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PRIVATE INFORMATION ARRIVAL AT INDONESIA STOCK EXCHANGE, REALITY OR IMAGINARY? U-SHAPED RETURN VARIANCE CURVE VERIFICATION[1]

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ABSTRACT

This research investigates occurrence of private information arrival in Indonesia Stock Exchange (IDX). The occurrence comes from overnight nontrading session as well as lunch-break hour. Lunch-break return variance decreases two times in comparison with early morning and lately afternoon return variances. This variance is due to private information arrival. This study finds that opening prices form the full day U-shape. It means that opening price causes stock mispricing. It also be concluded that lunch-break session produces the bottom line on the U-shape to move downward. U-shaped curve during morning until the end-afternoon session occurs. Therefore, the line formation implies the existence of private information arrival that is in short-lived.

Keywords*: U-shaped curve, private and public information*

INTRODUCTION

This study investigates a permanent research question "why does return volatility increase during every early morning and late afternoon trading?" Some previous research has tried many times to answer the questions which end up in price formation theory (French & Roll, 1986; Harris, 1986; Wood, Mcnish & Ord, 1985; Jain & Joh, 1988; Mcnish & Ord, 1990; Amihud & Mendelson, 1991; Peiers, 1997; Huang *et al*. 2000; Steeley & Chelley, 2001; Guner & Onder, 2002; Sumiyana, 2007; 2008; 2009). The inference obtained from those studies shows that there are three possibilities causing the high movement of return volatility. The first is public information that generally comes during trading sessions. Second, private information drives the trading which influences the price change during trading period. Third, error in pricing may occur during trading period. Furthermore, French & Roll (1986) stated that the first and third reason is denied because public information arrival does not change

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stock prices. Additionally, pricing error is observed with very low probability. Therefore, the main cause of high return volatility is only private information.

The examination of private information phenomenon which occurs especially in Indonesia Stock Exchange, herein after IDX, is conducted in series formulation of U-shaped. The U-shaped curve illustrates the distribution of return variance over certain period of time. The U-shaped curve consists of three parts, the descending line, the bottom line, and the ascending line. The early part of descending line represents return variance during morning. However, this line will flatten until lunch break. The rising return variance over afternoon is caused day-end effect phenomenon and makes the ascending line (Cheung, 1995; Jain & Joh, 1988; Ho & Cheung, 1991).

The existence of U-shaped induces that return variance during lunch break is lower than all return variance during morning and afternoon session. If the IDX also has that kind of return variance movement, it can be concluded that information dissemination during trading is correct and valid (Amihud & Mendelson, 1991; Ito & Lin, 1992). The reasons are the pressure of morning sessions as a result of private information accepted previously by investors. The trading pressure also drives the high return volatility during morning session (Ito *et al.* 1998). Frino & Hill (2001) and Balduzzi *et al.* (2001). The analysis of price volatility, trading volume, and bid-ask spreads indicates that adjustment against new information occurs very quickly, within 240 seconds. Therefore, to analyze private information arrival we use intraday data.

This study has prime contribution to detect the phenomenon of private information arrival in IDX. This phenomenon becomes extremely important due to various condition of stock market, especially emerging stock market compared to advanced stock market. As far as we know, this study is the first Indonesian research using intraday data from IDX. This study, therefore, implies that investors and potential investors in IDX should re-analyze current and future investment and investment decision. The acquired information is in form of stock price variability behavior during trading periods in IDX related to timing of sell-buy strategy. Another benefit is return information reliability during trading period in relation with the timing of investment decision taken by the investors and potential investors. Shortly, this research examines the dissimilarity of return distribution during some intervals within one day.

This study assumes that stock price behaviors between advanced capital market and emerging capital market are equal. We maintain this assumption because factors affecting return volatility behaviors in emerging capital market are the same as in advanced capital market. Furthermore, what we focused to examine U-shaped form would be identified more clearly because of the following reasons. *First*, in emerging markets there might be information leakage indicating the existence of insider trading (Dvoraks, 2005). *Second*, investors in emerging markets are accustomed to high price volatility so that they do not intelligently respond to good news, unlike investors in advance markets (Dvoraks, 2005). *Finally*, the magnitude of price fluctuations in emerging markets might be greater than that in advanced markets because stock prices might not reflect firms' fundamental values (Bhattacharya *et al*., 2000). This study also assumes that information arrives at capital market regardless of the signal from the company. This assumption makes this study purely finance in nature, and not accounting instead.

The remaining research discussion is set as follows. Section 2 discusses the literature reviews and hypothesis development, and re-examines using other sensitivity tests. Section 3 discusses research methods used to examine all hypotheses. Section 4 discusses result and finding. The last, Section 5 discusses conclusion inferred from the result and finding.

LITERATURE REVIEWS AND HYPOTHESES DEVELOPMENT

Information, Volatility and Trading Period

Fama (1970; 1991) stated that stock price reflects all available information, including previous price, public information and private information. Private information is rarely occurred and only affects the price through trading by informed investors, which usually do trading based on investor's information for more than one day (Fama, 1991). Public information is information recognized at the same time it affect the price, before the investors are able to use it as trading decision strategy (French & Roll, 1986; Berry & Howe, 1994). Public information is presented for all investors, but evaluated differently by investors who have different beliefs (Barron, 1995; Odean, 1998). Informed only do trading when new information available, such as future cash flows or other variables such as wealth, preferences, and investment opportunities. The investor's reaction against information occurs when the information arrives. The reaction causes price change that reflects the expected risks and investors acquirement (Berry & Howe, 1994).

Pritamani & Singal (2001) examined public information arrivals which are proxied by volume increase and price change. Grundy & Kim (2002) states that rank of information heterogeneity affects the increase of price variability, and subsequently contribute to price fluctuations. Suhaibani & Kryzanowski (2000) examined the information contents of new bids in Saudi Stock Market (SSM). The new bids which are greater and more aggressive are caused by information arrivals. The relative measurement of bids information implies that private information is dominant factors in stock trading decisions. Therefore, private information also affects price volatility.

