Intraday Lead-Lag Relationship between the Stock Index and the Stock Index futures market: Evidence from Thailand

ABSTRACT

This paper provides an empirical investigation of the intraday relationship between SET50 index return and SET50 index futures return. The study documents a contemporaneous correlation between cash market return and futures market return in Thailand and provides the strong evidence that the futures market leads the cash market depending on the flow of information. This evidence further finds that the SET50 index futures return stronger lead the components of SET50 index for infrequently traded stocks. The lead-lag relationship also appears symmetric in good news (up market) and bad news (down market).

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I. INTRODUCTION

The study of market microstructure has increased importance for financial market research. The high frequency, intraday asset prices, explores further insight in understanding the price behavior of stocks. According to theory of information efficiency, if abnormal return and trading volume can be observed, there is persistence in the speed of price adjustments related the market and information efficiency. Consequently, studies of the intraday and intraweek patterns can be exploited to earn abnormal return since empirical evidence such as Andersen and Bollerslev (1997) and Andersen et al. (1999) suggest that intraday data contains valuable information for improved volatility estimation at both daily and monthly data called long memory features. After that Andersen, Bellerose, and Cai (2000) and Bildik (2001) studied about the return pattern of the stock market are related to flow of information and microstructure. Darrat, Rahman, Zhong (2003) and Muntermanna and Guettler (2007) investigated that the information affected the volatilities of the stock market.

There are some market microstructure evidences in Thailand, the recent studies, Sangnapaboworn (2002), Chiradatesakunvong (2004) and Chatrirat (2006) examined the relationship between price and trading volume in stock markets. In addition, Prisarayup (2005) found that the intraday return pattern cannot be characterized by a smooth U or W shaped pattern in SET. However, there is strong positive related between trading volume and return with lagged return can predict change in volume within 5-10 minute as Momentum pattern in SET. In addition, the evidence from Ngandee (2006) suggests that price momentum is related to under reaction of new information whereas volume momentum is related to future liquidity and return expectations.

The introduction of derivatives is widely used as a hedging instrument. The futures instruments become an important role for investors to hedge their portfolio positions. The stock index derivatives, trading volume of index derivatives often exceeds the trading volume of underlying stocks because they provide a fast and inexpensive means of changing stock market exposures. The empirical studies on the intraday patterns in stock markets have been

extended to the futures market. There are several previous studies that examined the price change and volatility patterns of the stock market and derivatives market. Mercer (1997), Bae, Kwan and Park (2004), Tang and Lui (2001) and Chan (2005), for instance, examined that there is some relationship between futures market and underlying asset market.

Another interesting issue for studying derivative market is whether there is existence lead-lag relationship between cash market and futures market (see, e.g., Stoll and Whalley 1990; Chan et al. 1991; and Chan 1992). Chan and Karolyi (1991) examine that the intraday volatilities of the cash market and futures patterns can be predicted and also find the relationship of volatilities between the S&P500 index and S&P500 index futures. The results show that the futures markets return dominants the cash market due to non-synchronous trading. A plausible explanation is that the new information affects the future market faster the cash market. Furthermore, Chan (1992) examined lead-lag relationship in the constituent of the stock index and the actively trading stock lag the futures index market. Even in the case that an up market or a down market occurs as well as the market-wide information, more stocks move together the futures return also lead the cash market.

The Thailand Futures Exchange Plc. (TFEX) has launched SET50 Index Futures as the first product at April 28, 2006. The SET50 index which is the underlying asset is chosen because its constituent stocks comprise majority of the total stock market. According to the cost of carry model, the value of the two markets should simultaneously reflect the news and finally are the same prices. This paper, therefore, focuses on whether futures price provides predictive information regarding subsequent movement in the cash index. I utilize time-series regression analysis to investigate whether the lead-lag relationship exists between SET50 index and SET50 index futures[1]. First, this paper has to determine the lead-lag relationship between SET50 index and SET50 index futures influenced by the infrequent trading of SET50 component stocks. The second research question following Chan (1992) examines the relationship of change of lead-lag relationship under the various conditions

[1] I use the terms ‘‘SET50 index’’, “spot market”, and ‘‘cash market’’ as well as “SET50 index futures” and “futures market” interchangeably throughout this paper.

(i) bad news versus good news, (ii) the market wide information when more component stocks moving together.

The remainder of this paper is organized in the following fashion. Section II provides a review of existing literatures. Section III describes data used in this paper composed of 15-minute data of the SET50 index from the Stock Exchange of Thailand and 15-minute data of nearby month contract of SET50 index futures from TFEX. The sample periods are during July 9, 2006 until December 28, 2007. The types of contracts offered on the Futures Exchange include the spot series contract, the next-series contract, and the next two series-month contracts. However, this paper specifically examines data of the nearest maturity contract because it is the most actively traded contract on the TFEX. Section IV explains the research methods. The empirical results are discussed in Section V and Section VI concluded the paper.

II. LITERATURE REVIEW

According to the theory of information efficiency, securities prices should reflect immediately to information available to the efficient capital market (see Fama, 1970). Since the question of market efficiency is concerned with the speed at relevant information impounded into stock prices, the question of degree of efficiency in a certain market can be further refined through the use of intraday data.

The price of a stock index futures contract is equal to the price of the cash index plus a cost of carry[2] according to the cost-of-carry model (see Cornell and French, 1983; Figlewski, 1984; Yadav and Pope, 1990). This relationship is maintained by arbitrageurs trade in both markets try to earn risk-less profits when the index futures contracts are mispriced. Stoll and Whaley (1990) also argue that if the annual interest rate and the annualized dividend yield

[2]According to Fama (1996), pp. 149-151, assume constant expected return of futures and stock index is reasonable because an assumption of market efficiency is needed to ensure serially correlated rates of return.

(the carry cost) are constant over the short time period for which the return are calculated, the variance of return on the index and the index futures will be the same.

Consequently, in an efficient market, the return on cash market index and futures market index should be perfectly, contemporaneous correlated. Another suggestion is those futures prices reflect all available information regarding events that will affect the spot prices and responds quickly to the arrival of information. The movement of index futures thus reflects market expectations and may provide a sentiment indicator of forthcoming of cash index.

From the theoretical point of view, if one market reacts faster than another market, the lead-lag relationship between two markets should appear. There are several previous papers studied about the intraday price relationship between futures index and cash index (e.g. Kawaller, Koch, and Koch (1987); Harris (1989); Stoll and Whaley (1990); Lo and MacKinlay (1990); and Chan and Karolyi (1991)). They find the strong evidence that the futures market lead the cash market. This relationship can be supported by the trading cost hypothesis and the leverage effect hypothesis.

Another interesting issue supported by liquidity trading effect, Lo and MacKinlay (1990) examines that futures return will be dominant in leading cash return only higher illiquid component stocks. A component of stocks index is affected disproportionately to the new information relatively to the whole stock market; therefore, not all subset of cash index must be traded in each time interval to adjust completely and quickly to new information. As a result, the lead-lag relationship exists when the non-synchronous trading occurs. Chan (1992) further analyzes the lead-lag relationship between the components of underlying index and shows that intraday futures in terms of the MMI comprised of twenty actively traded stocks such as IBM also find in lag the futures index market as a result of idiosyncratic movements. Thus, the lead-lag relation is not well described by non-synchronous trading. In addition, Diamond and Verrecchia (1987) examine that futures prices are symmetric in reflecting news both bullish and bearish market because of no short-sale constraint in the futures market. On the contrary, there is prohibition of short-sales in cash market, so cash index should not lag

futures index to a greater degree under bearish market. However, Chan (1992) shows the same lead-lag relationship under good news and bad news.

Chan (1992) also finds that futures market is predominant the cash market a greater degree. The cash market is stronger when more component stocks move together because of differential transaction costs. It is implied that futures market becomes the main source of the market-wide information.

III. DATA

Market Background

The Stock Exchange of Thailand (SET) opens the market into two sessions; morning session opened in 10.01 AM and closed in 12.30 AM and afternoon session opened in 14.31 PM and closed in 16.30 PM. As an important step for serving for the futures and options trading, SET established SET50 index in August 16, 1995 to act as a benchmark of investment in Thai stock market.

