The Efficiency of Thailand's Stock Index Futures Market*

Pawat Ouppathumchua**

Abstract

The objectives of this study were 1) to examine the market efficiency in Thailand Futures Exchange (TFEX) specified in SET50 Index Futures in contracts of different maturity terms 2) to explain the Speed of Adjustment of future spot price in SET50 Index Futures in contracts of different maturity terms 3) to find out the volatility of the futures prices (change in a lag term and Time Varying Risk Premium) and 4) to purpose the TFEX policy implication related to market efficiency in individual contract terms.

This study conclvded that there was no market efficiency in all the contracts. However, the futures price and the future spot price have a long-run relationship in all the contracts when the Cointegration Model was utilized. Futures price in short-term contracts can better represent future spot price than that in long-term contracts. When the Error Correction Model (ECM) was utilized, it was fond that the speed of adjustment of the future spot price in the long-term contract had higher volatility.

TFEX should carefully revise the procedures on how to properly regulate maturity for all financial products in the SET 50 Index Futures because contracts with a maturity term of more than 3 months will have a low level of liquidity and are less predictable for "Future Spot Price." Also, TFEX should promote short-maturity contracts and carefully educate investors to have a profound understand of the derivative products in the SET50 Index Futures and market mechanism.

Keywords: Thailand future exchange (TFEX), cointegration, error correction model

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ประสิทธิภาพของตลาดซื้อขายล่วงหน้าดัชนีหลักทรัพย์ประเทศไทย*

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บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อ 1) อธิบายประสิทธิภาพของตลาดซื้อขายล่วงหน้าดัชนีหลักทรัพย์แห่งประเทศไทย 2) อธิบายความเร็วในการปรับตัวของราคาส่งมอบทันทีมีผลต่อดุลยภาพระยะสั้นของดัชนีหลักทรัพย์ล่วงหน้า ในแต่ละอายุสัญญา 3) หาความผันผวนของราคาซื้อขายล่วงหน้าที่ส่งผลมาจากเวลาที่เปลี่ยนไป และส่วนชดเชยความเสี่ยง 4) นำเสนอข้อเสนอแนะเชิงนโยบายในตลาดซื้อขายล่วงหน้าแห่งประเทศไทย

ผลการศึกษาพบว่า ตลาดซื้อขายล่วงหน้าดัชนีหลักทรัพย์แห่งประเทศไทย ไม่มีประสิทธิภาพตลาดในทุกอายุสัญญา อย่างไรก็ตาม ราคาซื้อขายล่วงหน้าและราคาส่งมอบทันทีมีความสัมพันธ์ระยะยาวในทุกสัญญา ราคาซื้อขายล่วงหน้าของสัญญาที่มีอายุสั้นจะสามารถเป็นตัวแทนคาดการณ์ราคาส่งมอบทันทีได้ดีกว่าสัญญาที่มีอายุยาว สำหรับความเร็วในการปรับตัวเข้าสู่ดุลยภาพระยะสั้นของราคาส่งมอบทันทีพบว่า อายุสัญญาสั้นจะมีความเร็วในการปรับตัวที่เร็วกว่าอายุสัญญายาว

สำหรับข้อเสนอแนะเชิงนโยบาย เสนอว่า ตลาดซื้อขายล่วงหน้าหลักทรัพย์แห่งประเทศไทยควรที่จะทบทวนอายุสัญญาของผลิตภัณฑ์อนุพันธ์ในตลาด เพราะว่าอายุสัญญาที่มีระยะเวลามากกว่า 3 เดือน ที่จะมีปริมาณการซื้อขายน้อย และราคาล่วงหน้าไม่สามารถเป็นตัวแทนคาดการณ์ราคาส่งมอบทันทีตามวัตถุประสงค์ของตลาดที่ต้องการให้นักลงทุนมาลงทุนเพื่อลดความเสี่ยง อีกทั้งตลาดยังควรให้ความรู้แก่นักลงทุน ในภาคปฏิบัติในแง่ของการเข้ามาซื้อขาย การดำเนินงานของตลาด เพื่อทำให้ตลาดซื้อขายล่วงหน้ามีประสิทธิภาพมากขึ้น

คำสำคัญ: ความสัมพันธ์ระยะยาว ประสิทธิภาพตลาด ตลาดซื้อขายล่วงหน้า

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Introduction

Thailand Futures Exchange (TFEX), a subsidiary of the Stock Exchange of Thailand (SET), was established on May 17, 2004 as a derivatives exchange. Since then TFEX has played an important role in the stability and sustainability of Thailand's financial market and economy. As derivative products in TFEX include many underlying assets—Stock Index Futures, Single Stock Futures (e.g., AOT, BLAND, BTS, IRPC, IVL, JAS, KTB, LH, PTT, QH, SIRI, TMB, TRUE, etc.), Gold Futures, Silver Futures, USD Futures and Oil Futures—they are suitable tools that investors can use to protect their portfolio from market volatility.

Figure 1 shows an upward trend on the daily average trading volume of the SET50 Index Futures in TFEX from 2006 to 2012. In 2012, the number of futures contracts in TFEX rose to 16,467 from 1,204 in 2006. Similarly, the number of open-interest contracts rose to 36,920 from 7,601.

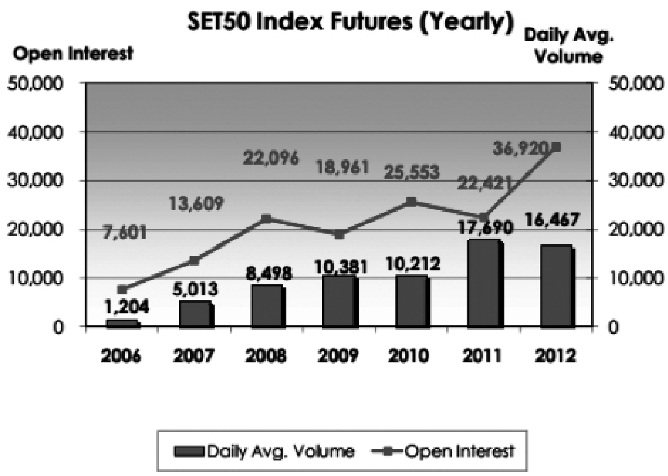

Figure 1. Open Interests Contracts and Daily Average Volume of SET50 Index Futures
Source: Thailand Futures Exchange (2013)

Figure 2 shows that the futures price was subject to fluctuation when, the S50U13 contract movement encountered volatility and moved together with the SET50 index. However, the question is 'Is there any significant correlation between the basis of SET50 and SET50U13?'