Berry & Howe (1994) stated that investors react against new information arrival that is reflected in expected risks and acquired return. Public information is responded longer in overnight periods than morning and afternoon session. Therefore, return volatility is hypothesized higher during nontrading than during trading. Furthermore, Amihud & Mendelson (1991) and Huang *et al.* (2000) proved empirically that return volatility is higher during trading caused by private information arrival. Private information is disseminated during trading by the informed traders, and it is hypothesized that return during trading is higher than during nontrading.

Examination Stage and Hypothesis

This study focuses on examining the existence of private information based on U-shaped formula. This formula is trading model which believe to private information arrival. Essentially, this formula explains corrected price variance during the early morning session (Wood *et al.* 1985; Harris, 1986; Andersen & Bollerslev, 1997; Admati & Pfleiderer, 1988; Foster & Vismanathan, 1990; Slezak, 1994). Private information refers to information that meet two criteria, namely not in form of publicly known and always related to price (Ito & Lin, 1992; Ito *et al.* 1998). Meanwhile, French & Roll (1986) define that private information is correctly identifiable because it is related to price momentarily.

The volatility returns form U-shaped pattern, in which the highest volatility return is at the opening and closing session of the market (Chan *et al.* 1995). The occurrence of high volatility at the opening and closing prices in capital market is also suggested by Wood *et al.* (1985) who examine intraday stock returns. The high volatility can be caused by the noise occurrences (Steeley & Steeley, 2001).

First stage, this study examines private information arrival based on French & Roll (1986) and Ito *et al.* (1998) who examined the lowest line in U-shaped curve. The bottom line of U-shaped reflects return volatility during lunch break which is the lowest. This examination uses lunch break return volatility by

comparing opening and closing return variance. When this ratio is greater than one, this indicates private information arrival. Inversely, if the comparison value is equal to one, this can be considered as public information arrival, which means that return variance does not change over the period. Therefore, return volatility during lunch break can be hypothesized as follows.

H1: Return volatility can be detected during lunch break in IDX.

$$\text{Test: } \frac{V_L^O}{V_L^C} > 1$$

Where, V_L^C and V_L^O are closing (C) and opening (O) lunch break (L) return variances.

Second stage, this study analyze the dissimilarity of private information arrival by examining the change of return volatility during morning and afternoon sessions. This stage conducts to assign model exposed by Admati and Pfleiderer (1988). The research suggests that if a number of private information did not change while the trading drives the change, private information should not cause price change whose return is not distributed during morning until afternoon. In fact, private information always drives price change which ends up in return distribution all day long. Therefore, this study deduces that return distribution occurs due to private information captured during trading.

H2: The return volatility follows a U-shaped curve decreasing until lunch break and increasing after the lunch break.

$$\text{Test: } \frac{V_L^C}{V_M^C} < \frac{V_L^O}{V_M^O} \text{ and } \frac{V_L^C}{V_A^C} < \frac{V_L^O}{V_A^O}$$

With additional notes from previous test, V_M^O and V_M^C are return variance during the opening and closing of morning session, and M (*morning*), and A (*afternoon*).

The prediction of private information arrival can be done by cutting off the trading during morning session for the first four hours. In other words, the trading is limited until lunch break. This cutting off is based on logical framework recommended by Ito *et al.* (1998). This research suggested that −if not limited during lunch break− bottom line of U-shaped curve flattens. It means that U-shaped during one full day is not confirmed (Slezak, 1994). U-shaped framework in morning session cutting off can be hypothesized as follows.

H3: Return volatility during early morning is moving downward sharply, and then turn the slightly flattened during mid morning, and finally become more flattened during late morning.

$$\text{Test: } \frac{V_{MM}^C}{V_{EM}^C} < 1 \text{ and } \frac{V_{LM}^C}{V_{MM}^C} < 1$$

$$\text{and } \frac{V_{LM}^O}{V_{MM}^O} \le 1, \text{ and } \frac{V_{MM}^C}{V_{EM}^C} > \frac{V_{LM}^C}{V_{MM}^C}$$

With additional notes from previous tests, V_{EM}^O, and others are return variances during the opening or closing price at early (E), mid (M), and late (L) morning session.

The examination of private information arrival continues by referring research concepts exposed by Kyle (1995). This research stated that private information is not related to price in long term. On the contrary, private information related to price in short term because informed traders do trading as long as the information is not reflected by the price (Ito *et al*., 1998). Return volatility during short term is suspected whether the opening return variance is higher than closing. It means that opening return variance during morning affects the return variance during all morning session. Moreover, opening return variance during afternoon should also be determined by return variance during previous morning session, because traders are motivated not to

delay their transaction which enlarges return variance during morning session (Foster & Viswanathan, 1990). Such characteristic refers to private information model, that private information hypothesis occurs during short term.

H4: Opening morning return variance is greater than opening afternoon, and closing morning return variance is less than closing afternoon.

$$\text{Test: } \left(\frac{V_M^O}{V_A^O}\right) > 1 \text{ and } \left(\frac{V_A^C}{V_M^C}\right) > 1,$$

$$\text{or } \frac{\left(\frac{V_M^O}{V_A^O}\right)}{\left(\frac{V_M^C}{V_A^C}\right)} > 1$$

RESEARCH METHOD

Sample, Return and Trading Session

The sample is companies listed in LQ45 index during either first or second semester of 2006-2007. LQ45 selection is based on reasons that are able to minimize sleeping stocks during the trading day. The sleeping stock can affect internal and conclusion validity of this study. This method is used because IDX is thin market marked by lots of sleeping stocks. Opening and closing return for each 30 minutes interval lay in trading day which acquired from intraday data. Return is calculated by natural logarithm of relative price $R_{i,30'm,(t)} = \ln(P_{i,30'm,(t)}/P_{i,30'm-1,(t)})$ where *i* is firm, *m* is minute and *t* is day for each firm. To calculate 30 minutes interval return, companies' trading data is divided into 12 intervals, and the formulation is as follows.