The SET50 index is created from the top fifty active trading stocks from the total stocks traded in the SET, regarding the largest market capitalization and highly liquidity listed in the SET and summit with the necessary requirement and qualification shown in the appendix I. It also has the replacement stocks in case of the uninterruption of the index. The SET50 index, market capitalized base, is consisted of seventy percent of the total market capitalization and sixty percent of the total trading volume; therefore, investors buy the SET50 index as a representative of the total Thai stock market.

[Figure 1 is here]

The SET50 index is revised every six months reflecting the change in the stock market such as initial public offerings and delisting stocks. The sample data used in this paper are divided into semi-annual periods starting from January and July due to the stock selection criteria. The companies used to calculate the SET50 index during the sample periods are shown in the appendix I.

In order to make more efficient market from price discovery through the hedging activities, the Thailand Futures Exchange Plc (TFEX), a subsidiary of The Stock Exchange of Thailand (SET) was found as a trading derivatives exchange market. As mentioned above, the SET50 index should be a good representative of Thai stock market. Consequently, the SET50 index futures was launch as the first product of TFEX having the SET50 index as an underlying asset in April 28, 2006. The investors hedge their position using SET50 index futures. If they expect the stock market will fall, the investors who have the portfolio move the same direction with SET50 should short the SET50 index futures to lock in the future price. In the contrary, if they expect the stock market will move up, investors should long the SET50 index futures. The detail of SET50 index futures is tabulated in Table I.

[Table I is here]

Data Description

The sample period was the 15-minute intraday data during the period of July 5, 2006 to December 29, 2007 in order to cover the whole year trading pattern. The sample data is obtained from the Apex-BisNews program provided by Reuters Software, Thailand. The data for component stocks were divided into three groups since the SET50 index has changed criteria every 6 months. The trading in futures commenced approximately 15 minutes prior to the underlying market opens, and continued for 15 minutes after the underlying market closed. Hence, the data available for this study totally is consisted of 17 time intervals excluding the 15 minutes before and after the cash index market opening and closing.

[Table II is here]

The 15-minute closing price series are used to generate the time series of return. The return for SET50 index and SET50 index futures are defined as $r_{st} = \ln(S_t / S_{t-1})*100$ and $r_{ft} = \ln(F_t / F_{t-1})*100$ respectively, where r_{st}, S_t, S_{t-1} are the rate of return for SET50 index at time t, the closing price of SET50 index at time t, and the closing price of SET50 index at time t-1 and $r_{ft,}$ F_t, F_{t-1} are the rate of return for SET50 index futures at time t, the closing price of

SET50 index futures at time t, and the closing price of SET50 index futures at time t-1 respectively[3].

The SET50 index futures products are divided into various series throughout the year and there are totally four contracts traded in each month. The SET50 index futures are on a quarterly expiration, March, June, September, and December. The expiration date is the last second trading day in the month of expiration. The series of sample data was started in the April 28, 2006[4] as shown in Table III. Because of the most actively trading series, this paper focuses on the nearby maturity month contract as illustrated in Figure 2.

[Table III is here]

[Figure 2 is here]

To select procedure of our sample of the various maturities of contracts and to make the data employed continuously, the nearest maturity contract will be replaced with the following contract ten days before the old one was expired[5].

IV. METHODOLOGY

This paper employs the several analyses to examine intraday lead-lag relationship of return of cash index and futures index under different cases such as the arrival of good news or bad news. The intraday is defined as the opening period until closing period each day.

[3] I use the change in the logarithm of the cash index and futures index, rather than the level of SET50index and SET50 index futures to ensure that, along with other variables, this variable is stationary.

[4] The sample data obtain the data from program and the starting date is on July 5, 2006; as a result, the first contract maturity on June, 2006 is low trading-volume.

[5] The number of ten days replaced the old contract, I calculate from comparing average trading volume at each time interval. I find a total of 7 contracts between July 2006 to December 2007, the next maturity contract have larger trading volume than the existing contract around 10 days before the nearest maturity expired.

1) Autocorrelations and Cross correlation of Intraday Return between cash index and futures index

This paper, first of all, examines whether there are autocorrelations of cash return and futures return. Therefore, this part tests that the values of past return can predict the future return. Furthermore, I test the lead and lag relationships for cash and futures return up to k correlations. When we analyze the intraday data, the often problem is the correlation between return of SET50 index and return of SET50 index futures return depending on their past members of series of observations ordered in time called autocorrelation. A time series data is said to exhibit the stationary process when the null hypothesis is rejected. However, if I take first difference of the logarithmic variables, the null of I (1) is rejected. Therefore, this paper used the change of index price instead of the price at that time.

In addition, the second part will investigate the serial correlation between SET50 index return and SET50 index futures return in order to ensure that not only the past return generated from itself but another past return of another security can also predict the future return. This part will analyze that price changes occur simultaneously within intermarket. If $\rho(r_{st}, r_{ft-k})$ are greater than level of significance, there exist cross-correlation between cash index return and futures index return.

2) Lead-lag relationship between cash index and futures index[6]

There are several studies showed that the return of futures market leads the cash index such as in other words, found that the cash market is leader instead of futures market return. Thus, following Chan (1992), the relationship of two markets can be described by this section. The release of new information should react the prices change in the spot market and futures market simultaneously from the market efficiency hypothesis. Consequently, the ordinary least squares regression[7] was perform in order to test the relationship between cash market

[6]The lead-lag relationship interpreted as one market react faster to the arrival of news than another market. It does not definitely explain that price change in one market cause price change of another market.

[7]This simple ordinary least square method only estimates the intraday relationship between SET50 Index market and SET50 index futures market and does not examine the variability of disturbances term and heteroskadasticity in regression.

and futures market. The SET50 index return are used as dependent variables in regression on lead, contemporaneous, and lag of SET50 index futures return as independent variables as follow:

$$r_{S,t} = a + \sum_{k=-K}^{K} b_k r_{f,t+k} + \varepsilon_{S,t} \quad (1)$$

In Equation (1), the parameter b_k examine whether the SET50 index futures return is significantly exposed to the underlying asset, and ε_t is an error term. The k lead and lag terms are determined by the highest R-square summary statistic. The parameters that I focus on are the beta coefficients on the SET50 index futures return, b_k. In our specification, a value of b_k significantly different from zero signifies a lead –lag relationship.

$$r_{i,t} = a + \sum_{k=-K}^{K} b_k r_{f,t+k} + \varepsilon_{S,t} \quad (2)$$

This section further analyze the lead-lag relationship between SET50 futures index and the constituent stocks of SET50 index in order to test whether all of component stocks are related to futures or only a few stocks does. I employ the rate of return for the member of SET50 index at time t ($r_{i,t}$) as dependence variables as specified in Equation (2). Instead of continuous trading throughout the day as SET50 index, not all the components SET50 index are traded at the same time, a delay exists between the release of new information time and the time enters to trade stock. Therefore, the hypothesis should be futures index leads the cash index due to infrequent trading. If there is lead-lag relationship between the return of stock including in components of SET50 index and futures index return, b_k should be greater than the level of significance. Furthermore, I calculate the average number of trading probability for each component stocks in order to investigate the non-synchronous trading. All test have to examine for overall test χ^2-statistic test to examine whether the lead or lag coefficients are jointly zero.

3) Lead-lag relationship between cash index and futures index under various conditions

This paper, furthermore, checks the robustness of the lead-lag relationship between two indexes. I propose and illustrate a various conditions for determining the lead-lag relationship, assuming under the bull market (up market) or the bear market (down market) and also the cluster of the information.

(i) Lead-lag relation under bad news and good news

Following *Chan (1992)*, this part examines the arrival of good and bad news affecting the futures index in the different way. In this part, I use the quintile method divided into five quintiles using 15 minute intervals and sorting by the sign and size of SET50 index return. The first quintile is defined as bad news which has the smallest return and downward price movements. On the contrary, the fifth quintile is the best return and upward price movement defined as good news. The relationship equation is expressed as follow:

$$r_{S,t} = a + a' d_t + \sum_{k=-k}^{K} b_k r_{f,t+k} + \sum_{k=-k}^{K} b'_k \, d_t r_{f,t+k} + \varepsilon_{S,t} \qquad (3)$$

where dummy variable (d_t) is equal to one if the SET50 index futures return are in each SET50 index return quintile and zero, for other SET50 index return quintiles. The above equation is used to test that the dummy slope coefficients are affected by bad news (down market) and good news (up market) in the different way. The null hypothesis test is that if coefficient of dummy variable has probabilities greater than level of significance. It can be implied that the futures market react indifferently to cash market from the release of good news and bad news.