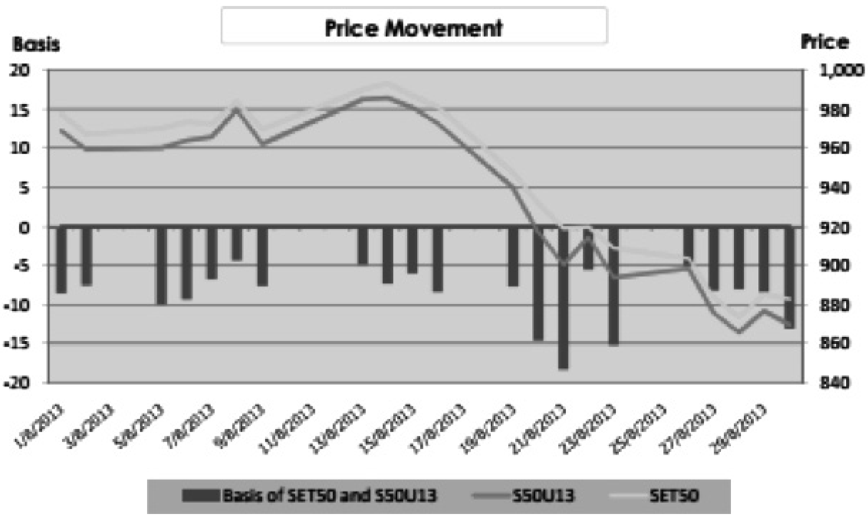

Figure 2. Price movement of the basis of the SET50 and S50U13
Source: Thailand Futures Exchange (2013)

The futures price, an unbiased predictor of the systematically observed spot price, Fama (1970: 383-417) called the market efficiency theorem. Investors need to use the futures price for predicting the future spot price so that they can reduce risks and gain profits from the stock market. Most researchers have recognized the importance of market efficiency.

For example, Longworth (1981: 43-49) tested the market efficiency of the foreign exchange in Canada from July 1970 to December 1978. The assumption of his research was that the spot rate could be predicted from the futures rate by using the semi-strong form Market Hypothesis Efficiency Model. He found that the futures rate could well predict the future spot rate. This finding could help the Canadian government to determine appropriate strategies for the Foreign Exchange in Canada. Chinn, LeBlanc and Coibion (2005) studied the market efficiency of the energy futures market in the United States of America (USA). They examined the relationship between the futures price and the future spot price, using the data from 1999 to 2004. They wanted to prove by using Ordinary Least Square (OLS) that energy products, such as benzene, fuel oil and natural gas would be of high volatility in a short run. This study concluded that the energy futures market in the USA was efficient because of high liquidity and that investors understood derivative products in the market well.

Last but not least, Mall, Pradhan and Mishra (2011: 168-171) showed that two series of FTSE/JSE Top 40 futures and future spot price were cointegrated (under the Johansen test). The findings brought to the conclusion that there was a comovement between South African futures price and future spot price when cointegrating relationship was tested. These findings were helpful to traders, speculators and financial managers in dealing with emerging stock futures market.

With regard to the Thailand Futures Exchange (TFEX), one important question is whether investors can use the futures price to predict the future spot price or not. The answer can help those concerned to determine suitable strategies for investors, speculators and hedgers in the market. It can also help set the criteria on when a company should sell the futures, such as the PTT single stock futures and on how it can use TFEX for speculating or avoiding market risks.

Objective of the Study

Based on the statements above, the objectives of the study are as follows:

1. To examine the market efficiency in TFEX specified in SET50 Index Futures in contracts of different maturity terms.
2. To explain the speed of adjustment of future spot price in SET50 Index Futures in contracts of different maturity terms.
3. To find out the volatility of the futures price (change in a lag term and Time Varying Risk Premium).
4. To propose the TFEX policy implication related to market efficiency in individual contract terms.

Contributions of the Study

1. This study has proved whether SET50 Index Futures is efficient or not and its results can help TFEX determine appropriate strategies for hedgers and speculators.
2. The capability of the futures price for predicting the future spot price will be known. This can assist investors in planning their investment timing with greater accuracy.

3. The degree of the market efficiency in SET50 Index Futures will be reveal, so TFEX can be strengthened and reduce the investment volatility reduced aligned with the TFEX policy.

Literature Reviews

Market Efficiency

Investors in the stock market hope to reduce the stock volatility. Similarly, one objective of the futures stock market is to help investors in the market to reduce such volatility. However, investors doubt if futures stock market is efficient. What is futures stock market efficiency?

The term 'market efficiency' has attracted attention of many economists and researchers because it is significant for capital and commodities markets. Fama (1970: 383-417) defines market efficiency and price efficiency based on recent available information that affects the market. He divides market efficiency into three levels. The first level is weak-form efficiency, which means the previous price and the current price are not correlated. The second is a semi- strong form of efficiency, which means change of public information affects price efficiency. Lastly, a strong form of efficiency occurs when the market is strong and public information cannot change the stock price in the market. The assumptions of market efficiency are: 1) all players in the market receive market information at the same time; 2) information is costless; and 3) all players in the market have homogeneous expected returns. The model for testing weak-form efficiency is shown in Equation 1

$$F_{t+1,T} - F_{t,T} = \mu_{t+1} \qquad \text{Equation 1}$$

The futures price can be an unbiased estimator of the future spot price, where μ_{t+1} is a random variable with a value of zero. $F_{t+1,T}$ is futures price at present; t is delivery at time T. A weak form of market efficiency is $E(S_t) = F_{t,T}$ Beck (1994: 249-257), Sabuhoro and Larue (1997: 171-184) developed the market efficiency model in the semi-strong form of market efficiency as shown in Equation 2

$$S_{t+n}=\alpha_0+\beta_0 F_{t,n}+\mu_t \qquad \text{Equation 2}$$

This equation is to test the hypothesis if $\alpha_0 = 0$ and $\beta_0 = 1$ can be a joint hypothesis by using the Wald test technique. This hypothesis proves to traders if the market risk is neutral. And if so, they can use full information in the market for making decisions. If the null hypothesis is not rejected, it means the market is efficient. On the other hand, if the null hypothesis is rejected, it means that market is not efficient.

Since, the data used in this model is time series data, the non-stationary problem may occur. To avoid this problem, Sabuhoro and Larue (1997: 171-184) modified model to test the change of the market price in a short- run relationship as follows:

$$S_{t+n}-S_t=\alpha_0+\beta_0\,(F_{t,n}-St)+\mu_t \qquad \text{Equation 3}$$

Where

$F_{t,u}-S_t$ = basis risk.

Equation 3 proves that market efficiency will occur when $\alpha_0 = 0$ and $\beta_0 = 1$, which is aligned with the conclusion from Equation 2. West (1975: 30-34) found the difference between external efficiency and internal efficiency in stock markets. External efficiency depended upon the trading direction, while, internal efficiency was fully reflected by current information as well. The finding that the futures price and future spot price are related was supported by French (1986: 39-54), who found that the futures price was related with the future spot price in all commodity markets.