Trading session is not equal during each day. Trading is opened at 09.00 every day, but the first session is closed at 12.00 on Monday until Thursday, while on Friday the first session is closed at 11.30. The second session is opened at 13.30 on Monday until Thursday, while on Friday the second session is opened at 14.00. The second session is closed at 16.00 every day. **Figure 1** shows trading day and trading period along with their relation with hypotheses examination in this research.

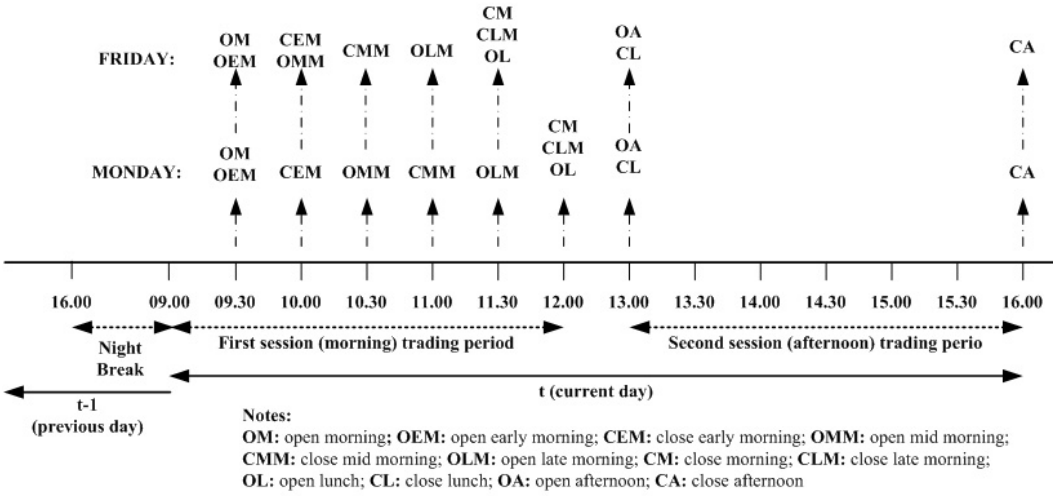

Figure 1. Return of 30 minutes interval and its relation with examination

Data Analysis

Data analysis has following procedural steps. *First*, from intra-day data, 12 series of price was obtained that is price within 30 minutes interval. This 30 minutes interval price was used to calculate return. Then, calculating return by $R_{i,30'm,(t)}=\ln(P_{i,30'm,(t)}/P_{i,30'm-1,(t)}$, which is return within minute interval from the first until twelfth. Opening return was calculated by $\ln(P_{i,09.30(t)}/P_{i,16.00(t-1)})$, and forming 12 series of 30 minutes interval return from Monday until Friday. The analysis in this examination is only focused to differentiate the return in one 30 minutes interval from other returns of 30 minutes interval.

Second, eliminating the days around dividend announcement, stock dividend, stock split and other firms' specific news announcements during the day between t_{-3} and t_{+3}. Firms' specific information, unlike public and market related information, cause high price fluctuation, and may compromise conclusion validity. *Third*, identifying and then calculating all variances related to time separation as described in figure 1. *Fourth*, conducting sensitivity test using firm size, trading volume, and bid-ask spread. Sensitivity test by firm size serves to verify the consistency of previous hypotheses examination. Fama and French (1992) suggests that size influences return more consistently. Admati & Pflederer (1988) argue that the average of trading volume forms a "U" pattern. It means that trading periods with high trading volume tend to have high return variability. Easley & O'Hara (1987) and Stoll (1989) suggested that the highly traded stock has smaller risk than the rarely traded stock as a result of information arrivals. Therefore, we consider that this sensitivity test is necessary to enhance the analysis.

RESULTS

Descriptive Statistics

The descriptive statistics shows highly varied 30 minutes interval data during 2006. Table 1.a shows that the magnitude of mean of return 30 minutes interval with the lowest number during the period from previous day closing until the following 09.30 at -0.00093. This lowest mean is at the beginning of 30 minutes interval. Meanwhile, the highest mean of return is during 09.30-10.00 that is 0.0005 and during 15.30-16.00 that is 0.00424.

It illustrates that the highest mean is within the earliest 30 minutes interval during early morning session and within late trading day. This condition serves as the evidence that the return is surging compared to the previous 30 minutes interval. Meanwhile, the number of observations for the first 30 minutes interval is 10,845 and from this sum, only 9,956 are usable or 889 are excluded. This exclusion is caused by lack of transaction during this interval causing no price differences or no return. This explanation is applicable for the rest discussion.

The standard deviation of each 30 minutes interval varies in relatively equal number. For 30 minutes interval 15.30-16.00 is 0.00708. The minimum value, and maximum value, is presented following the standard deviation column. For instance, minimum value for the last 30 minutes interval during trading day (return of 15.30-16.00) is -0.03, the maximum value is 0.04 and the range between minimum value and maximum value is 0.07. The high return during 09.30-10.00 and 15.30-16.00 along with the day-end effect presented graphically in Figure 2.

The U-shaped curve as graphed in Figure 2 was retested using regression analysis with the return as dependent variable. This test is used to show the unstationarity of return distribution along the day. Table 1.b presents the result. It could be noted that all coefficients among the interval have positive or negative signs intermittenly. Therefore, we inferred that the returns data are unstationary distributions. Table 1.b also shows that the correlation coeficients are positively significant at return data during interval 09.00-10.00, negatively sig-

nificant afterward, then become positively significant again during interval 15.30-16.00. We concluded that the result from this test confirms the U-shaped graphical test.

