I. INTRODUCTION

The commodity futures market covers wide range of the underlying asset for example gold, aluminum, copper, orange, wheat, soybean and etc. As an agricultural base country, Thailand produces and exports various kinds of crop. One of the prominent exports is rubber since the country is the world largest producer and exporter of rubber (on year 2005). This largest position, however, can not help stabilize the price of rubber. Producers and traders still face with the problem of price fluctuation due to the price's susceptibility to various factors such as demand and supply of global market, the expected crop yield, global economic wellbeing and etc. Such problem commonly exists in other Thai agricultural products as well. To mitigate the difficulty, traders and producers have to form such strategy as the buy-sell strategy, inventory hold, and forward contract.

With the aim to improve the efficiency of agricultural markets, the Department of Trade, the Ministry of Commerce, has established the Agricultural Futures Exchange of Thailand (AFET) as the first commodity futures market in Thailand. The market opened on May 28, 2004 with futures contract traded on the underlying product of natural rubber, ribbed and smoked sheets No 3. The founding of the agricultural future market provides bundles of advantage. The main purpose of market is to provide the place for both traders and producers to trade the products and hedge against risk. The existing of well organized market provides the economical transaction channel. Moreover, the price in the agricultural futures market provides perspectives of future demand and supply. This price discovery mechanism will help alleviate the uncertainty of future product's price and be used as the reference for the plantation and business strategy.

Besides enhancing market efficiency, agricultural futures exchanges also acts as an alternative channel of investment for increasing portfolio yield. Hence, agricultural futures market is not only the market for just agriculture related persons but also the market for the investors, mutual funds, investors in equity as well as bond traders. Investors can diversify risks or hedge against price risks. Hedgers can hold short position at a bit low price to provide incentive and compensate for risk taken by counterparty, probably speculator. Speculators,

then, will bear risk and create liquidity. Ronald G. Layard-Liesching mentioned that commodity investing provides various source of return. The collateral yield is the return on cash used as margin to take long derivatives exposure. Roll yield return is the return from rolling forward the maturity of derivatives position. Price return is the return from the fluctuation of price.

The analysis through out this study is focused on three main objectives. First objective is to examine the relationship between price and volume in AFET and TOCOM in order to see the information arrival process as well as the trading behavior of traders. Second objective is to investigate the price discovery function of futures market and the interaction of futures and spot price in AFET which could explain the price discovery function. Finally, the last objective is to reveals the relation between AFET and TOCOM futures price which implies market integration.

The scope of study is emphasized on AFET, the contract of ribbed smoked sheet3 (RSS3), since the tiny number of research related to market and the aims to provide information about AFET so that the related parties would have better understanding about market. The reason that TOCOM is selected as a comparative partner in this study is due to the economics characteristic of Japan natural rubber market. Japan is the country that relies 100% of its domestic natural rubber use on import. Thailand export of natural rubber to Japan is account for 56%of domestic consumption on year 2006 and 48% of domestic consumption on year 2007 during period from January to September. With this economic transaction, the linkage between two countries is expected to exist. Moreover, TOCOM is the most actively rubber traded futures contracts worldwide ranked by number of contract traded (Jan-Mar 2008).

With the period of study starting from May 28, 2004 to December 30, 2007, the time series data provided by AFET contain 20,553 observations on Ribbed Smoked Sheet no. 3 (RSS3), white rice 5% (WR and BWR), Tapioca starch premium grade (TS), Standard Thai Rubber 20 (STR20), Concentrated Latex (Latex), and Tapioca Chip (TC). The review of data triggers some concerned issue that is the constraint of this study. There exists the time interval,

either a day or many consecutive trading days, that there is no trading transaction of some particular products. This inactive and no traded interval, that is available in data, can distort the result. The analysis, then, focuses on the product of Ribbed Smoked Sheet no. 3 (RSS3) and the data is obtained from Agricultural Futures Exchange of Thailand. The limitation of the study is due to the thin transaction and the short life of the market. The sample set, then, is not that large. Moreover, the analysis in the study is based on the daily data which is expected to provide less clear information than the analysis based on intra day data.

The remainder of the paper is organized as follows. Section II describes a brief review of related literatures. Section III presents the data and its description. Section IV explains the methodology and Section V shows empirical result. Finally, section VI provides a conclusion.

