance results in every sub industry. The same effect is not represented in raw returns since the data in raw returns do not assign factors that need to be adjusted in order to get adequate data sample to be tested. As a result, it may lead to the insignificance outcome to detect whether there is positive effect of leader stocks to follower stocks in particular sub industry. This is not surprising as a market-wide shock perhaps encourage lead-lag effects yet the signal that provokes these effects is not as strong compared to the industry signal. Moreover, that leader's stocks have a greater effect on follower stocks than follower stocks do on leader stocks. Considering this criterion,

the daily raw returns results show only applied in banking and investment sectors. These two sectors have significance at the level 10% respectively. The other eight sectors encompass negative presence of the greater effects of leaders on followers than the other way around. This is because the summation of the leader to follower coefficients derived from five lags equal to be less than the total five lags coefficients of followers to leaders. Therefore, in these eight sectors using their daily raw returns data, the implication of greater effects of leader stocks do not apply. In the daily market adjusted returns; leader stocks generally have greater effect on follower stocks in the food and beverages, banking, investment, animal feed and coal mining sectors.

This study also demonstrates the corresponding results for weekly market-adjusted returns. The use of weekly returns for this study is consistent with previous studies conducted in developed markets such as Hou (2007), Haque (2010). The results in weekly raw returns seem to be different from the results in market adjusted returns. Based on the findings, only one sector confirms the existence of positive effects of leaders on follower stocks that is textile sector. The sector has the outcome of t-statistics of 1.80393, which obviously greater than 1.645, as a result it is considered as achieving the 90% confidence level. Since this sector demonstrates the result in 10% level of significance, that means the positive effect of leaders is there yet it is less strong compared to the weekly market

adjusted returns results. In weekly market-adjusted returns, strong lead-lag effects are observed for fewer sub industries compared to daily market adjusted returns.

There are only three sectors that included to be enclosing the positive effects of leaders on followers' stocks. The sectors are plantation, investment and textile, which show strong positive effects of leaders on followers particularly in the weekly market adjusted returns. The strongest effect is seen in plantation sector, which results in a significance of one percent (1%) level. The greater effects of leaders on followers than vice versa also found in this study for both raw and market adjusted of weekly returns. Unlike the results from daily returns, it is obvious to see that this effect is shown more results in weekly returns. In weekly raw returns, the property, wholesale, banking, investment, automotive and textile sectors have given contribution in the presence of greater effects of leader portfolios on follower portfolios than follower stocks to the leader ones. In the weekly market adjusted returns result, only plantation sector that has the greater effect of leaders on followers than vice versa by means that in this sector leader stocks have greater influence towards the followers rather than followers to leaders.

This study finds the duration of lead-lag effects in Indonesian industry portfolios. It demonstrates how soon after a shock to a sub industry's leaders, a response is seen in the leader stocks and in the follower stocks of that sub industry. In addition, the table

explains for how long those effects last in that particular period in which for this study is using five periods of lags.

For the results in Indonesia, the durations of lead-lag effects help investors to know when is the best time to invest in particular sector. In daily returns, it shows investors on which day after the leaders' shock that make significant contribution in the raising of the follower stocks. In daily raw returns results do not have any outcome that stand as evidence of the existence of lead-lag effects between leader and follower stocks. The significance of results is demonstrated in food and beverages, investment, animal feed and coal mining sectors. As a result, the durations of lead-lag effect in these returns are only to explain the duration of those sectors. For instance, the food and beverages sub industry, in the daily market adjusted returns, indicates lead-lag effect starts in second day periods after the shock and the effects of the shock can be seen up to the fifth period of days following the shock. For investment sector, the duration of lead-lag effects in daily market-adjusted returns shows the result of 1:2. It confirms that the leaders shock has significant contribution in the follower's shock, which begins from first day after the shock until the next day after the shock. Moreover, the study shows the result for animal feed sector to be 1:4 which indicates that the followers' shock happens from the first day after the leaders' shock and it ends on the fourth day. Finally, the last sector that contributes significant result in duration of lead-lag effect for daily

market-adjusted returns is coal mining sub industry. This sector signifies that when the leaders shock happens on the second day, the duration of followers' shock following the leaders exist directly in the same day after the initial shock. The duration of lead-lag effects in daily returns, as mentioned above provides the magnitude of in which day and how long the investment strategy could be implemented. The duration is shorter within days in which investors desire to invest for short-term period. The existence of daily duration of lead-lag phenomenon is consistent with Hou (2007) who believes that transmission of information to leader stocks will affect to follower stocks immediately and last for short period of time. In addition, the duration of lead-lag effects can be the reflective moment in buying or selling the follower stocks. Based on the daily returns data there are four sectors out of ten sectors that are being analysed in this study, which have strongly positive effects of the existence of lead-lag phenomenon. The sectors are food and beverages, investment, animal feed and coal mining sectors. These sub industries demonstrate that lead-lag effects do exist in daily returns although it does not cover in all sectors. This could be the evidence of certain sectors that lead for investors to invest in those particular small stocks in order to obtain abnormal returns of short-term investment.