Table 1.a. Descriptive Statistics

	N($)	N(and)	Mean	Std. Dev.	Min.	Max.
return 09.30	10,845	9,956	-0.0009	0.0182	-0.7000	0.3900
return 10.00	10,890	10,067	0.0005	0.0153	-0.5100	0.1200
return 10.30	10,890	9,202	-0.0006	0.0272	-1.3900	0.5100
return 11.00	10,890	8,661	0.0004	0.0312	-0.8500	1.4000
return 11.30	10,890	8,329	0.0000	0.0275	-0.7600	0.8400
retrun 12.00	8,820	6,483	0.0004	0.0180	-0.3700	0.5300
return 13.30	8,820	6,694	-0.0005	0.0189	-0.9700	0.3400
return 14.00	10,890	9,415	-0.0004	0.0202	-0.4100	1.0100
return 14.30	10,890	8,700	-0.0004	0.0361	-1.3900	0.8800
return 15.00	10,890	8,478	-0.0005	0.0398	-1.1200	1.3900
return 15.30	10,890	8,820	-0.0003	0.0361	-0.7900	1.1200
return 16.00	10,890	9,768	0.0042	0.0285	-0.7600	0.8300
return 09.30(t+1)	10,845	9,956	-0.0009	0.0182	-0.7000	0.3900

Notes: N($): Number of Observations; N(and): Number of included case

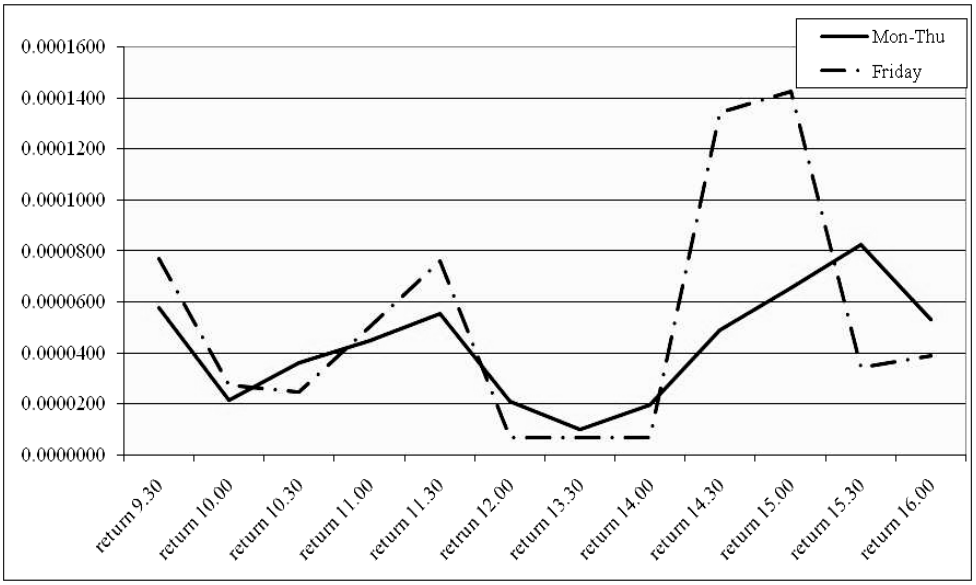

Figure 2. The Shift of Return Mean

Table 1.b. Correlation and Stationary Tests

	B	t-value	Sig.	
return 09.30	0.0007	0.9854	0.3245	
return 10.00	0.0018	2.5948	0.0095	***
return 10.30	-0.0006	-0.8516	0.3945	
return 11.00	-0.0002	-0.2145	0.8302	
return 11.30	-0.0007	-0.9460	0.3442	
retrun 12.00	-0.0001	-0.1131	0.9100	
return 13.30	-0.0002	-0.2459	0.8057	
return 14.00	0.0001	0.1281	0.8980	
return 14.30	-0.0003	-0.3634	0.7163	
return 15.00	-0.0021	-2.9370	0.0033	***
return 15.30	0.0001	0.1731	0.8626	
return 16.00	0.0031	4.3754	0.0000	***

First Stage Examination Result

Hypothesis H1 can also be interpreted that return variance during opening of lunch break session is greater than during the closing. This stage examines the whole sample using the period of three first months within year of observation, cumulative six months, cumulative nine months, and cumulative twelve months periods. The result shows that ratio between return variance of the opening lunch break session and that of the closing is greater than one.

Table 2. Examination for hypothesis H1

Sample period	$\frac{V_L^O}{V_L^C} > 1$
3 months	2.8227
6 months	2.7869
9 months	2.7681
12 months	3.3111
calc-t	14.7710***

Notes: * significant at level of 10%;
** significant at level of 5%;
*** significant at of level 1%

Table 2 shows that all ratios return variance between during lunch break opening and during lunch break closing are greater than one. These ratios are in detail within a range between 2.7 and 3.3. Tested by means comparison, the results show significant result, with t-value (sig.) equals to 14.7710 (0.000). This result supports H1. Therefore, we conclude that return variance during lunch break is probably caused by private information arrival (French & Roll, 1986, and Ito *et al.*, 1998).

Second Stage Examination Result

This second stage investigates further evidence of private information arrival at IDX. It deepens the proof of morning U-shaped curve. This second stage is also conducted in the same way as the first one. Table 3 shows in detailed result from all samples.

Table 3. Examination for hypothesis H2

Sample period	$\frac{V_L^C}{V_M^C} < \frac{V_L^O}{V_M^O}$	$\frac{V_L^C}{V_A^C} < \frac{V_L^O}{V_A^O}$
3 months	2.5207	4.5221
6 months	1.1312	5.7585
9 months	0.9765	6.7213
12 months	1.6900	17.5736
calc-t	1.6600	2.5390*

Notes: * significant at level of 10%;
** significant at level of 5%;
*** significant at of level 1%

Table 3 shows that return variances during opening morning and afternoon are greater than the closing return variances during afternoon and lunch break. The result shows that all ratios are greater than one, which in details are in a range between 1.13 until 17.57, except for the third row that is 0.97. These ratios examined by one sample mean comparison test show insignificant difference with t-value (sig.) that equals to 1.660 (0.195). However, tests using one lag show significant results, t-value equals to 2.593 (0.085). It supports H2. This result indicates that high return variance during opening lunch break caused by private information arrival. Therefore, return variance during closing afternoon is greater than during opening and closing lunch break, and during afternoon. Therefore, we conclude that bottom line in U-shaped curve is the lowest return variance compared to all return variance within full day (French and Roll, 1986; and Ito *et al.* 1998). This finding supports private information arrival in IDX as stated in H1.