Many studies on the commodity markets have been conducted. Longworth (1981: 43-49) tested the market efficiency of the Foreign Exchange in Canada from July, 1970 to December, 1978. The assumption was that the forward rate could predict the future spot rate. The model for testing the semi-strong form market efficiency hypothesis was used and found that the futures rate could well predict the future spot rate. Arshad and Mohamed (1991: 25-39) examined the forward pricing of the crude palm oil price in Indonesia. Many forecasting models, such as univariate, Box-Jenkin, Moving average and exponential smoothing are used in this research. They concluded that market efficiency could predict the future spot price of crude palm.

Mckenzei and Holt (2002: 1319-1532) studied the market efficiency of the agricultural market in the USA. They found the relationship between the futures price and the future spot price when the bias equals zero. This research was conducted on four types of agriculture products (Cow, Pig, Corn and goods made of corns). The cointegration technique was used to find out the long-term relationship and the Error Correction Model (ECM) to find out the speed of adjustment of the future spot price for each product. It was found that four types of agriculture products have a long- term relationship between the futures price and the future spot price. Paschali (2007: 118-132) conducted research on the market efficiency of the Bulgarian agricultural market, using the Johanson test to find out the long run relationship between the futures price and the future spot price in Bulgaria during 1994 – 1998. He found that there was no efficiency in agricultural futures market in Bulgaria and that policy change caused the lag of policy that was important for the agricultural futures market in Bulgaria.

Chinn, LeBlanc and Coibion (2005) studied the performance of the futures price in order to forecast the future spot price of high volatility products in the energy futures market (such as crude oil and gasoline). In this research, ordinary least squares (OLS) was used to test the monthly price data from 1999 to 2004. The result showed that energy futures market was efficient. Ouppathumchua (2011) studied the relationship between the futures price and the future spot price of the Ribbed Smoked Rubber Sheet No. 3 (RSS3) by using cointegration and Error Correction Model (ECM) (Engle & Granger, 1987: 251-276). The objective of this research was to prove whether the futures price could predict the future spot price. The empirical result was that the futures price and the future spot price of RSS3 had a long-term relationship (cointegrated) in all the futures contracts. However, AFET’s market itself was inefficient in the short run relationship. With the application of the Error Correction Model (ECM), it was found that the future spot price in short-term contracts tended to adjust to the speed of price faster than in long-term contracts.

Many researchers have been interested in stock and futures stock markets. Kawaller, Koch and Koch (1987: 107-125) investigated the relationship between the S&P 500 index and the S&P 500 index futures by using the Regression Model to examine minute-by-minute data of 1984–1985 in order to explain the lead and lag of the index futures. The result showed that the S&P index market was efficient only during the movement of the futures price in the ranges of 25 to 40. Hoque, Kim and Pyun, (2007: 488-502) analyzed time series data from April, 1990 to February, 2004 to find out the Asian market efficiency. They used the variance ratio test to explain the Asian stock market efficiency in Hong Kong, Indonesia, Malaysia, Korea, Singapore, Philippines, Taiwan and Thailand. They found that five out of eight markets (Indonesia, Malaysia, Philippines, Singapore and Thailand) were efficient.

Wang, Lee and Lin (2008: 58-66) conducted a study on the effects of general election and political change in the USA, Japan, England and France on the stock market. They used multiple regression analysis to examine panel data in 1987 and came to the conclusion that political change had a negative effect on the stock market. Erdinc and Milla (2008) assessed cointegration among stock exchange markets in major European Union (EU) countries, such as France, Germany, and UK. It was found that their economic structures shared the same characteristics and that their high level of development enabled them to possess the heaviest volume in the EU stock exchange markets. In addition, they explored the monthly data of the stock exchanges in the period of January, 1991 – September, 2006 using unit root test and cointegration test. This result indicated that a long term relationship existed when the European countries were matched with each other.

Srinivasan and Bhat (2011: 28-37) studied the lead–lag relationship between the national stock exchange (NSE) spot and the futures market in 21 Indian commercial banking stocks. With daily data from 27th May 2005 to 29th May 2008 in NSE website, Johansen's cointegration technique followed by the vector auto regressive model shown below the equation were used to identify the lead-lag relationship between futures and spot markets. Mall, Pradhan and Mishra (2011: 168-171) studied whether the futures price could provide unbiased predictions of the spot price in Indian futures stock market. By using data from June 2000 to May 2011, they found that futures market served at least four functions, which were discovering the competitive price; managing of risk; facilitating financing; and promoting of efficient resource allocation. This study summarized that the Indian futures market was a relatively efficient price discovery vehicle and it would certainly help the traders to take hedging and arbitrage positions more securely to make maximum returns at minimum risk exposure.

Alam, Yasmin, Rahman and Uddin (2011) found supporting evidence that showed the impact of continuous policy reforms on the market efficiency in the Dhaka Stock Exchange (DSE). Their research used different formed and reformed policies during 1994-2005 and categorized them into eleven groups, depending on their time of policy formation. The research then utilized both non-parametric tests (Kolmogrov-Smirnov Normality Test and Run Test) and parametric tests (Autocorrelation Test, Autoregressive Test) to analysis each policy group and found that formed/reformed policies of Dhaka Stock Exchange(DSE) failed to improve the market efficiency, even at the weak form level during the study period.

Bashir, Ilyas and Furrukh (2011: 160-175) empirically examined the weak form of capital market efficiency in the banking sector of Pakistan stock markets by using the data from June 1997 to April 2009. The researchers initially applied the Augmented Dickey Fuller (ADF) to test the stationary state of data and then applied the first differentiation to adjust the data to achieve the stationary state. After that cointegration and Variance Auto Regressive (VAR) test were used, and the null hypothesis was rejected, meaning that the banking sector of Pakistan market was inefficient. Accordingly, they recommended that Pakistan banking needed to improve the understanding of small investors.

Michael (2011: 99-102) conducted a comparative analysis of the efficiency levels in capital markets in Africa which was separated into two regions: Sub Saharan Africa (Nigeria, Ghana, Kenya and South Africa) and North Africa (Egypt and Tunisia). This research used the stock turnover ratio as an indicator to compare the two regions. T-test was used to explain whether the two regions were different or not. The result showed that the stock turnover of North Africa was more efficient than that of Sub-Saharan Africa. Jie (2013: 87-92) examined the weak and semi-strong forms of the Hangseng index futures market by using cointegration and error correction model technique. The result showed that the Hangseng index futures market was efficient in both weak and semi-strong forms. Additionally, it showed that the Hangseng index futures market tended to lead the Hangseng stock market, the most important for this futures market.

In conclusion, in most previous research, the semi-strong from market efficiency model was applied for testing market efficiency by using cointegration relationship below Equation 4.

$$S_{t+n}=\beta_0+\beta_1 F_{t,n}+\mu_t \qquad \text{Equation 4}$$

Where

S_{t+n} = Natural logarithm of the future spot price at time t + n

$F_{t,n}$ = Natural logarithm of the futures price at time t for delivery at time t + n

μ_t = Residual

Table 1 shows the summary of market efficiency literatures.