The textile sector has the duration of (1:4) in the weekly raw returns results. It signifies that the followers' shock occurs on the first week until the fourth week

following the leaders' shock. For market-adjusted results, the sectors that show significant outcomes consist of plantation, investment and textile sectors. The duration in the plantation sector states 1:2 by means the duration of followers' shock lasts only one week after the leaders'. The next sector that has significant result is investment sector in which the follower's shock occurs at the same week after the leaders' shock. On the other hand, the effect in textile sector shows the duration of 2:5 that explains followers' shock will be occurred on the second week until the fifth week following the leaders' shock. Finally, textile sector contributes the duration of follower shock following the leader shock of 2:5. It affirms that follower's shock happens on the second day after the leaders' shock and it stops at the fifth week. The weekly duration of lead-lag effects is confirmed in certain sectors, which include plantation, investment, and textile sectors. These sectors provide evidence that lead-lag effects can be occurring in longer period than days. Lead-lag phenomenon in weekly returns verified that investors might see the opportunity to invest in small stocks of the proven sectors as longer investment than the daily ones. Based on the results of both daily and weekly returns in table 4.8, it is consistent to observe that those outcomes are by some means connected to each other. For example, the result in daily market adjusted returns for investment sector is stated 1:2, which means the follower's shock occurs on the first day after the leader's shock and will last until

the second day. In the weekly market adjusted returns result 1:1 by means the follower's shock happens during the first week following the leader's shock and it stops on the same week. This is unswerving with the daily market adjusted returns result that also asserts the shock appears to be happening during two days on a week period. Another confirmation is seen in the food and beverages, animal feed and coal mining sector, which consistently show only significance in daily returns but not in weekly returns. These sectors explain that the lead-lag duration simply occur in daily period and not in weekly period. This is validated by the non-existence of lead-lag durations on their weekly returns results. The duration of lead-lag phenomenon is strongly showed significance in the plantation's weekly market adjusted return result. And yet again, this sector is not significance in the daily market adjusted return result. One of the factors that triggers of weekly significance results in duration is the slow diffusion of information of leader stocks that affect the follower stocks. The transmission of information does not occur in days but it takes place in weeks.

CONCLUSION

From the results analysed and discussed in this paper, there is evidence to support the existence of lead-lag phenomenon in Indonesia equity portfolios. It discovers returns to stocks with relatively high market capitalization lead returns to stocks with relatively low market capitalization in the same given sector. Nevertheless, from

the ten sectors, which are tested in this study, not all of the sectors encompass the phenomenon. There are six (6) sectors that show the positive effect of leader stocks on the follower portfolios, which include food and beverages, plantation, investment, textile, animal feed and coal mining. The rest of the sectors, property, wholesale, banking and automotive sectors do not show any significance results neither in 1%, 5% nor 10%.

This perhaps due to the lack of homogeneity in the business nature between leaders and followers stock, as a result the followers do not tend to follow the leader stocks with a lag. The insignificant results may arise also as a response to the data used in this study. In other words, the selected data that represent leader stocks might have similar market capitalizations to the followers' ones. This is because of the inadequate samples to signify leaders and followers in duration of lead-lag effects. This is useful in terms of implementing the trading strategy in Indonesian capital market. The durations assign information in when to buy and sell the small stocks based on the increase of big stocks' share price. Moreover, this kind of information are presented in daily and weekly returns therefore, investors may gain effective comprehension in which terms of period they desire to invest.

This study has made a number of major contributions in the empirical literature on lead-lag effects, particularly in Indonesian literature. It has demonstrated that lead-lag effects may be stronger in the sectors that

have more clearly defined leader stocks. In specific strong lead-lag effects are found for the plantation sector in Indonesia whose larger stocks or leader stocks are significantly larger than the remaining stocks in the sub industry. Nonetheless, the lead-lag phenomenon found in Indonesia is not as strong as those documented by Hou (2007) and Haque (2010). This might due to the more clearly defined leader stocks in US and Australia than the corresponding sectors in Indonesia. Moreover, it has shown that lead-lag effects may be because of the behavioural trend chasing as the results of significance are seen more in the daily returns than in the weekly returns. Finally, it has been shown that even as lead-lag relationships perhaps due to differential response times of stocks to market-wide information, there is also possible to be a within-industry transmission effect from leader stocks to follower stocks that drives the lead-lag phenomenon.

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