The second stage is continued with H3 examination. The test is limited until return variance during lunch break in order to be able to form U-shaped curve. This hypothesis has simple reason that if U-shaped is confirmed by morning return then one day U-shaped curve may be examined. The detailed result of H3 is presented in Table 4 as follows.

Table 4 confirms that closing return variance during mid morning is greater than closing early morning session. Therefore, the second column of Table 4 shows that the ratio of closing return variances is less than one, which confirms that was hypothesized. Furthermore, the ratio, when examined by one sample mean comparison test using one lag shows significant difference, with t-value (sig.) equals to -2.948 (0.060). The similar result is also shown in the third column, although one sample mean comparison test using one lag shows insignificant difference. In fact, the first column is bigger than the second column. Therefore, this study concludes that return variance at IDX does support the validity of morning U-shaped curve (French and Roll, 1986; Ito *et al.* 1998).

Table 4. The examination for hypothesis H3

Sample period	$\frac{V_{MM}^{C}}{V_{EM}^{C}} < 1$	$\frac{V_{LM}^{C}}{V_{MM}^{C}} < 1$	$\frac{V_{LM}^{O}}{V_{MM}^{O}} \leq 1$
3 months	4.1870	0.2975	0.2653
6 months	1.6664	0.6589	1.4538
9 months	1.5247	0.6418	1.4810
12 months	1.5045	0.9126	1.5375
t-value	4.5400^{++}	-2.9480*	-0.5750

Notes: * significant at level of 10%;
** significant at level of 5%;
*** significant at level of 1%;
$^{+}$ significant at level of 10%,
$^{++}$ significant at level of 5%,
$^{+++}$ significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

The second stage is sharpened by H4 examination. Table 5 induces that hypothesis H4 is supported. Return variance ratios are greater than one, with the lowest ratio is 1.794 and the highest one is 10.3987. One sample mean comparison tests result significant difference, with t-value (sig.) equals to 2.810 (0.067). The conclusion is the confirmation of private information arrival which always related to price

Table 5. The examination for hypothesis H4

Sample period	$\frac{\left(\frac{V_M^O}{V_A^O}\right)}{\left(\frac{V_M^C}{V_A^C}\right)} > 1$
3 months	1.7940
6 months	5.0907
9 months	6.8832
12 months	10.3987
calc-t	2.8100*

Notes: * significant at level of 10%;
** significant at level of 5%;
*** significant at level of 1%;

and the arrival occurs within one trading day only or does not influence the next trading day (French & Roll, 1986; Foster & Viswanathan, 1990; Kyle, 1995; and Ito *et al*. 1998). Such examination result can also be interpreted as in accordance with hypotheses H1 and H2.

Sensitivity tests by firm size

To perform sensitivity test, this research divides firm size into five categories from the smallest to the biggest ones. The detailed examination result is presented in Table 6 as follows.

Table 6 shows that ratio between opening and closing return variance during lunch break is greater than one for almost all firm size, except the smallest one. One sample mean comparison test with one lag shows that firm size categories those are not the smallest ones (B group or above) have significant difference, with t-values (sig.), consecutively, 3.038 (0.056), 5.905 (0.010), 2.974 (0.059), and 4.5 (0.020). Hypothesis H1 is re-supported which means that opening return variance compared to closing during lunch break is caused by private information (French & Roll, 1986 and Ito *et al.* 1998). Additionally, medium to big firm size tend to capture private information at IDX. The sensitivity test for H2 shows consistent results with previous H2 examination. The opening return variance during early morning session compared to during lunch break or during around lunch break is greater than one.

Table 7 shows that the first ratio is proven greater than one for medium firm size. Examination using one sample mean comparison test with one lag results significant difference with t-value (sig.) that equals to 7.500 (0.005). Meanwhile, the ratio of second return variance is also proven greater than one from the smallest until the biggest firm size. The statistics examination shows t-value with significance level of 5% and 10%. Therefore, this study concludes that all ratios are greater than one, then the bottom line of U-shaped curve is the lowest return variance compared to all within one day.

Table 8 shows a notably interesting result. Except medium firm size (column C), all other three ratios examined for H3 are supported. The results show that for all firm size, except medium firm size, the first return variance ratio support H3, because return variance during early morning is bigger than during closing mid-morning, and return variance during closing mid-morning is greater than closing late morning, or $\frac{V_{MM}^{C}}{V_{EM}^{C}} > \frac{V_{LM}^{C}}{V_{MM}^{C}}$. This means that return variance at IDX support the validity of U-shaped curve formulation.

Table 6. The sensitivity tests by firm size (hypothesis H1)

Sample period	$\frac{V_L^O}{V_L^C} \leq 1$				
	Smallest	B	C	D	Biggest
3 months	1.2116	1.9555	5.7378	2.8754	3.3908
6 months	0.3515	4.3161	12.4527	2.2167	2.3755
9 months	0.3747	4.7212	10.7480	2.3258	2.0142
12 months	0.4177	1.9921	8.9602	5.3706	2.0351
calc-t	-1.9760	3.0380*	5.9050***	2.9740*	4.5000**

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%

Table 7. The sensitivity tests for firm size (hypothesis H2)

Sample period	$\frac{V_L^C}{V_M^C} < \frac{V_L^O}{V_M^O}$				
	Smallest	B	C	D	Biggest
3 months	2.4526	0.9290	4.2691	9.1150	4.3789
6 months	0.1812	1.5418	7.2202	2.0157	1.2140
9 months	0.1713	1.3500	6.2649	1.8579	1.0873
12 months	0.2014	0.7026	5.2865	21.0851	1.1662
calc-t	-0.4380	0.6820	7.5000***	1.6640	1.1930

Sample period	$\frac{V_L^C}{V_A^C} < \frac{V_L^O}{V_A^O}$				
	Smallest	B	C	D	Biggest
3 months	0.6016	55.6538	11.2753	3.9962	18.0694
6 months	0.1277	77.4542	18.4022	10.2409	10.2928
9 months	0.1714	54.3502	21.5761	13.8117	9.8875
12 months	0.4690	10.7988	42.4820	18.2633	15.7688
calc-t	-5.7210^{++}	3.4770**	3.3460**	3.5110**	6.1650***