Table 1. Summary of Market Efficiency Literature

Author	Finding	Context of the study	Measuring method
Longworth (1981)	The futures rate can well predict the futures spot rate	Foreign Exchange in Canada	OLS - Short run relationship
Kawaller, Koch and Koch (1987)	From the Market efficiency that futures price movement 25 to 40 minutes lead to S&P index price	S&P 500 futurea index in United state	OLS - Short run relationship
Arshad and Mohamed (1991)	Crude palm oil futures index indicatess market efficiency	Crude palm oil futures index in Indonesia	Univariate, Box-Jenkin, Moving average and exponential smoothing
McKenzie and Holt (2002)	The futures and future spot price not have a long term relationship in agriculture futures market	Agriculture futures market in the United state (4 types of products: Cow, Pig, Corn and goods from corns)	Cointegration and Error correction model (ECM)
Paschali (2007)	Agriculture futures market in Bulgaria had no efficiency	Agricultural futures market in Bulgaria	Johanson Cointegration test
Chinn, LeBlance and Coibion (2005)	Energy futures market had efficiency	Eneegy futures market in the United state	OLS - Short run relationship
Hoque, Kim and Pyun (2007)	Five futures stock markets (Indonesia, Malaysia, Philippine, Singapore and Thailand) are efficient	Futures market in Indonesia, Malaysia, Philippine, Singapore and Thailand	Variance ratio test
Wang, Lee and Lin (2008)	Political change had negative side in stock markets	Stock markets in Japan, United state, United Kingdom and French	OLS - Short run relationship

Erdinc and Milla (2008)	Future markets have long term relationship in major EU countries	Futures market in EU stock markets	Cointegration
Srinivasan and Bhat (2011)	Futures prices influence to future spot price in the most of commercial bank in India	Banking stock market in India	Johanson Cointegration
Ouppathumchua (2011)	Long term relationship of RSS3 rubber in all contracts. Base on the correction model, the future spot price in short term contracts tend to change the speed of adjustment faster than long term contract	AFET Thailand	Cointegration and Error correction model (ECM)
Mall, Pradhan and Mishra (2011)	Indian futures stock market is efficient	India futures stock market	Cointegration
Bashir, Ilyas and Furrukh (2011)	Banking futures market has no market efficiency	Banking futures market in Pakistan	Cointegration
Alam et al.(2011)		Policy reformed for the Dhaka stock exchange failed to increase market efficiency	Dhaka stock exchange (DSE)in Bangladesh
Michael (2011)	Stock turnover in North Afriica had more efficiency than Sub-Saharan Africa	Capital market in Africa	Hypothesis testing of stock turnover ratio
Jie (2013)	Hangseng futures market is efficient	Hangseng futures index in Hongkong	Cointegration and Error correction model (ECM)

Time Varying Risk Premium

This section reviews the studies of whether Time Varying Risk Premium affects the market efficiency or not. Kaminsky and Peruga (1990: 47-70) found that the cost of risk varied according to time in the futures market, which was termed Time varying Risk Premium. Futures price of various products in the market were examined by using the assets model. The researcher found the evidence that the existing cost resulted from varied risks that occurred in six-month futures contracts. Hansan and Myers (1995: 265-276) studied the returns and from agricultural prices in the United States and found the relationship between the returns and the time varying risk premium in the market efficiency model. Sabuhoro and Larue (1997: 171-184) investigated if the Johansen & Juselius cointegration test could indicate the stability of the cocoa price and if the Error Correction Model (ECM) could reveal the speed of adjustment of the cocoa price in the cocoa futures market from 1983 to 1990. They concluded that the risk cost varied depending on change of time in the cocoa futures market.

Cheung and Fung (1997: 255-271) examined the relationship between the three-month Eurodollar spot rate and the futures interest rate, using monthly data during January 1983 – July 1997. This research used the causality testing AR-Garch to examine the volatility of risk that caused the heteroscedasticity problem.

Frank and Garcia (2009: 715-725) explored the impact of the time varying risk premium on corn, soy bean and pork and found that agricultural markets were efficient but did not have evidence to support that agricultural markets had a time varying risk premium. All studies came to the same conclusion that time varying risk premium affected the market efficiency.

To sum up, the problems of time varying risk premium were sorted out by testing the relationship of variables with Generalized Autoregressive Condition Heteroscedasticity (GARCH) as shown in equation 5.

$$\sigma_t^2=\alpha_0+\alpha_1 e^2_{t=4}+\lambda_1\sigma^2 \qquad \text{Equation 5}$$

Where

σ_t^2 = the variation of future spot price.

Conceptual Framework

The framework which testing market efficiency and the relationship of futures price and futures spot index in TFEX is shown in Figure 3.

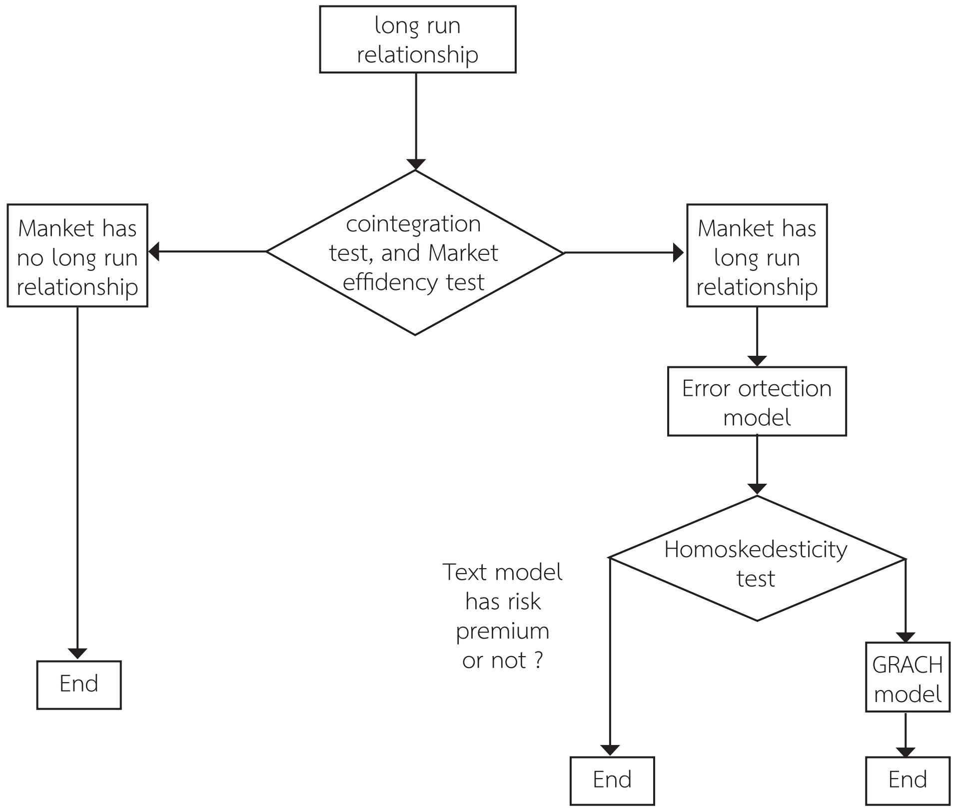

Figure 3. Conceptual Framework of Market Efficiency and Long Run Relationship of the Futures Price and the Future Spot Price

Research Methodology

Unit root test

As mention in the previous section, this research aimed to test the market efficiency of the futures stock market in Thailand. All the data in this research were the time series data. Time series techniques were applied to understand the time related properties of the futures stock market. This section will show the relationships between futures price and future spot price that can be used to interpret the futures stock market efficiency. We will check if the stationary data is by Unit Root Test (Said & Dickey, 1984: 599-607). The efficient market reflects the price movements in the futures price and in the future spot price and in the same direction. This means that the two variables are correlated it can be explained by using cointegration in next topic.