(ii) Lead-lag relation under the market wide information

The market wide information defined as several stock prices are moving together not only the same direction but also the different direction. Most component stocks in the index moving in the same direction information would cause investors to gain a higher net profit because of exploiting the information in the futures market. It implies that investors prefer

trading futures index than invest in each stocks as a result of lower trading cost. The hypothesis is the new arrival of information should react futures market faster than the cash market. The higher market is wide; therefore, the larger will be different between SET50 index futures return and SET50 index return. This paper employs two variables, RATIO and PROP, to measure the market-wide movement.

a) RATIO is the co-movement ratio estimated by:

$$\left|\sum_{i=1}^{50}\Delta S_i\right| \Big/ \sum_{i=1}^{50}\left|\Delta S_i\right| \tag{4}$$

where ΔS_i is the price change of SET50 component stock i within 15 minutes. The price changes will be $\left|\sum_{i=1}^{50}\Delta S_i\right|$ if the investors exploit the information in the futures market, and $\sum_{i=1}^{50}\left|\Delta S_i\right|$ if they use the information in the cash market. Consequently, the higher ratio represents more stocks be comprised of SET50 index moving together. However, the RATIO variable concerns about the magnitude of prices change, so a few higher share prices can impact on the co-movement ratio. *Chan (1992)* further uses another variable, PROP, measuring the number of stocks moving together.

b) PROP is the co-movement ratio measures by:

$$\frac{\left|N_u - N_d\right|}{\left|N_u + N_d + N_z\right|} \tag{5}$$

The movement of the market can also be measured by the number of stocks moving upward (N_u), moving downward (N_d) and no change (N_z) in the number of SET50 component within the time interval. The hypothesis for the higher feedback from the SET50 index membership movement caused higher impact of futures market to spot market.

After separating the sample data into different quintiles from Ratio and PROP criterions, the test uses the dummy variables technique as shown in Equation (3). Therefore, the ought to expect the value of b_k' in Equation (3) to be zero if the co-movement of stock is not subject to the SET50 index futures. On the other hand, the co-movement of component stocks can have

impact on futures return. The cash index and futures index have a symmetric access to information.

V. EMPIRICAL RESULT

This section presents the results from estimating the model defined in the previous part. This part employs first difference in the logarithm because using return (logarithmic difference) instead of price index is implied by simple unit root properties. First of all, I present descriptive statistics for 15 minute return observations on SET50 index and SET50 index futures during the period May 5, 2006 to December 28, 2007. The mean return, and standard deviations of the spot market are 0.0006% and 0.2303, respectively. The futures market mean return and standard deviation are 0.0048% and 0.2664 which more volatile than that of the cash market, respectively. The highest and lowest mean return are generated by cash market and futures market are 5.0185%, (3.9130%), 5.6523%, and (-5.1914%), respectively.

I also examine the behavior of SET50 index and SET50 index futures return. Table IV documents the autocorrelation estimates at six lags for the price change on both SET50 index and SET50 index futures in Panel A and cross-correlation between cash and futures index in Panel B. The SET50 index return and SET50 index futures return coefficients are greater than 0.01 level of significance. There is correlation between SET50 index return and the past SET50 index return up to 12 lag terms; therefore, the return of either cash market or futures market has relationship with the past return.

[Table IV is here]

1) Lead-lag relationship between cash index and futures index

The regression results for the relationship between SET50 index return and SET50 index futures return during July 2, 2007 to December 28, 2007 are described. The lead coefficients ($\hat{b}_{-k}$), contemporaneous coefficients ($\hat{b}_0$), and lag coefficients ($\hat{b}_k$) for SET50 index futures obtained from Equation (2). The null hypothesis tested for lead-lag relationship has no lead-

lag relationship between the return of SET50 index and SET50 index futures return. If the return coefficients (b_k) are greater than 0.01 significance level, the lead-lag relationship exists between two variables. The simple linear regression shows that the null hypotheses of zero coefficients are also rejected with P-value equal to zero estimating at the 5% level of significant are summarized in Table V (see Appendix II for more details).

The result indicates that the price change of futures index lead the price changes of the underlying index up to two lags and strongly statistically significant for contemporaneous intervals. Nevertheless, there is weak evidence that the futures market return lag the cash market return reported in Appendix II. Overall results indicate consistently with the data from July 5, 2006 to June 29, 2007

[Table V is here]

Furthermore, this paper defines the average number of trading interval as a measure for frequency trading. The large number of trading intervals, the higher liquidity the member of SET50 index is. Table V presents summarized regression from Equation (2) during July 2, 2007 to December 28, 2007. The table is divided by non-trading probability, high (more than 7%), medium (2-7%), and low (less than 2%) respectively. The lag coefficient ($\hat{b}_{-2}$) parameters are statistically significant for higher non-trading probability, while the significant probability of the lag coefficient ($\hat{b}_{-1}$) and the contemporaneous ($\hat{b}_0$) coefficients have increased for the frequent trading probability. However, there is weak evidence from the lead coefficients. The result shows that return of SET50 index futures are slightly significantly more lags those of cash market for higher frequent trading probability. Overall results indicate consistently with the data from July 5, 2006 to June 29, 2007 that the futures market leads the cash market. Because most stocks are not traded continuously within 15 minutes, the index will respond to release of information with a lag. This evidence implies that the lead-lag relationship between two markets can be explained by non-synchronous trading or the illiquidity trading consistent with the previous study.

2) Lead-lag relationship between cash index and futures index under various conditions

Accountings for SET50 index return effects when return are segregated by the different news allow the model to more precisely describe the relationship. This part provides additional evidence on the linkage between cash market and futures market under various situations. The dummy variables are exploited in this regression Equation (3). There is no different evidence for the arrivals of an up market or a down market. The futures index return react the cash market simultaneously and also lead the cash index up to 30 minutes as shown in Table VI similar results to sample period July 5, 2006 to June 29, 2007. The prohibition of short-sale regulations in the cash market, the futures should lead cash market a greater degree under the bad news. Nevertheless, futures market return is symmetric in reflecting the good news and bad news. The lead-lag relationship is caused by the flow of information.

[Table VI is here]

In order to assess the extent to the co-movement measurement, this paper further employ other variables, RATIO and PROP, to examine the market wide information as illustrated in Tables VII and VIII. The results obtained when the RATIO variables are used is the lag one and contemporaneous coefficients return are statistically significant at the 5% or 1% level throughout all specifications. In case of PROP variables, the leadership and contemporaneous coefficients from the SET50 index futures return on SET50 index are statistically significant at 1% level of confidence only the first, third, and highest quintiles. The results can be described that when more component stocks move together, the feedback from the SET50 futures market does not impact difference to the SET50 index market. The futures market can be a source of market information even if the release of the news is influenced differently on each stock component. The SET50 index and SET50 index futures have a symmetric access to the information. The sample period during July 5, 2006 to June 29, 2007 yields the same results.

[Table VII is here]

[Table VIII is here]

The overall results are based on the simple OLS regression, the more complex estimation procedure is not mentioned in this paper. The above evidence can be summarized that investors' views appear to contradict the EMH.

VI. CONCLUSION

The purpose of this paper is to empirically examine the temporal relation of the intraday return between SET50 index and SET50 index futures movement. The 15-minute price series are then used to generate the time series of instantaneous rates of return. The sample observations from July 5, 2006 to December 28, 2007 finds that lagged changes in the futures price can help to predict changes in the spot price. A contemporaneous correlation is found between the SET50 index return and the SET50 index futures return. The estimation output reveals strongly significance of lag pattern for infrequent trading component stocks. The significant coefficients in both the contemporaneous and lagged variables suggest that the linkage between spot and futures market in Thailand is probably efficient market and these two markets reflect indifferently with the flow of information. The lead-lag relationship is caused by the trading cost hypothesis and leverage effect. In addition, SET50 index and SET50 index Futures are symmetric in reflecting private good news and bad news. The evidence also shows that when futures index market return do not lead the cash index to a greater degree when there are more stocks moving together. The result shows that futures market does not update market-wide information faster than the cash market. However, the evidences that futures lead all component stocks are robust.