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 8. The sensitivity tests by firm size (hypothesis H3)

Sample period	$\frac{V_{MM}^C}{V_{EM}^C} < 1$				
	Smallest	B	C	D	Biggest
3 months	5.7789	4.4712	0.5119	17.5737	3.8802
6 months	3.2339	2.5035	0.4006	5.8375	1.9877
9 months	2.4064	2.2961	0.4142	4.0008	1.9531
12 months	2.0501	2.1052	0.4601	4.7035	1.8244
t-value	9.5500^{+++}	11.1210^{+++}	-10.2520***	19.7900^{+++}	8.1850^{+++}

Sample period	$\frac{V_{LM}^C}{V_{MM}^C} < 1$				
	Smallest	B	C	D	Biggest
3 months	0.3432	0.0654	2.9169	0.3075	0.3057
6 months	0.2950	0.3172	9.9467	0.2992	0.4181
9 months	0.3383	0.4690	7.0464	0.3433	0.4592
12 months	0.3603	0.8197	5.4814	1.4302	0.4938
t-value	-47.9000***	-3.6910**	3.6360^{++}	-1.4540	-14.2050***

Sample period	$\frac{V_{LM}^{O}}{V_{MM}^{O}} \leq 1$				
	Smallest	B	C	D	Biggest
3 months	0.4960	0.0792	0.6120	0.3078	0.3289
6 months	0.4614	0.6442	0.4921	0.5219	2.2971
9 months	1.4897	0.9648	0.5396	0.6755	2.1532
12 months	1.6948	1.2926	0.5707	2.3832	2.0525
t-value	-0.8530	-1.040	-9.6980***	-1.3080	-0.1660

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

The re-enhancement by H4 examination shows that private information arrival is revealed during short term trading if ratio of opening return variance is less then ratio of closing return variance outside lunch break or if the descending line of U-shaped curve is formed. Table 9 induces that hypothesis H4 is re-supported. It means that all examined return variance ratios are greater than one. These ratios with one lag result is significant difference, with t-values (sig.) that equal to 4.225 (0.024) for the smallest (column B), 2.427 (0.094) for medium, and 4.061 (0.027) for the biggest firm size. This study concludes that private information arrival does not influence stock price in the next trading day (French & Roll, 1986; Foster & Viswanathan, 1990; Kyle, 1995; and Ito et al., 1998).

Sensitivity tests by trading volume

Similar to sensitivity tests by firm size reasoning, sensitivity tests by trading volume is also aimed to ensure the consistent results. All examinations show results which do not too far in comparison with the result of firm size sensitivity tests. Considering that on sensitivity tests by firm size, hypothesis H1, H2, and H4 are re-supported, while H3 is not supported. Therefore, this research concludes that results of trading volume examination are consistent with the previous results.

Table 9. The sensitivity tests by firm size (hypothesis H4)

Sample period	$\frac{\left(\frac{V_{M}^{O}}{V_{A}^{O}}\right)}{\left(\frac{V_{M}^{C}}{V_{A}^{C}}\right)} > 1$				
	Smallest	B	C	D	Biggest
3 months	0.2453	59.9062	2.6411	0.4384	4.1264
6 months	0.7049	50.2376	2.5487	5.0806	8.4785
9 months	1.0008	40.2606	3.4440	7.4340	9.0940
12 months	2.3291	15.3701	8.0359	0.8662	13.5216
calc-t	0.1560	4.2250**	2.4270*	1.4520	4.0610**

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%;

Table 10. The sensitivity tests by trading volume (hypothesis H1)

Sample period	$\frac{V_L^O}{V_L^C} > 1$				
	Smallest	B	C	D	Biggest
3 months	1.3740	22.6404	2.4002	0.6748	19.3066
6 months	0.9228	0.0522	29.2032	0.7620	9.4588
9 months	0.7625	0.0626	22.5127	0.8191	6.2319
12 months	0.3970	0.0865	14.9673	0.8879	10.3968
calc-t	-0.6710	0.8350	2.8310*	-4.7440++	3.6980**

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 11. The sensitivity tests by trading volume (hypothesis H2)

Sample period	$\frac{V_L^C}{V_M^C} < \frac{V_L^O}{V_M^O}$				
	Smallest	B	C	D	Biggest
3 months	0.6774	75.1840	5.6399	1.9693	105.9074
6 months	0.2189	0.0526	175.9039	0.5656	19.1991
9 months	0.1662	0.0548	116.5751	0.3372	10.1968
12 months	0.1093	0.0977	41.2316	0.3937	53.6812
calc-t	-5.4360++	0.9500	2.1970	-0.4740	2.1330

Sample period	$\frac{V_L^C}{V_A^C} < \frac{V_L^O}{V_A^O}$				
	Smallest	B	C	D	Biggest
3 months	11.2405	108.7516	5.3170	0.1178	96.3584
6 months	4.7845	0.0016	127.2324	0.5436	102.5511
9 months	2.9269	0.0036	81.4198	1.0164	57.1086
12 months	0.8430	0.0078	94.4756	1.9109	65.6238
calc-t	1.7580	0.9630	2.9500*	-0.2670	7.0880***

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 12. The sensitivity tests by trading volume (hypothesis H3)

Sample period	$\frac{V_{MM}^{C}}{V_{EM}^{C}} < 1$				
	Smallest	B	C	D	Biggest
3 months	20.6456	0.7652	10.4065	4.7950	1.7997
6 months	5.3694	1.1528	5.0841	2.2001	1.1906
9 months	5.8719	0.9229	4.2065	1.7300	1.0900
12 months	4.5684	0.8587	4.0248	1.5532	1.2132
t-value	22.6630^{+++}	-1.1500	23.1910^{+++}	5.5110^{++}	2.7340^{+}