Cointegration

Engle and Granger (1987: 251-276) examined that if x_t and y_t are the time series data, xt and yt will be cointegrated of Order. The cointegration Model explains the long run relationship.

Error Correction Model

If the relationship of the futures price and future spot price has a long run relationship, changing in some of the variables correlated with the magnitude of the shift from equilibrium is a must. The Error Correction Model (ECM) can then be used to explain. The objective of ECM is to find out the speed of adjustment of the future spot price. Comparison is made between one, two, three, four, five, six, seven, eight, nine, ten, eleven and twelve - month contracts in the futures market.

Time Varying Risk Premium in the Efficient Market

This section explains how to run the ECM model to test whether the fluctuation on the future spot price is volatile (Heteroscedasticity) and the volatility happens at 'stable' certain times (Homoscedasticity). Heteroscadasticity and homoscedasticity can be tested by the ARCH LM test. The heteroscedasticity problem might lead to cost that comes with the volatility in accordance with time. If there is volatility when time changes, Generalized Autoregressive Condition Heteroscedasticity (GARCH) (Ender, 1995) will be used to find out the relationship of variable.

Policy implications in TFEX

Thailand Futures Exchange (TFEX) plays an important role to enhance financial market stability and economy of the country. Since derivative products are used to manage risk for investors effectively as well as make profit from price fluctuation. Reflected from futures price, the expectation of investors in the market can be quite accurate to predicted future spot price in the future.

Consequently, the importance of this research is to study how are methodology, policy imposed in TFEX in order to set policy implications.

Starting from product policy in the market, it is found that TFEX has provided various derivative products such as Stock Futures, Gold Futures, Interest Rate Futures and Silver Futures to spread over financial market and capital market in the more international way. TFEX also stipulates "Extended Trading Hours" to cover longer trading time of underlying asset which is necessary to consistency with liquidity policy of derivative products trading in TFEX.

Even TFEX has put effort to set "Market Maker" from members in futures market and potential investors, it found that for some products in TFEXs, there are very low or none transaction of trading in the market. From study of liquidity related policy, it is not clear how TFEX should take action. On the other hand, Education and Public Relations policy in TFEX, it specifies to hold seminars and pass on knowledge through media extensively. From taking TFEX course, trainings focus more on theory. Due to this unclear policies, it causes TFEX to have lower liquidity than it should have.

From all of above reasons, we found that TFEX's policy is imposed in broad picture in order to make things work effectively in operation. However, the existing policies are unclear what it should be or how to deal with it. In the last chapter of this research, I therefore compile, evaluate the result of this study and produce policy implications in order to guide TFEX's policy setting to impose clear and practical to apply in concrete.

Scope of the Study

This research was limited to test market efficiency of the SET 50 index in one, two, three, four, five, six, seven, eight, nine, ten, eleven and twelve - month contracts, using the daily data from June, 2006 to June, 2014.

Data Collection

The data collection was as follows:

1. The Daily settlement prices of SET 50 Index Futures from June, 2006 to June, 2014 were obtained from Thailand Futures Exchange Public Company Limited (TFEX).

2. The Daily SET 50 index was obtained from the Stock Exchange of Thailand (SET).

Results and Discussion

Unit Root test

The study began with the test of unit root. Before the time series data are used, they must be adjusted by using natural logarithm (ln) for both the futures price and the future spot price for easy interpretation.

Ordinary Least Square (OLS) is used for the estimation of the model. The data are time series in the nature. If data is non-stationary, they will have spurious regression. The procedures of unit root test and the Augmented Dickey-Fuller test (ADF) are shown in the following diagram:

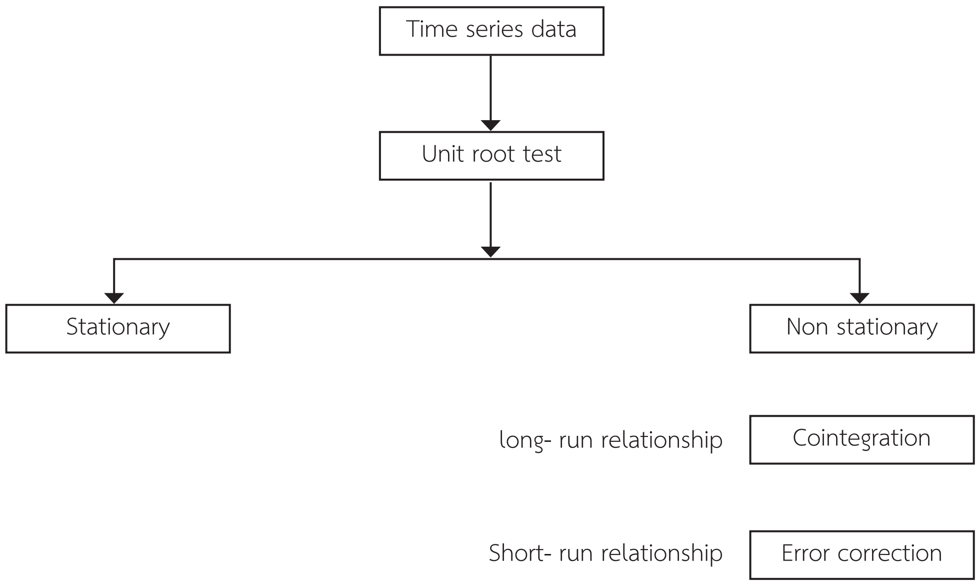

Figure 4. Diagram of Time Series Data Testing

The unit root test and the Augment Dickey-Fuller Test (ADF) respectively are shown in the equations:

$$\Delta x_t = a + \theta x_{t=1} + B_t + e_t \qquad \text{Equation 6}$$

The assumptions are

H_0: θ : = 0

H_1: θ : $\neq$ 0

If it accepted H_0 that meant x_t is non-stationary because x_t had changed when time change. This result showed unit root test of futures Index and futures index for each contract.