Consequently, the futures index market serves as a primary market of price discovery and the arrival of information spreads into the futures market before the cash market. Investors can exploit this concept to determine the cash market and use futures as a financial hedging instrument. The efficient price discovery helps policy regulator to concern about market efficiency and to monitor the mispricing instruments in terms of transparency and accurate price discovery.

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Table I
The Summary of SET50 Index Futures Contract Specifications

Item	Heading	Individual Contract specification	
1	Underlying index	SET50 Index which is compiled, computed and disseminated by the Stock Exchange of Thailand	
2	Contract Multiplier	THB 1,000 per index point	
3	Contract Months	March, June, September, December up to 4 quarters	
4	Minimum Price fluctuations	0.10 index points	
5	Price Limit	+/- 30% of the previous settlement price	
6	Trading Hours	Pre-open:	9:15 - 9:45 hrs.
		Morning session:	9:45 - 12:30 hrs.
		Pre-open:	14:00 - 14:30 hrs.
		Afternoon session:	14:30 - 16:55 hrs.
7	Speculative Position limit	Net 10,000 delta equivalent SET50 Index Futures contracts on one side of the market in any contract month or all contract months combined.	
8	Final Trading Day	The business day immediately preceding the last business day of the contract month. Time at which trading ceases on Final Trading Day is 16.30 hrs.	
9	Final Settlement Price	The final settlement price shall be the numerical value of the SET50 Index, rounded down to the nearest two decimal points as determined by the exchange, and shall be the average value of the SET50 Index taken at one-minute intervals between 16:00-16:30 hours plus the closing index value, after deleting the three highest and three lowest values.	
10	Settlement Procedures	Cash Settlement	
11	Exchange and clearing fee	THB 50 per contract per size	
12	Brokerage commission	Freely negotiable	

Source: www.tfex.co.th (as of November 20, 2008)

Table II
The SET 50 index and SET50 index futures-15 minutes time intervals

This table shows15-minute interval data of SET50 index and SET50 index futures. The cash market opens the market into two sessions; morning session opened in 10.01 AM and closed in 12.30 AM and afternoon session opened in 14.31 PM and closed in 16.30 PM. On the contrary, the futures market has opened 15 minute before cash market and closed 15 minute after cash market does.

Table III
The SET 50 and SET50 index futures-15 minutes periods

Period	SET50 Index		SET50 Index Futures	
	Start	End	Start	End
1	x	x	*9.46	*10.00
2	10.01	10.15	10.01	10.15
3	10.16	10.30	10.16	10.30
4	10.31	10.45	10.31	10.45
5	10.46	11.00	10.46	11.00
6	11.01	11.15	11.01	11.15
7	11.16	11.30	11.16	11.30
8	11.31	11.45	11.31	11.45
9	11.46	12.00	11.46	12.00
10	12.01	12.15	12.01	12.15
11	**12.16	**12.30	**12.16	**12.30
12	14.31	14.45	14.31	14.45
13	14.46	15.00	14.46	15.00
14	15.01	15.15	15.01	15.15
15	15.16	15.30	15.16	15.30
16	15.31	15.45	15.31	15.45
17	15.46	16.00	15.46	16.00
18	16.01	16.15	16.01	16.15
19	16.16	16.30	16.16	16.30
20	x	x	*16.31	*16.45

* This paper excluded the intervals which the underlying, SET50 index, does not trade.
** The 15-minute interval data is cumulative from 12.16 - 12.29; therefore, the system does not have the 15-miute data in this period.

Table III
The series of the sample data periods

The SET50 index futures products are divided into various series through out the year and there are four contracts traded in each month. The series are composed of four settlement months, March, June, September, and December. The new series was created in the preceding last trading days before the old contract was maturity.

Periods	Descriptions	Series	Maturity Months
1	April 28 – June 29, 2006	S50M06	June
2	June 28 -September 29, 2006	S50U06	September
3	October 2 - December 28, 2006	S50Z06	December
4	January 3 - March 29, 2007	S50H07	March
5	March 30 - June 28, 2007	S50M07	June
6	June 29 - September 27, 2007	S50U07	September
7	September 28 - December 27, 2007	S50Z07	December

Note: * The first day SET50 index futures trading is on April 28, 2006
** TFEX launched SET50 index options on October 29, 2007

Table IV
Autocorrelation of SET50 index return and SET50 index futures return and cross-correlation between SET50 index return and SET50 index futures return

This table shows Autocorrelation coefficients $\rho(r_{st}, r_{st-k})$ and $\rho(r_{ft}, r_{ft-k})$ for up to k lags in Panel A. Panel B illustrate Cross-correlation coefficients $\rho(r_{st}, r_{ft-k})$ to indicate cross-correlations between future futures return and current cash return. Positive lags (k>0) indicate cross-correlations between past futures return and current cash return and negative lags (k<0). The sample data are computed from 15 minute intraday of SET50 index and SET50 index futures return respectively beginning with the 10.01 AM price quote and ending with the 16.30 PM price quote each day.

Panel A: Autocorrelation of return

lag (k)	$\rho(r_{st}, r_{st-k})$		$\rho(r_{ft}, r_{ft-k})$	
1	-0.0680	**	-0.1030	**
2	-0.0200	**	0.0610	**
3	0.0230	**	0.0520	**
4	-0.0280	**	-0.0240	**
5	0.0070	**	0.0430	**
6	-0.0080	**	-0.0860	**
7	0.0210	**	0.0370	**
8	0.0060	**	-0.0150	**
9	-0.0210	**	0.0110	**
10	0.0200	**	0.0080	**
11	0.0280	**	-0.0040	**
12	-0.0110	**	0.0300	**

** Indicates significance at 0.01 level

Panel B: Cross-correlation of return

lag (k)	$\rho(r_{st}, r_{ft-k})$
0	0.7131
1	0.0249
2	0.0057
3	0.0857
4	-0.0678
5	0.0462

Table V
Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{f,t}$) during July 2 to December 28, 2007

This table provides the summary of number of significance estimating from the following regression: $r_{i,t} = a + \sum_{k=-K}^{K} b_k r_{f,t+k} + \varepsilon_{i,t}$ where $r_{i,t}$ denotes the rate of return for the component stocks of SET50 index at time t. The component stocks are divides into 3 groups depending on the non-trading probability (%) as shown in column 1 and column 2. The number of statistical coefficients for each group is divided by number of total observations.

Non-trading Probability	**%**	Obs	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_{0}$	$\hat{b}_{1}$	$\hat{b}_{2}$ (%)
High	> 7%	16	12.24	24.49	12.24	0.00	2.04
Medium	2 - 7%	17	4.08	28.57	32.65	0.00	0.00
Low	< 2%	16	4.08	30.61	32.65	0.00	4.08

*Total number of 49 stocks

The average trading volume for each stock are computed by average the volume for each 15-minute time interval during the sample period (July 2, 2007 – December 28, 2007), then I count the number of non-trading period in order to denote the non-trading probability.

Table VI
Regression of 15-minute SET50 index return on lags and leads of 15-minute SET 50 index futures for five quintiles during July 2 to December 28, 2007

This table shows the relationship between cash index return and futures index return concerning the arrival of good new and bad news. The regression model is specified as:

$$r_{S,t} = a + a' d_t + \sum_{k=-k}^{K} b_k r_{f,t+k} + \sum_{k=-k}^{K} b'_k \, d_t r_{f,t+k} + \varepsilon_{S,t}$$

where k is the lead and lag variables and d_t is dummy variables for each return quintile ($d_1, d_{2,} ... d_5$). The highest quintile represents the good news arrival and the lowest quintile represents the bad news arrival. The null hypothesis is that $(b'_1 = b'_2 = ... = b'_k = 0)$.