Sample period	$\frac{V_{LM}^{C}}{V_{MM}^{C}} < 1$				
	Smallest	B	C	D	Biggest
3 months	0.0642	8.0047	0.2573	0.5504	1.9417
6 months	0.1129	3.0340	2.2712	0.5728	1.6067
9 months	0.1077	2.2684	2.2571	0.5768	1.5768
12 months	0.1461	2.8707	2.1819	0.6090	4.2161
t-value	-53.0690***	2.2890^{+}	1.4980	-35.0230***	2.1120

Sample period	$\frac{V_{LM}^{O}}{V_{MM}^{O}} \leq 1$				
	Smallest	B	C	D	Biggest
3 months	0.9828	11.0744	0.2292	0.1486	1.8847
6 months	1.1095	3.2056	3.1202	0.9252	1.8945
9 months	1.4096	2.3018	3.0986	1.1709	2.7820
12 months	1.4328	3.2264	2.9788	1.1345	3.2497
t-value	2.1720	9.9580^{+++}	-0.3330	-0.9570	9.8970^{+++}

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%;
+significant at level of 10%, ++significant at level at 5%,
+++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 13. The result of sensitivity tests by trading volume (hypothesis H4)

Sample period	$\frac{\left(\frac{V_M^O}{V_A^O}\right)}{\left(\frac{V_M^C}{V_A^C}\right)} > 1$				
	Smallest	B	C	D	Biggest
3 months	16.5947	1.4465	0.9427	0.0598	0.9098
6 months	21.8613	0.0305	0.7233	0.9611	5.3414
9 months	17.6074	0.0657	0.6984	3.0142	5.6006
12 months	7.7159	0.0797	2.2913	4.8542	1.2225
calc-t	5.0310**	-1.7120	0.4320	1.1390	1.7800

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%;

Return variance during lunch break session must be smaller than opening and closing return variance during morning and during afternoon. This finding is consistent and supports to hypothesis H1. Therefore, the bottom line of U-shaped curve is the return variance during lunch break which is the smallest variance compared to all that within one day. This finding re-supports H2. Furthermore, hypothesis H3 examination also confirms that U-shaped curve is proven during morning session for the smallest and D-column quintiles. This means that U-shaped curve is a function of return variance in full day period. The last one, H4 examination shows that private information arrival is always related to the stock price and its arrival occurs within one trading day or does not have permanent effect on stock price. The overall results of hypotheses on trading volume sensitivity tests conclude that private information occurred validly in IDX.

Sensitivity tests by bid-ask spreads

From Table 14 until Table 17 show similar results compared to the previous examination by both firm size and trading volume. All examinations confirm that private information arrival is proven valid in IDX. This is marked by the opening return variance during early morning session compared to closing return variance during lunch break or return variance around lunch break which is greater than one. This finding is consistent and in supporting to H1. Therefore, the bottom line of U-shaped curve is return variance during lunch break which is the smallest variance compared to all within one day. This finding supports to H2. Furthermore, hypothesis H3 examination also confirms that U-shaped curve exist during morning session for the biggest and B- and C-columns bid-ask spreads. This means that U-shaped curve is a function of return variance in full day period. The last one, H4 examination, shows that private information arrival does not have permanent effect on stock price. The detailed results of hypotheses are presented in the following consecutive tables.

Findings and Consequences

This study, after all hypotheses are examined and re-examined using firm size, trading volume, and bid-ask spreads sensitivity tests, finds evidence that existence and occurrence of U-shaped curve is proven valid. This means that opening return variance during early trading period is the highest return variance compared to the return variance around lunch break. With the sign of

the highest return variance during early trading period, this study concludes that private information arrives at every morning session in IDX. This confirmation is also supported by the existence and occurrence of high closing return variance around late afternoon session. Therefore, U-shaped curve formula is closing to the complete form.

Table 14. The sensitivity tests by bid-ask spreads (hypothesis H1)

Sample period	$\frac{V_L^O}{V_L^C} > 1$				
	Smallest	B	C	D	Biggest
3 months	3.9703	1.9543	0.8377	0.7066	0.9612
6 months	0.9401	2.0936	0.9879	1.2824	0.8668
9 months	1.0992	2.0491	0.9643	1.3764	0.7908
12 months	1.8875	2.1921	0.9822	0.1856	0.8037
calc-t	1.3980	21.7090***	-1.6060	-0.4050	-3.7110++

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 15. The sensitivity tests by bid-ask spreads (hypothesis H2)

Sample period	$\frac{V_L^C}{V_M^C} < \frac{V_L^O}{V_M^O}$				
	Smallest	B	C	D	Biggest
3 months	3.5794	5.6087	0.5788	0.2644	0.6326
6 months	0.2751	1.4733	0.5509	0.6244	0.4183
9 months	0.2951	1.2037	0.4878	0.8219	0.0939
12 months	0.8544	1.6046	0.5294	0.1266	0.0969
calc-t	0.3190	1.4040	-24.1420+++	-3.3780++	-5.2390++

Sample period	$\frac{V_L^C}{V_A^C} < \frac{V_L^O}{V_A^O}$				
	Smallest	B	C	D	Biggest
3 months	32.8503	0.7880	2.2500	2.6188	4.1973
6 months	1.5757	4.8654	1.7512	3.7360	3.6712
9 months	2.0803	5.3549	2.9381	3.6633	3.0247
12 months	9.5599	8.1038	4.3655	0.0864	3.2344
calc-t	1.4320	2.5040*	3.2160**	1.7910	9.7580***

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%; +significant at level of 10%, ++significant at level at 5%, +++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 16. The sensitivity tests by bid-ask spreads (hypothesis H3)

Sample period	$\frac{V_{MM}^{C}}{V_{EM}^{C}} < 1$				
	Smallest	B	C	D	Biggest
3 months	13.4887	0.7618	2.1189	2.0757	13.0215
6 months	4.8169	0.8554	1.6316	2.2552	6.6821
9 months	4.1098	0.9266	1.0070	2.2717	7.0783
12 months	3.5888	1.5461	1.1853	1.8576	7.0336
t-value	17.8830^{+++}	-0.3620	2.3180^{+}	22.9410^{+++}	51.3340^{+++}