Table 2. Augment Dickey-Fuller (ADF) test statistic

Variable	Level ADF-Stat	P-Value	1st Difference ADF-Stat	P-Value
Spot	2.109898	0.5389	-28.78077	0.0000***
One-Month futures	-2.784625	0.2034	-29.98599	0.0000***
Two-Month futures	-2.591335	0.2844	-31.28668	0.0000***
Three-Month futures	-2.990118	0.1356	-29.77803	0.0000***
Four-Month futures	-2.720358	0.2285	-28.66059	0.0000***
Five-Month futures	-2.378049	0.3907	-26.93194	0.0000***
Six-Month futures	-2.837043	0.1844	-26.25856	0.0000***
Seven-Month futures	-2.472468	0.3418	-25.84446	0.0000***
Eight-Month futures	-2.342968	0.4095	-25.35888	0.0000***
Nine-Month futures	-2.803327	0.1966	-24.77753	0.0000***
Ten-Month futures	-2.508106	0.3241	-23.27089	0.0000***
Eleven-Month futures	-2.413293	0.3721	-23.81092	0.0000***
Twelve-Month futures	-2.610573	0.2758	-22.42386	0.0000***

MacKinnin (1996) one- sided p-value

Note: *** significant at 0.01

Table 2 shows that the data at all levels have a unit root, so ordinary least square cannot be applied because the spurious equation problem will occur. After 1st differentiation, the data don't have a unit root which means that the data are the stationary. Next, cointegration and the error correction model are used to explain market efficiency, the long run relationship and the speed of adjustment of future spot price.

Cointegration

To test market efficiency, Engle and Granger (1987: 251-276) was used to determine if x_t and y_t are the time series data and x_t and y_t are cointegrated of order. The cointegration model which explains the long run relationship is shown in the equation below.

$$S_{t+n}=\beta_0+\beta_1+F_{t,n}+e_t \qquad \text{Equation 7}$$

Where

S_{t+n} = Natural logarithm of the future spot price at time t+n

F_{t+n} = Natural logarithm of the futures price at time t for delivery at time t + n

The cointegration test was to find out the long run relationship between the futures and the future spot price. There would be unbiasness if the value of constant risk premium is zero. In cointegration test, time series data were used in regression, even though they were non-stationary and the variables met the qualifications for "cointegration." The result would not meet spurious regression problem. The concept of cointegration was developed by Engle and Granger (1987: 251-276), who concluded that "The two time series data might have a simultaneous relationship which is called cointegration, even though the data is non-stationary." From previous information, the unit root test revealed that the futures and future spot price were stationary at the first differentiation or I (1). The stationary state of the estimated error terms showed that this equation had cointegration or the long run relationship.

To test whether this cointegration is long run or not, the stationary state of the residual variables without intercept and trend had to be identified.

$$\Delta\hat{e}_t = \Omega\hat{e}_{t-1} + F_{t,n} + \mu_i \qquad \text{Equation 8}$$

$H_0{:}\Omega = 0$

$H_0{:}\Omega \neq 0$

In Equation 8, if Ho is rejected, it means that the futures price and the future spot price have long run relationship, or the so called cointegration.

Engle-Granger Two Step Procedure (Engle and Granger, 1987: 251-276) is applied to test the qualification of the unit root of residual variable without trend and intercept. If the residual is stationary, it means the futures price and the future spot price have long run relationship or cointegration. After that the hypothesis: $H_0{:}= \beta_0$ and $\beta_1 = 1$; $H_1{:}\beta_0 \neq 0$ or $\beta_1 \neq 1$ is tested (See table 3) from equation 14. H0 cannot be rejected, it will show that the market is efficient in the long run, whereas $\beta_0 = 0$ means that the investors in the market are naturally at risk and if $\beta_1 \neq 1$, it means that investors in the market can use all market information to make decisions.

The results of cointegration and Wald test are shown in Table 3.

Table 3. Cointegration for Each Contract and Wald Test

	Contract Equation	Wald Test	P-Value	R^2
One-month	$S_{t+n} = 0.166389 + 0.975565F_{t,n}$	27.63041	0.0000*	0.985231
Two-month	$S_{t+n} = 0.280882 + 0.959176F_{t,n}$	32.80151	0.0000*	0.955071
Three-month	$S_{t+n} = 0.458706 + 0.933611F_{t,n}$	56.70867	0.0000*	0.926035
Four-month	$S_{t+n} = 0.685938 + 0.899138F_{t,n}$	49.60901	0.0000*	0.847324
Five-month	$S_{t+n} = 0.875349 + 0.870796F_{t,n}$	48.15432	0.0000*	0.770526
Six-month	$S_{t+n} = 1.105901 + 0.836837F_{t,n}$	63.45788	0.0000*	0.722576
Seven-month	$S_{t+n} = 1.479525 + 0.780030F_{t,n}$	69.83394	0.0000*	0.603863
Eight-month	$S_{t+n} = 1.699039 + 0.748312F_{t,n}$	77.30016	0.0000*	0.541392
Nine-month	$S_{t+n} = 1.865637 + 0.723989F_{t,n}$	94.09154	0.0000*	0.520833
Ten-month	$S_{t+n} = 2.034193 + 0.698813F_{t,n}$	84.31166	0.0000*	0.450829
Eleven-month	$S_{t+n} = 2.335457 + 0.653437F_{t,n}$	86.21096	0.0000*	0.379855
Twelve-month	$S_{t+n} = 2.605139 + 0.612956F_{t,n}$	116.2092	0.0000*	0.370154

Note: - * significant at 0.01

The Wald test showed that the joint null hypothesis of forward unbiased $H_0 := \beta_0$ and $\beta_0 = 1$ were rejected the null hypothesis for all contract. This result provides evidence that the futures price could not be used as an unbiased predictor of the future spot price, even though cointegration was found.

The futures price is unbiased for predicting the future spot price coefficient if the bias coefficient is close to 1. The coefficients of the one, two and three-month contracts were 0.975565, 0.959176 and 0.93611, respectively. The coefficient of constant risk premium is close to zero (0.166389 and 0.28082 for one and two-month contracts). As for four to twelve month contract, the futures price can be unbiased by reducing the proportion of coefficients from four-month contracts and to twelve-month contracts. The bias coefficients showed that full information in the market for making decisions declined from one-month contracts to twelve-month contracts. The results in Table 3 indicated that the longer the length of the contract, the worst the forecaster of the futures price it would be, and that the capacity of predicting the future spot price decreased starting from four-month contracts on. Also, this suggested that for contracts with the maturity of four-months or more, the investors could not have much effective response to the information in TFEX causing inefficiency in the market because buying and selling SET50 index might have less liquidity or none of volume occurred. Another reason was the investors and agents have a problem in predicting the future spot price or the investors might not have enough understanding and get enough knowledge of derivative products in TFEX. Speculators who are sophisticated should use one, two or three-month contracts to make profits because the short-term contracts are cheaper than described long-term contracts.

Next, cointegration was tested by using the residual (See in Table 4). If the residual is stationary, the futures price and the future spot price can be said to be co-integrated to have a long run relationship.