Quintile	b'_{-2}	b'_{-1}	b'_{-0}	b'_1	b'_2	$\overline{R}^2$
1	0.0293	0.1141	0.0204	-0.0345	0.0379	0.4736
(Low)	1.1480	4.4549 **	0.7319	-1.2405	1.3197	
2	0.0702 *	-0.0125	0.0282	-0.0207	-0.0526	0.4708
	2.4016	-0.4227	0.9010	-0.6478	-1.6962	
3	0.0749 **	-0.0605	0.0814 *	0.0332	0.0324	0.4729
	2.6088	-1.9261	2.4569	1.0402	0.9934	
4	-0.1064	-0.1040	-0.0822	-0.0227	0.0074	0.4793
	-4.7061 **	-4.5668 **	-3.1324 **	-0.8161	0.2422	
5	0.0001	0.0461	0.0357	0.0285	-0.0177	0.4702
(High)	0.0042	1.5958	1.1860	1.0020	-0.5977	

* Indicates significance at 0.05 level
** Indicates significance at 0.01 level

Table VII
Regression of 15-minute SET50 index return on lags and leads of 15-minute SET 50 index futures for five quintiles sorted by the RATIO variable during July 2 to December 28, 2007

Ratio is the co-movement ratio estimated by: $\left|\sum_{i=1}^{50}\Delta S_i\right| \Big/ \sum_{i=1}^{50}\left|\Delta S_i\right|$; where ΔS_i is the price change of SET50 component stock i within 15 minutes. The price changes are $\left|\sum_{i=1}^{50}\Delta S_i\right|$ if the investors exploit the information in the futures market, and $\sum_{i=1}^{50}\left|\Delta S_i\right|$ if they use the information in the cash market.

Quintile	b'_{-2}	b'_{-1}	b'_{-0}	b'_{1}	b'_{2}	$\overline{R}^2$
1	0.0186	-0.2269	-0.3650	0.0233	0.0200	0.5639
(Low)	0.4522	-4.7605 **	-6.5605 **	0.5452	0.4725	
2	-0.0441	-0.1463	-0.3321	-0.0017	0.0829	0.5551
	-1.0413	-3.0349 **	-6.0434 **	-0.0376	1.8135	
3	-0.0856	-0.1417	-0.2774	0.0661	0.0594	0.5626
	-2.5101 *	-3.7154 **	-6.6508 **	1.8086	1.6431	
4	-0.0283	-0.0809	-0.1471	-0.0109	0.0220	0.5444
	-0.8371	-2.2536 *	-3.9045 **	-0.2933	0.5966	
5	0.0223	0.1536	0.1778	-0.0355	0.0260	0.5612
(High)	0.6530	4.4840 **	5.0262 **	-0.9964	0.7279	

* Indicates significance at 0.05 level
** Indicates significance at 0.01 level

Table VIII
Regression of 15-minute SET50 index return on lags and leads of 15-minute SET 50 index futures for five quintiles sorted by the PROP variable during July 2 to December 28, 2007

PROP is the co-movement ratio measures by $\frac{\left|N_u - N_d\right|}{\left|N_u + N_d + N_z\right|}$; where N_u, N_d, and N_z are the number of SET50 component moving upward, moving downward and no change in the number of SET50 component within the time interval.

Quintile	b'_{-2}	b'_{-1}	b'_{-0}	b'_1	b'_2	$\overline{R}^2$
1	-0.0125	-0.1876	-0.3972	-0.0040	-0.0184	0.5457
(Low)	-0.2279	-2.4458 *	-4.6778 **	-0.0714	-0.3085	
2	0.0152	-0.1638	-0.3313	0.0581	0.0487	0.5571
	0.3771	-3.6128	-5.8641	1.3589	1.2025	
3	-0.0276	-0.1974	-0.2885	0.0163	0.0282	0.5599
	-0.6391	-4.4413 **	-6.2803 **	0.3779	0.5980	
4	-0.0479	-0.0645	-0.0254	0.0622	-0.0333	0.5366
	-1.1825	-1.3936	-0.5279	1.3690	-0.7748	
5	0.0231	0.1836	0.3463	-0.0392	-0.0617	0.6065
(High)	0.6510	5.3710 **	10.1668 **	-1.0003	-1.5773	

* Indicates significance at 0.05 level
** Indicates significance at 0.01 level

Figure 1
The SET50 index capitalization and SET index capitalization

This figure illustrates the comparison between SET50 index capitalization and SET index capitalization during January 2006 to December 2007. The SET50 index capitalization is comprised of 70% of the total market capitalization.

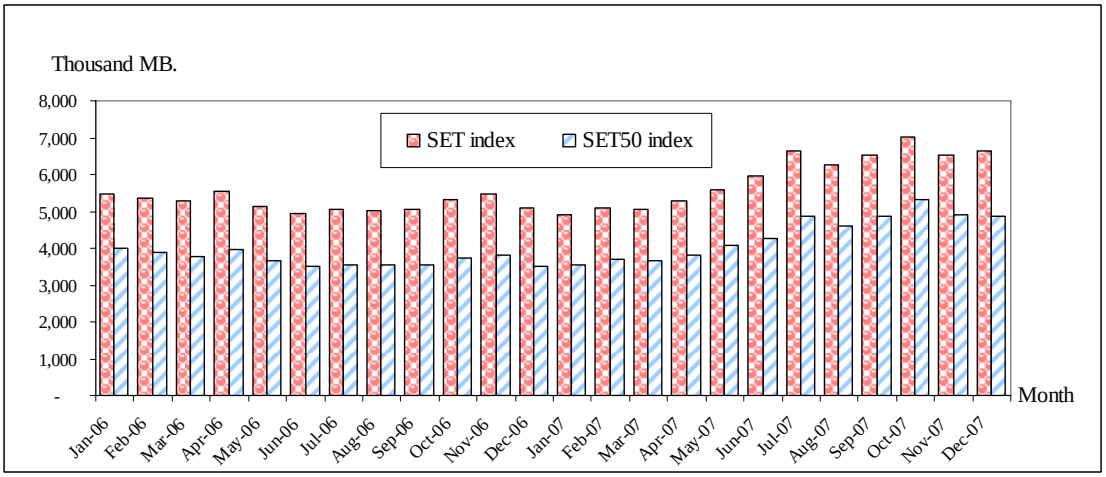
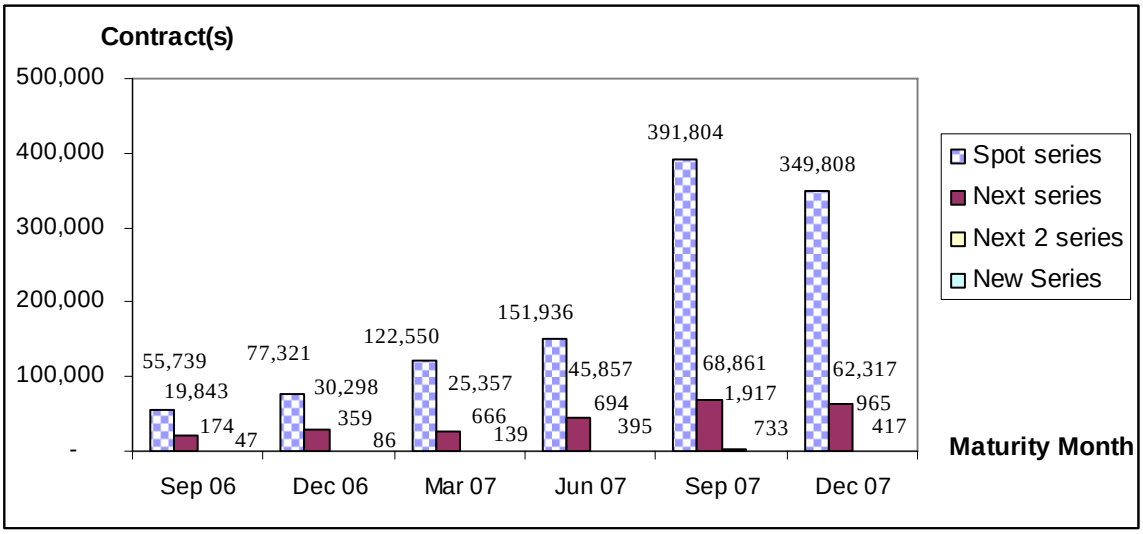


Figure 2
The total trading volume classified by maturity during the sample period

This figure shows the number of contracts traded from June 30, 2006 to December 27, 2007. The trading volumes are divided by the type of contracts, the spot-series contracts, the next-maturity month contracts, and the next two and three-maturity month contracts, respectively. Only data of the nearest maturity month contract is employed in our analysis because it is the most actively traded contract on the TFEX.