Sample period	$\frac{V_{LM}^{C}}{V_{MM}^{C}} < 1$				
	Smallest	B	C	D	Biggest
3 months	0.0655	3.6193	0.2314	0.4404	0.0740
6 months	0.1150	1.3954	0.5864	0.6523	0.0799
9 months	0.1335	1.3857	0.8130	0.8001	0.0870
12 months	0.2397	1.2324	0.6780	0.9389	0.0896
t-value	-23.4800***	1.5890	-3.4010**	-2.7380*	-259.9640***

Sample period	$\frac{V_{LM}^{O}}{V_{MM}^{O}} \leq 1$				
	Smallest	B	C	D	Biggest
3 months	0.0991	2.8750	0.1184	0.3729	0.0509
6 months	0.2144	2.0476	0.7170	3.4165	0.1857
9 months	0.2904	1.8579	0.6517	9.5335	0.1835
12 months	0.3367	1.5650	0.6056	7.6565	0.1880
t-value	-2.6190*	8.1990^{+++}	-1.3040	0.3150	-2.2300

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%;
+significant at level of 10%, ++significant at level at 5%,
+++significant at level of 1%, whose mark + refers to opposite result of that is hypothesized

Table 17. The result of sensitivity tests by bid-ask spreads (hypothesis H4)

Sample period	$\frac{\left(\frac{V_M^O}{V_A^O}\right)}{\left(\frac{V_M^C}{V_A^C}\right)} > 1$				
	Smallest	B	C	D	Biggest
3 months	9.1775	0.1405	3.8876	9.9064	6.6353
6 months	5.7287	3.3023	3.1787	5.9832	8.7773
9 months	7.0501	4.4487	6.0236	4.4570	32.2256
12 months	11.1887	5.0504	8.2458	0.6829	33.3889
calc-t	6.0710***	2.0440	3.7900**	2.2310	2.6510*

Notes: *significant at level of 10%; **significant at level of 5%; ***significant at level of 1%;

The occurrence of private information arrival is also sharpened by the result of examination of U-shaped curve, though morning session support U-shaped curve formation for the smallest, medium and the biggest sized firm; the smallest and medium trading volume; and the smallest, medium and the biggest bid-ask spreads. The point is, with all confirmed results of this U-shaped form, return formulation in U-shaped curve occurs within period of one full day. This study later found sharpening evidence that private information is revealed short lived, i.e. one day, on the IDX' stock market. This study suggests that private information always related to stock price during every trading day in IDX.

With the confirmation of U-shaped curve formula at IDX, this study formulates a trading strategy that can be applied by investors. The investors at IDX could do trading if only they have information, refers to informed investors. This strategy must also be complemented not just with information, but also with strict observed time when return variance is high. This high return variance occurs during early morning session and during late afternoon session. The investors' prudential behavior is necessary to observe high return variance during early morning session and late afternoon session along with specific information acquired which is not well known publicly among other investors.

The timing of trading strategy is also found in this study. The investors who wish to acquire high return should trade during period when the return variance is high, that is during early morning or during late afternoon session. However, during all this time, the investors may also suffer great losses. Meanwhile, if the investors wish for certain returns but in small number, the investors should trade during around before and after lunch break. The reason is, during around this period, it is proven that lunch break return variance is the lowest compared to other return variance within one day period. This can also be inferred that the period having the highest return variance refers to the high risk period, whereas the period having low return variance refers to low risk period. The prudential principle for investors trading during high return variance is absolutely necessary.

Sell-buy strategy is the third findings in this study. By maintaining the concept of informed investors, buy strategy can be applied during around lunch break, and sell strategy can be applied during late afternoon session or during early morning session on the next day. This concept also formulates that buy strategy to hold stock inventory is recommended dur-

ing period having the lowest return variance. Inversely, sell strategy is recommended to be applied during period having high return variance. This means that investors should wait until early morning session on the next day, to see whether there is new private information arrival or not. The reasons that support this sell-buy strategy is shown that stock mispricing only occurs during period having high return variance and it is not likely to occur during period having low return variance. The last attention to these all findings is to be considered that private information arrival is related to stock price in short lived. In other words, it only occurs within period that is not longer than one day.

CONCLUSION AND LIMITATIONS

This study is able to confirm the existence and occurrence of return formulation at IDX in form of U-shaped curve, as the return variance formulation at other countries stock market. Basically, this study concludes the research findings as follows. *First*, the occurrence of private information at IDX is proven validly. *Second*, return variance during morning session is the highest value which affects all return variance during morning and afternoon. *Third*, descending line of U-shaped curve during morning session and then ascending line of U-shaped curve during the end-afternoon occur, for certain groups. *Fourth*, the effect of private information arrival occurs within short term.

All four conclusions have impacts against trading strategy for investors at IDX. The best strategy is as follows. The investors do trading if only they have information. Investors who wish for high returns should trade during period having high return variance that is during early morning session or during late afternoon session. By maintaining the concept of informed investors, buy strategy may be applied during around lunch break, and sell strategy may be applied during late afternoon or during early morning on the next day. In addition, investors should keep in their mind that private information arrival related to price in short lived. In other words, the relationship between private information arrival and stock price only occurs within period that is not longer than one day.

This study has limitations that may decrease conclusion validity. These limitations are as follow. *First*, this research only used 30 minutes interval data, whereas the price high price instability may occur within less or more than 30 minutes. This price variability is not captured within this study. *Second*, this study used sensitivity tests on firm size, trading volume and bid-ask spreads. Further study can be designed by applying trading day and market-up or -down condition. *Third*, this research used all stock within LQ45 list index, so that it only describes the frequently traded stock. *Fourth*, this study ignores to economic and market-related events. Although we know that emerging capital market is very vulnerable to these events, eventually, the effects are simultaneously to all traded stocks. *The Last*, this study uses bid-ask spreads as a sensitivity test. This requires a caution that bid-ask spreads is not based on the information asymmetry concept but transitory component concept instead. The concept of transitory component calculates spread value based on inventory cost and its completion cost.

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