Table 4. Augmented Dickey-Fuller Tests of the Stationary of Residuals on Each the futures price and the future spot price in TFEX

Variable	Augmented Dickey-Fuller Test Level	
	McKinnon t-Statistic	p-value
One-month residual	-7.134505	0.0000***
Two-month residual	-5.529659	0.0000***
Three-month residual	-5.823191	0.0000***
Four-month residual	-3.778224	0.0002***
Five-month residual	-3.390711	0.0007***
Six-month residual	-3.653558	0.0003***
Seven-month residual	-2.734739	0.0061***
Eight-month residual	-2.534509	0.0115**
Nine-month residual	-2.815311	0.0048**
Ten-month residual	-2.252113	0.0247**
Eleven-month residual	-2.059194	0.038**
Twelve-month residual	-2.15674	0.0315**

Note: *** significant at 0.01

** significant at 0.05

According to Table 4, the null hypothesis from equation 15 was rejected at 1 percent significant in one to seven month contracts and at 0.05 levels in eight to twele month contracts. Since the residual value had no unit root, the residual was stationary. It could be concluded that the futures price and the future spot price in SET50 index have cointegrated (long run relationship).

Error Correction Model

Next, the movement of the variables in response to outside of the equilibrium was studied by using the Error Correction Model (ECM) because as evidenced the futures and the future spot price used in Cointegration were non-stationary from the use of the unit root test that was illustrated in the previous section. Because of, the spurious equation problem cointegration could not account for the phenomenon. ECM was then applied to solve this problem by using the first differentiation in variables. ECM would increase lag term in the equation described. The relationship between the futures price and the future spot price and the speed of adjustment of future spot price were following equation;

$$\Delta S_{t+n} = \alpha + \Phi \hat{e}_{t-1} + \sum_{t=1}^{n} \delta \Delta S_{(t+n)-i} + \sum_{j=0}^{m} \gamma \Delta F_{t+j} + \mu_t \qquad \text{Equation 9}$$

Where

ΔS_{t+n} = First difference of the natural logarithm of future spot price

$\Delta F_{t,n}$ = First difference of the natural logarithm of futures price

Φ = Speed of adjustment of future index

$\hat{e}_{t-1}$ = Residual of Co-Integration model

μ_t = Residual of Error Correction Model (ECM)

We found the Error Correction Model of SET50 index futures for different maturity contracts below Table 5.

Table 5. The Error Correction Model (ECM) Equation in the contracts of different maturity term

Contract	Error Correction Model (ECM) Equation	Durbin-Watson Stat
One-month	$\Delta\hat{S}_{t+n} = -0.067568\ e_{t+1} + 0.634357\ \Delta S_{(t+n)-1}$	1.982463
Two-month	$\Delta\hat{S}_{t+n} = -0.029948\ e_{t+1} + 0.508476\ \Delta S_{(t+n)-1}$	1.994332
Three-month	$\Delta\hat{S}_{t+n} = -0.021549\ e_{t+1} + 0.319939\ \Delta S_{(t+n)-1}$	1.968516
Four-month	$\Delta\hat{S}_{t+n} = -0.001666\ e_{t+1} + 0.272285\ \Delta S_{(t+n)-1}$	2.003278
Five-month	$\Delta\hat{S}_{t+n} = -0.002719\ e_{t+1} + 0.090659\ \Delta S_{(t+n)-1}$	2.006869
Six-month	$\Delta\hat{S}_{t+n} = -0.001741\ e_{t+1} + 0.022225\ \Delta S_{(t+n)-1}$	2.00649
Seven-month	$\Delta\hat{S}_{t+n} = -0.002852\ e_{t+1} + 0.080423\ \Delta S_{(t+n)-1}$	2.006205
Eigth-month	$\Delta\hat{S}_{t+n} = -0.003628\ e_{t+1} + 0.098431\ \Delta S_{(t+n)-1}$	2.03707
Nine-month	$\Delta\hat{S}_{t+n} = -0.001505\ e_{t+1} + 0.133180\ \Delta S_{(t+n)-1}$	2.006338
Ten-month	$\Delta\hat{S}_{t+n} = -0.000123\ e_{t+1} + 0.173942\ \Delta S_{(t+n)-1}$	2.007589
Eleven-month	$\Delta\hat{S}_{t+n} = -0.000372\ e_{t+1} + 0.173156\ \Delta S_{(t+n)-1}$	1.986642
Twelve-month	$\Delta\hat{S}_{t+n} = -0.001299\ e_{t+1} + 0.151355\ \Delta S_{(t+n)-1}$	1.975518

Important values from all the equations above can be summarized in Table 6 below.

Table 6. Speed of adjustment from Error Correction Model in the contracts of different maturity term

Error correction Model contract	Speed of adjustment	P-Value	R^2	Durbin-Watson Stat
One-month	-0.067568	0.0000***	0.701436	1.982463
Two-month	-0.029948	0.0013***	0.436380	1.994332
Three-month	-0.021549	0.0199**	0.233370	1.968516
Four-month	-0.001666	0.8160	0.139411	2.003278
Five-month	-0.002719	0.6968	0.016179	2.006869
Six-month	-0.001741	0.7902	0.001284	2.006490
Seven-month	-0.002852	0.6022	0.005400	2.006205
Eigth-month	-0.003628	0.5144	0.017186	2.037070
Nine-month	-0.001505	0.7828	0.045865	2.006338
Ten-month	-0.000123	0.9811	0.058963	2.007589
Eleven-month	-0.000372	0.9448	0.057640	1.986642
Twelve-month	-0.001299	0.8150	0.060452	1.975518

Note: *** significant at 0.01
** significant at 0.05

The results from the error correction model show that the speed of adjustment was significant for one to three-month contracts. There was no significance for four to twelve-month contracts. With regard to the speed of adjustment that was represented by error-correction term, the future spot price in one-month contracts had the speed of adjustment to the equilibrium of 6.7518 percent per period when there was deviation from the equilibrium. On the other hand, the two and three-month contracts, the future spot price had the speed of adjustment to the equilibrium of 2.9948 percent and 2.1549 percent per period, respectively. As for one-month contracts, the future spot price had a faster speed of adjustment to the long range equilibrium than the others. The future spot price of the short term contracts had less volatility, comparing to the long-term contracts, like cointegration in the previous section.

It can be summarized that the long-term contract had higher volatility. To elaborate, the one-month contracts had more liquidity than two, three, four, five, six, seven, eigth, nine, ten, eleven, twelve-month contracts causing the reduction in the short range volatility. In the other word, the speed of short-term contracts could adjust that it could resume a long run relationship shown by cointegration. However, when the previous information on the long run relationships was considered, the future spot price of one-month contracts could be adjusted than the other contracts. However, too long term of maturity would affect market inefficiency, leading to the futures price not being able to predict the future spot price.

In the next step, the serial correlation problem was checked by using Breusch-Godfrey Serial Correlation LM test (B-G Test). The result showed that the null hypothesis “no serial correlation” for all contracts was not rejected as shown in Table 7 below.