APPENDIX I

LIST OF SECURITIES IN THE SET50 INDEX
For calculating the index during July 1, 2006 - December 31, 2006

Sector	Securities Name	
Industry Group: Agro & Food Industry		
Agribusiness	CHAROEN POKPHAND FOODS PCL.	CPF
Food and Beverage	MINOR INTERNATIONAL PCL.	MINT
	THAI UNION FROZEN PRODUCTS PCL.	TUF
Industry Group: Financials		
Banking	BANK OF AYUDHYA PCL.	BAY
	BANGKOK BANK PCL.	BBL
	KASIKORNBANK PCL.	KBANK
	KIATNAKIN BANK PCL.	KK
	KRUNG THAI BANK PCL.	KTB
	THE SIAM COMMERCIAL BANK PCL.	SCB
	SIAM CITY BANK PCL.	SCIB
	TISCO BANK PCL.	TISCO
	TMB BANK PCL.	TMB
Finance and Securities	KIM ENG SECURITIES (THAILAND) PCL.	KEST
	THANACHART CAPITAL PCL.	TCAP
Industry Group: Industrials		
Petrochemicals & Chemicals	THE AROMATICS (THAILAND) PCL.	ATC
	PTT CHEMICAL PCL.	PTTCH
	THAI PLASTIC AND CHEMICALS PCL.	TPC
Industry Group: Property & Construction		
Construction Materials	THE SIAM CEMENT PCL.	SCC
	SIAM CITY CEMENT PCL.	SCCC
	SAHAVIRIYA STEEL INDUSTRIES PCL.	SSI
	TPI POLENE PCL.	TPIPL
Property Development	AMATA CORPORATION PCL.	AMATA
	CENTRAL PATTANA PCL.	CPN
	ITALIAN-THAI DEVELOPMENT PCL.	ITD
	LAND AND HOUSES PCL.	LH
Industry Group: Resources		
Energy & Utilities	BANPU PCL.	BANPU
	ELECTRICITY GENERATING PCL.	EGCOMP
	GLOW ENERGY PCL.	GLOW
	PTT PCL.	PTT
	PTT EXPLORATION AND PRODUCTION PCL.	PTTEP
	RATCHABURI ELECTRICITY GENERATING HOLDING PCL.	RATCH
	THAI OIL PCL.	TOP

APPENDIX I (Continue)

LIST OF SECURITIES IN THE SET50 INDEX

For calculating the index during July 1, 2006 - December 31, 2006 (Continue)

Sector	Securities Name	
Industry Group: Services		
Commerce	C.P. SEVEN ELEVEN PCL.	CP7-11
	SIAM MAKRO PCL.	MAKRO
Health Care Services	BANGKOK DUSIT MEDICAL SERVICES PCL.	BGH
	BUMRUNGRAD HOSPITAL PCL.	BH
Media & Publishing	BEC WORLD PCL.	BEC
	MCOT PCL.	MCOT
Transportation & Logistics	AIRPORTS OF THAILAND PCL.	AOT
	BANGKOK EXPRESSWAY PCL.	BECL
	PRECIOUS SHIPPING PCL.	PSL
	REGIONAL CONTAINER LINES PCL.	RCL
	THAI AIRWAYS INTERNATIONAL PCL.	THAI
	THORESEN THAI AGENCIES PCL.	TTA
Industry Group: Technology		
Communication	ADVANCED INFO SERVICE PCL.	ADVANC
	SHIN SATELLITE PCL.	SATTEL
	TRUE CORPORATION PCL.	TRUE
Electronic Components	CAL-COMP ELECTRONICS (THAILAND) PCL.	CCET
	DELTA ELECTRONICS (THAILAND) PCL.	DELTA
	HANA MICROELECTRONICS PCL.	HANA

APPENDIX I (Continue)

LIST OF SECURITIES IN THE SET50 INDEX
For calculating the index during January 1, 2007 - June 30, 2007

Sector	Securities Name	
Industry Group: Agro & Food Industry		
Agribusiness	CHAROEN POKPHAND FOODS PCL.	CPF
Food and Beverage	KHON KAEN SUGAR INDUSTRY PCL.	KSL
	MINOR INTERNATIONAL PCL.	MINT
	THAI UNION FROZEN PRODUCTS PCL.	TUF
Industry Group: Financials		
Banking	BANK OF AYUDHYA PCL.	BAY
	BANGKOK BANK PCL.	BBL
	KASIKORNBANK PCL.	KBANK
	KIATNAKIN BANK PCL.	KK
	KRUNG THAI BANK PCL.	KTB
	THE SIAM COMMERCIAL BANK PCL.	SCB
	SIAM CITY BANK PCL.	SCIB
	TISCO BANK PCL.	TISCO
	TMB BANK PCL.	TMB
Finance and Securities	THANACHART CAPITAL PCL.	TCAP
Industry Group: Industrials		
Industrial Materials & Machinery	SAHAVIRIYA STEEL INDUSTRIES PCL.	SSI
Petrochemicals & Chemicals	THE AROMATICS (THAILAND) PCL.	ATC
	PTT CHEMICAL PCL.	PTTCH
	THAI PLASTIC AND CHEMICALS PCL.	TPC
Industry Group: Property & Construction		
Construction Materials	THE SIAM CEMENT PCL.	SCC
	SIAM CITY CEMENT PCL.	SCCC
	TPI POLENE PCL.	TPIPL
Property Development	AMATA CORPORATION PCL.	AMATA
	CENTRAL PATTANA PCL.	CPN
	ITALIAN-THAI DEVELOPMENT PCL.	ITD
	LAND AND HOUSES PCL.	LH
Industry Group: Resources		
Energy & Utilities	BANPU PCL.	BANPU
	ELECTRICITY GENERATING PCL.	EGCOMP
	GLOW ENERGY PCL.	GLOW
	IRPC PCL.	IRPC
	PTT PCL.	PTT
	PTT EXPLORATION AND PRODUCTION PLC.	PTTEP
	RATCHABURI ELECTRICITY GENERATING HOLDING PCL.	RATCH
	THAI OIL PCL.	TOP

APPENDIX I (Continue)

LIST OF SECURITIES IN THE SET50 INDEX

For calculating the index during January 1, 2007 - June 30, 2007 (Continue)

Sector	Securities Name	
Industry Group: Services		
Commerce	C.P. SEVEN ELEVEN PCL.	CP7-11
	SIAM MAKRO PCL.	MAKRO
Health Care Services	BANGKOK DUSIT MEDICAL SERVICES PCL.	BGH
	BUMRUNGRAD HOSPITAL PCL.	BH
Media & Publishing	BEC WORLD PCL.	BEC
	MCOT PCL.	MCOT
Transportation & Logistics	AIRPORTS OF THAILAND PCL.	AOT
	BANGKOK EXPRESSWAY PCL.	BECL
	PRECIOUS SHIPPING PCL.	PSL
	REGIONAL CONTAINER LINES PCL.	RCL
	THAI AIRWAYS INTERNATIONAL PCL.	THAI
	THORESEN THAI AGENCIES PCL.	TTA
Industry Group: Technology		
Electronic Components	CAL-COMP ELECTRONICS (THAILAND) PUBLIC CCL.	CCET
	DELTA ELECTRONICS (THAILAND) PCL.	DELTA
	HANA MICROELECTRONICS PCL.	HANA
Information & Communication Technology	ADVANCED INFO SERVICE PCL.	ADVANC
	TRUE CORPORATION PCL.	TRUE

APPENDIX I (Continue)

LIST OF SECURITIES IN THE SET50 INDEX
For calculating the index during July 1, 2007 - December 31, 2007

Sector	Securities Name	
Industry Group: Agro & Food Industry		
Agribusiness	CHAROEN POKPHAND FOODS PCL.	CPF
Food and Beverage	KHON KAEN SUGAR INDUSTRY PCL.	KSL
	MINOR INTERNATIONAL PCL.	MINT
	THAI UNION FROZEN PRODUCTS PCL.	TUF
Industry Group: Financials		
Banking	BANK OF AYUDHYA PCL.	BAY
	BANGKOK BANK PCL.	BBL
	KASIKORNBANK PCL.	KBANK
	KIATNAKIN BANK PCL.	KK
	KRUNG THAI BANK PCL.	KTB
	THE SIAM COMMERCIAL BANK PCL.	SCB
	SIAM CITY BANK PCL.	SCIB
	TMB BANK PCL.	TMB
Finance and Securities	THANACHART CAPITAL PCL.	TCAP
Industry Group: Industrials		
Industrial Materials & Machinery	SAHAVIRIYA STEEL INDUSTRIES PCL.	SSI
Petrochemicals & Chemicals	THE AROMATICS (THAILAND) PCL.	ATC
	PTT CHEMICAL PCL.	PTTCH
	THAI PLASTIC AND CHEMICALS PCL.	TPC
Industry Group: Property & Construction		
Construction Materials	THE SIAM CEMENT PCL.	SCC
	SIAM CITY CEMENT PCL.	SCCC
	TPI POLENE PCL.	TPIPL
Property Development	AMATA CORPORATION PCL.	AMATA
	CENTRAL PATTANA PCL.	CPN
	ITALIAN-THAI DEVELOPMENT PCL.	ITD
	LAND AND HOUSES PCL.	LH
Industry Group: Resources		
Energy & Utilities	BANPU PCL.	BANPU
	ELECTRICITY GENERATING PCL.	EGCO
	GLOW ENERGY PCL.	GLOW
	IRPC PCL.	IRPC
	PTT PCL.	PTT
	PTT EXPLORATION AND PRODUCTION PCL.	PTTEP
	RATCHABURI ELECTRICITY GENERATING HOLDING PCL.	RATCH
	RAYONG REFINERY PCL.	RRC
	THAI OIL PCL.	TOP

APPENDIX I (Continue)

LIST OF SECURITIES IN THE SET50 INDEX
For calculating the index during July 1, 2007 - December 31, 2007

Sector	Securities Name	
Industry Group: Services		
Commerce	CP ALL PCL.	CPALL*
	SIAM MAKRO PCL.	MAKRO
Health Care Services	BANGKOK DUSIT MEDICAL SERVICES PCL.	BGH
	BUMRUNGRAD HOSPITAL PCL.	BH
Media & Publishing	BEC WORLD PCL.	BEC
	MCOT PCL.	MCOT
Transportation & Logistics	AIRPORTS OF THAILAND PCL.	AOT
	BANGKOK EXPRESSWAY PCL.	BECL
	PRECIOUS SHIPPING PCL.	PSL
	REGIONAL CONTAINER LINES PCL.	RCL
	THAI AIRWAYS INTERNATIONAL PCL.	THAI
	THORESEN THAI AGENCIES PCL.	TTA
Industry Group: Technology		
Electronic Components	CAL-COMP ELECTRONICS (THAILAND) PCL.	CCET
	DELTA ELECTRONICS (THAILAND) PCL.	DELTA
	HANA MICROELECTRONICS PCL.	HANA
Information & Communication Technology	ADVANCED INFO SERVICE PCL.	ADVANC
	TRUE CORPORATION PCL.	TRUE

APPENDIX II

Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{f,t}$) between July 2 to December 28, 2007

Symbol	Average Volume	Non-trading Probability	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_0$	$\hat{b}_1$	$\hat{b}_2$	χ^2_{lag}	χ^2_{lead}	$\overline{R}^2$
SET50			-0.005	0.175	0.545	-0.039	-0.028	101.941	7.591	0.537
			-0.322	10.090 **	30.630 **	-2.158 *	-1.568	0.000 **	0.023 *	
KSL	595	30.20%	0.073	0.168	0.093	0.011	-0.241	4.499	6.970	0.016
			0.872	1.937	1.027	0.113	-2.636 **	0.106	0.031 *	
SCCC	57	26.21%	-0.006	0.238	0.238	-0.098	-0.026	12.156	2.165	0.040
			-0.095	3.485 **	3.417 **	-1.385	-0.375	0.002 **	0.339	
TUF	730	20.21%	0.135	0.039	-0.058	0.035	-0.050	12.367	1.901	0.016
			3.432 **	0.938	-1.360	0.806	-1.167	0.002 **	0.387	
MAKRO	139	19.76%	0.164	0.098	0.054	0.035	0.017	13.229	0.529	0.017
			3.116 **	1.838	0.987	0.621	0.306	0.001 **	0.768	
TPC	605	17.03%	0.059	0.155	0.155	-0.036	-0.037	16.856	1.521	0.039
			1.487	3.812 **	3.672 **	-0.832	-0.845	0.000 **	0.467	
BH	352	15.82%	0.039	0.073	0.156	0.032	-0.006	4.140	0.557	0.022
			0.961	1.780	3.697 **	0.740	-0.144	0.126	0.757	
SSI	6,545	14.56%	0.126	0.223	0.091	-0.031	-0.108	13.290	2.446	0.017
			1.879	3.114 **	1.252	-0.421	-1.462	0.001 **	0.294	
GLOW	1,031	13.35%	-0.020	0.174	0.332	-0.109	0.081	8.776	4.955	0.057
			-0.354	2.934 **	5.651 **	-1.855	1.340	0.012 *	0.084	
DELTA	563	13.26%	0.014	0.103	0.214	-0.079	0.053	5.889	4.163	0.038
			0.336	2.402 *	4.825 **	-1.759	1.180	0.053	0.125	
BGH	663	12.90%	0.277	0.220	0.058	0.051	0.037	52.039	1.621	0.070
			5.756 **	4.458 **	1.140	0.988	0.709	0.000 **	0.445	
BECL	801	11.92%	0.045	0.116	0.058	-0.047	-0.015	11.989	1.917	0.016
			1.277	3.229 **	1.604	-1.301	-0.402	0.003 **	0.384	

APPENDIX II (Continue)

Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{f,t}$)

between July 2 to December 28, 2007

Symbol	Average Volume	Non-trading Probability	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_0$	$\hat{b}_1$	$\hat{b}_2$	χ^2_{lag}	χ^2_{lead}	$\overline{R}^2$
RCL	696	10.48%	0.368	0.433	0.016	-0.088	0.020	73.620	1.626	0.085
			5.652 **	6.535 **	0.236	-1.257	0.294	0.000 **	0.444	
AOT	552	9.99%	0.066	0.166	-0.046	0.077	-0.081	8.725	3.091	0.009
			1.150	2.757 **	-0.765	1.253	-1.314	0.013 *	0.213	
KK	774	9.77%	0.175	0.223	-0.029	-0.014	-0.040	34.795	0.767	0.038
			3.798 **	4.611 **	-0.577	-0.281	-0.807	0.000 **	0.681	
CPN	1,134	9.09%	0.232	0.535	0.071	-0.121	-0.068	66.061	3.528	0.076
			3.295 *	7.398 **	0.960	-1.606	-0.895	0.000 **	0.171	
MINT	1,646	8.02%	0.004	0.266	0.286	0.037	0.029	22.256	0.651	0.054
			0.075	4.717 **	4.759 **	0.607	0.486	0.000 **	0.722	
ATC	3,709	7.97%	-0.107	0.186	0.646	-0.061	0.011	15.433	1.154	0.145
			-1.991 *	3.328 **	11.378 **	-1.066	0.186	0.000 **	0.562	
HAHA	863	7.84%	0.033	0.104	0.159	0.053	-0.001	5.603	1.261	0.019
			0.738	2.245 *	3.353 **	1.121	-0.025	0.061	0.532	
CCET	3,100	7.57%	0.120	0.108	0.212	0.079	0.010	9.675	2.084	0.030
			2.301 *	2.038 *	3.879 **	1.418	0.187	0.008 **	0.353	
SCIB	2,287	7.39%	0.003	0.240	0.334	-0.012	-0.030	30.140	2.672	0.098
			0.078	5.488 **	7.290 **	-0.250	-0.657	0.000 *	0.263	
RRC	15,380	6.85%	-0.039	0.115	0.598	0.014	-0.048	7.901	1.236	0.180
			-0.925	2.634 **	13.519 **	0.323	-1.081	0.019 *	0.539	
MCOT	1,332	5.60%	-0.011	0.233	0.433	0.032	-0.069	15.472	1.367	0.073
			-0.197	3.928 **	7.044 **	0.504	-1.086	0.000 **	0.505	
TPIPL	5,889	5.38%	-0.038	0.147	0.444	0.053	0.052	6.703	1.537	0.067
			-0.674	2.499 *	7.327 **	0.858	0.850	0.035 *	0.464	