Table 7. Breusch-Godfrey Serial Correlation LM test

Error correction Model contract	**Breusch-Godfrey Serial Correlation LM test**	
	NR^2	**p-value**
One-month	0.041686	0.838219
Two-month	0.007857	0.929368
Three-month	0.096940	0.755533
Four-month	0.002202	0.962577
Five-month	0.008172	0.927970
Six-month	0.008841	0.925088
Seven-month	0.006365	0.936412
Eigth-month	0.208464	0.647974
Nine-month	0.009225	0.923482
Ten-month	0.007969	0.928867
Eleven-month	0.022154	0.881678
Twelve-month	0.073239	0.786678

After continuing attempt to test the volatility on time by using ARCH LM Test (Table 8) in order to the answer the question, “Does the volatility be on time?” We find the null hypotheses (H_0 is Homoscedasticity) for all contracts are not rejected, which means that the volatility of the future spot price on the SET50 index has characteristic of “Homoscedasticity”, not of “Heteroscedasticity.” Therefore, we do not have to work on the GARCH Model. It can be concluded that the SET 50 index does not have any risk premium from the volatility of futures price that depend on time.

Table 8. Heteroscedasticity ARCH LM test

Error correction Model contract	Breusch-Godfrey Serial Correlation LM test	
	NR^2	p-value
One-month	0.006077	0.937865
Two-month	0.097545	0.754796
Three-month	0.054269	0.815795
Four-month	0.094595	0.758415
Five-month	0.072239	0.788105
Six-month	0.085539	0.769926
Seven-month	0.099896	0.751955
Eigth-month	0.106924	0.743674
Nine-month	0.119301	0.729794
Ten-month	0.100351	0.751409
Eleven-month	0.080209	0.777015
Twelve-month	0.083859	0.772135

Conclusions and Recommendation

The purpose of this study was to study the relationship between the futures price and the future spot price on the SET 50 futures index in TFEX for the period of 10 years. This research started from unit root testing to figure out the nature of time series variables. Afterward, it examined the long-run and short-run relationship between the futures and future spot price by using cointegration and the Error Correction Model (ECM). The volatility in accordance with time change in lag term and Time varying risk premium was tested by using ARCH-LM test to find out whether "Heteroscedasticity" existed in this model.

Conclusions

Market efficiency as tested by the unit root test, cointegration, the Error Correction Model (ECM) and volatility in prices are summarized in table 9 below.

Table 9. Results of the Unit root test, cointegration, Error Correction Model and price volatility

Tests	Results
Unit root test	
Test stationary by using Augment Dickey Fuller test (Mackinnon t-statictic)	- Futures and future spot price at level are non-stationary - Futures and future spot price are stationary at first differentiation
Co-Integration	
- Stationary of residual without trend and constant (Mackinnon t-statistic)	- All contracts have long run relationship - Wald test - No market efficiency in all contracts
Error correction Model (ECM)	
- Speed of adjustment	- Speed of adjustment is significant in contract one, two and three month
- Breusch-Godfrey Serial Correlation LM	- The null hypothesis was rejected that there is no serial correlation in all contracts
- ARCH LM	- The null hypothesis could not be rejected. The volatility of future spot price had a stationary state (Homoscedasticity)

The result of cointegration reveals that futures price and future spot price in SET 50 index futures have a long run relationship in all contracts. Regarding, long-term contracts, the unbiasness of futures price declines, depending on the duration of the contract. That means that the speculators cannot have much effective response to the information in TFEX because the market is not efficient and because there is no unbiasness of the futures price in four to twelve-month contracts. This may consequently cause less liquidity of the buying and selling of SET50 index. The investors and agents might also have a problem of predicting the future spot price or the investors might not have enough understanding, nor might they get enough knowledge of derivative products in TFEX.

Another reason why SET 50 index futures was incapable of representing the future spot price in short-term contracts was less liquidity, particularly of one, two and three month short-term contracts. More often, the investors and agents have a difficulty anticipating the price lack deep knowledge about the SET 50 Index futures. As a result, the futures price is incapable of being a representative for use in future spot price speculation.

In the next step, the analysis suggests that the investors who take part in futures market of the SET 50 Index tend to not carry neutral risks. They have to naturally absorb all the costs associated with risks. This is called "Risk Premium". The risk premium grows exponentially based on the maturity of a particular contract. Moreover, the idea of "Risk Premium" also emphasizes that the mounting in maturity of a contract will potentially not only lessen the forecast capability of pricing but also increase the volatility.

Error Correction Model (ECM) was revealed by adding the "Lag Term" in to the model in order to effectively explain the correlation and adaptation ability of the future spot price. The future spot price was found to have fastest to pace to equilibrium in one-month futures contracts followed by two-month and three-month contracts respectively. The contracts that had the maturity of four-three months, the model could not identify the adapted pace to the equilibrium of the contracts maturity. Furthermore, the finding was also in line with result of the cointegration test, which explains that the fluctuation would be escalated when the contract aged.

Implications for TFEX Policy

TFEX is an incompetent market and the futures price is incapable of being a representative for future spot price of the speculation. Therefore, the hedgers should trade in long-maturity contracts. For example, SET 50's investors should participate in a future trade where the trading price is a pre-speculated price (Long asset and Short future). This can potentially reduce risks associated with the fluctuation in futures price due to the lessening ability to speculate the future spot price of long-term contracts. As, for the profit-seeking investors, short-term contracts would be a more suitable option for them and well fit with their investing purpose because the price speculation is more accurate and the price fluctuates less with short-term contracts. Investment will lead to the ability to make a trading profit for futures investment.

Furthermore, TFEX should thoroughly review the procedures on regulating a proper maturity for all financial products in the SET 50 index futures. Because the contracts which have the maturity of longer than three months will have a low level of liquidity and is less predictable in terms of "Future spot price." TFEX should promote short-term contracts and carefully educate investors to understand in-depth about the products and market mechanism. The summary of policy implications in TFEX are as follow:

- TFEX should revise the terms of contract in the SET50 index in Thailand's futures market.
- TFEX should promote long-term contracts (four to twelve-months) for investors to increase high liquidity in the futures market.
- TFEX should provide relevant information and data for investor to make decisions.
- TFEX should provide training on practical more than theoretical knowledge.
- TFEX should give more support to market makers that play an important role as catalyst in the secondary market and in enhancing liquidity.

Implications for Further Studies

It is interesting for scholars and researchers to conduct further research. In future, the data should be collected as time goes by to formulate a suitable equation and further studies should include other products in TFEX such as Single Stock Futures (such as AOT, BLAND, BTS, IRPC, IVL, JAS, KTB, LH, PTT, QH, SIRI, TMB, TRUE, etc.), Gold futures, Silver futures, USD futures and Oil futures because open short-time contracts can lead to less liquidity. If more data from trading are available, it will be possible to make generalization.

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