APPENDIX II (Continue)

Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{F,t}$)

between July 2 to December 28, 2007

Symbol	Average Volume	Non-trading Probability	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_0$	$\hat{b}_1$	$\hat{b}_2$	χ^2_{lag}	χ^2_{lead}	$\overline{R}^2$
RATCH	751	5.33%	0.014	0.158	0.200	-0.018	-0.022	14.575	0.469	0.040
			0.340	3.805 **	4.731 **	-0.432	-0.511	0.001 **	0.791	
EGCO	417	4.75%	0.039	0.168	0.288	0.026	0.056	11.615	1.461	0.049
			0.802	3.309 **	5.523 **	0.489	1.070	0.003 **	0.482	
TCAP	3,934	4.61%	-0.004	0.341	0.317	0.034	-0.105	3.156	0.293	0.002
			-0.023	1.777	1.625	0.170	-0.523	0.206	0.864	
AMATA	1,079	3.76%	-0.028	0.215	0.269	-0.019	-0.027	13.055	0.306	0.034
			-0.491	3.582 **	4.413 **	-0.311	-0.436	0.002 **	0.858	
BEC	2,938	3.18%	0.008	0.079	0.300	0.006	-0.024	2.973	0.269	0.044
			0.177	1.719	6.304 **	0.122	-0.512	0.226	0.874	
CPF	6,031	3.05%	0.049	0.105	0.172	0.055	-0.061	6.980	3.035	0.024
			1.129	2.394 *	3.838 **	1.205	-1.338	0.031 *	0.219	
PSL	1,961	2.91%	0.041	0.264	0.573	0.029	-0.037	17.345	0.459	0.097
			0.661	4.112 **	8.640 **	0.434	-0.549	0.000 **	0.795	
THAI	1,395	2.69%	0.021	0.268	0.196	-0.038	-0.055	46.159	2.870	0.074
			0.558	6.773 **	4.811 **	-0.937	-1.349	0.000 **	0.238	
TMB	24,328	2.42%	-0.051	0.253	0.353	-0.082	-0.083	13.160	2.672	0.038
			-0.741	3.541 **	4.831 **	-1.116	-1.117	0.001 **	0.263	
PTT	2,928	2.37%	0.011	0.084	0.802	-0.079	-0.037	3.638	3.836	0.255
			0.257	1.895	17.609 **	-1.728	-0.804	0.162	0.147	
BAY	5,283	2.15%	-0.054	0.229	0.483	-0.083	-0.081	14.189	3.433	0.076
			-0.883	3.653 **	7.558 **	-1.283	-1.257	0.001	0.180	
LH	11,185	2.15%	-0.026	0.247	0.344	-0.071	-0.010	25.434	2.010	0.075
			-0.547	5.011 **	6.757 **	-1.386	-0.202	0.000 **	0.366	

APPENDIX II (Continue)

Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{f,t}$)

between July 2 to December 28, 2007

Symbol	Average Volume	Non-trading Probability	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_0$	$\hat{b}_1$	$\hat{b}_2$	χ^2_{lag}	χ^2_{lead}	$\overline{R}^2$
ITD	8,989	2.06%	0.010	0.419	0.646	-0.049	0.022	54.241	0.798	0.173
			0.175	7.361 **	11.098 **	-0.835	0.373	0.000 **	0.671	
BANPU	927	1.16%	-0.024	0.273	0.486	0.048	-0.140	24.756	6.485	0.106
			-0.458	4.956 **	8.624 **	0.843	-2.460 *	0.000 **	0.039 *	
SCB	2,950	1.16%	-0.094	0.214	0.496	-0.046	0.002	27.110	0.969	0.136
			-2.148 *	4.730 **	10.684 **	-0.984	0.041	0.000 **	0.616	
PTTCH	1,836	1.43%	-0.015	0.239	0.712	-0.068	-0.037	18.787	1.927	0.166
			-0.279	4.326 **	12.498 **	-1.181	-0.644	0.000 **	0.382	
ADVANC	1,986	1.34%	0.059	0.146	0.313	0.055	0.019	16.154	2.141	0.082
			1.556	3.716 **	7.782 **	1.351	0.476	0.000 **	0.343	
SCC	934	1.03%	-0.064	0.115	0.361	0.031	-0.011	8.732	0.482	0.070
			-1.465	2.560 *	7.820 **	0.663	-0.247	0.013 *	0.786	
TRUE	13,420	1.03%	-0.177	0.274	0.645	0.012	-0.086	33.251	2.120	0.148
			-3.194 **	4.787 **	11.005 **	0.201	-1.453	0.000 **	0.346	
PTTEP	3,063	0.76%	-0.031	0.173	0.735	-0.104	-0.066	10.983	5.343	0.175
			-0.592	3.259 **	13.454 **	-1.889	-1.198	0.004 **	0.069	
KTB	15,917	0.72%	-0.022	0.141	0.585	-0.082	-0.108	7.409	6.630	0.122
			-0.440	2.684 **	10.820 **	-1.513	-1.971 *	0.025 *	0.036 *	
BBL	2,364	0.72%	-0.024	0.081	0.439	-0.039	0.066	3.058	2.257	0.081
			-0.504	1.676	8.864 **	-0.792	1.325	0.217	0.324	
IRPC	30,202	0.54%	-0.019	0.167	0.532	-0.041	-0.001	10.825	0.607	0.109
			-0.389	3.265 **	10.106 **	-0.776	-0.017	0.005 **	0.738	
TTA	5,840	0.54%	0.095	0.367	0.711	0.024	0.006	35.466	0.145	0.148
			1.543	5.758 **	10.875 **	0.363	0.093	0.000 **	0.930	

APPENDIX II (Continue)

Regression of 15-minute return of SET50 component stock ($R_{i,t}$) on lags and leads of 15-minute return of SET50 index futures ($R_{f,t}$)

between July 2 to December 28, 2007

Symbol	Average Volume	Non-trading Probability	$\hat{b}_{-2}$	$\hat{b}_{-1}$	$\hat{b}_0$	$\hat{b}_1$	$\hat{b}_2$	χ^2_{lag}	χ^2_{lead}	$\overline{R}^2$
KBANK	3,217	0.45%	-0.021	0.133	0.553	-0.061	-0.018	11.104	2.418	0.170
			-0.530	3.287 **	13.321 **	-1.463	-0.430	0.004 **	0.299	
TOP	5,763	0.45%	-0.013	0.126	0.833	0.006	-0.083	8.112	3.261	0.272
			-0.300	2.831 *	18.312 **	0.136	-1.806	0.017 *	0.196	

* Indicates significance at 0.05 level
** Indicates significance at 0.01 level
*** For the components of SET50 index during July 2 to December 28, 2007, the CPALL data are not available

The regression model are $r_{i,t} = a + \sum_{k=-K}^{K} b_k r_{f,t+k} + \varepsilon_{i,t}$; where $r_{i,t}$ denotes the rate of return for the component stocks of SET50 index at time t. The null hypothesis tested for lead-lag relationship is no lead-lag relationship between the return of component of SET50 index and SET50 index futures return. If coefficients are greater than 0.01 significant level, there exists lead-lag relationship between the return of stock including in SET50 index and futures index return. All test have to test for overall test χ^2 -statistic test to examine whether the lead or lag coefficients are jointly zero.