II. LITERATURE REVIEW

The price and volume relationship has been extensively examined in different market. Karpoff (1987) mentioned that the investigation on price and volume relationship provides the perspective of the structure of financial market. The well-know alternative explanations for casual relationship are the sequential information hypothesis (SIH) and mixture distribution hypothesis (MDH).

The sequential arrival of information model mentions that information promulgates consecutively to trader, and those uninformed trader can not observe the occurrence of informed trading. At the first stage where all traders have homogeneous set of information, market is in equilibrium. As the time of information arrival, each individual will receive information independently and randomly and do a transaction subject to the information. Optimistic view will shift demand curve up and pessimistic view will shift demand curve down. At particular time, the pattern of price volatility will depend on past price pattern and the view toward information on that particular time. As all traders observe and receive the signal of information, market then back to equilibrium. The uniformed traders are assumed not to be able to infer the arrival of information from the informed transaction and the short sale

prohibition. This sequential flow of information, then, will trigger both trading volume and price movement.

The Mixture of distribution hypothesis explains the positive relationship between volume and price volatility that the fluctuation of price depends on the rate of information arrival. The arrival of information brings about the change in price and trading volume. The MDH mentions that price and volume have a joint response to the information due to their common distribution. All Traders, then, immediately adjust as the arrival of information. The market turns to equilibrium immediately. Since it's hardly measure the rate of information arrival. Trading volume, then, is used as proxy for it. The MDH assumes that the joint distribution of price changes and trading volume bivariate normal condition upon the arrival of information and the information arrival is random.

Blum et al. (1994) investigate the role of volume and mention that volume is used as the proxy for the quality or precision of information about past price movements which can not be deduced form price statistics.

The linear relationship between price and volume exist from price to volume, volume to price and bidirectional causality. Lee and Rui (2002) examine the dynamic effects between stock market trading volume and returns for both domestics and cross country. The data is obtained from stock exchange of New York, Tokyo and London market. The data covers the period during 1973-1999. By employing the regression, the result shows positive contemporaneous relationship between trading volume and return in all three markets. The further analysis is implemented by employing the vector autoregressive (VAR). The result shows that the trading volume does not granger-cause stock market return for each of three markets. Trading volume helps predict return volatility and vice versa. Neither expected nor unexpected volume has a significant causal effect on stock returns. However, the expected volume granger causes volatility in only New York and Tokyo markets. The return granger causes trading volume in both New York and Tokyo markets. The New York market has the predictive power toward London and Tokyo markets.

Mcmillan and Speight (2002) examine the relationship between volume and return and absolute return. The result shows the positive relationship between volume and absolute return. The bidirectional causality is observed for both Short Sterling and Long Gilt futures contracts while FTSE-100 found the bidirectional causality for intra day data which asserts the sequential arrival of information hypothesis. There, then, exists the information dissemination. However, there exists of no causal relationships at all based on daily data. The author mentions that the absence of relationship is due to the quick information dissemination. The market reaches equilibrium quickly so that only contemporaneous correlation between volume and absolute return appear. This is consistent with the MDH.

Chen et al. (2006) investigate the price-volume relationship on products of copper, soybean, wheat and aluminums. The data is obtained from China commodity futures market and cover the period from 1996 to 2002. The result shows the causality for copper, soybean and wheat which supports the sequential information arrival. The result is different for aluminums since there is no significant causality between price and volume which supports the mixture distribution hypothesis.

Moosa and Silvapulle (2000) examine both linear and nonlinear relationship between price and volume on crude oil futures market. The period of study is during 1985 to 1996 and the data is obtained from West Texas Intermediate crude oil. The linear test shows the causality from volume to price regardless of maturity, price variability and time period. The test of nonlinear causality reveals the bi-directional causality due to volatility dependence. The test shows the existing of liquidity or maturity effect and market inefficiency.

Ciner (2001) gathers the data of gold, platinum and rubber futures contracts from Tokyo commodity exchange in order to investigate the relationship between volume and absolute return. The data cover the period from year 1992 to 2000. By employing the GMM the result shows the positive contemporaneous relationship between volume and absolute return for all contracts. The author mentions that volume conveys valuable information to absolute return. This supports the MDH. Moreover, there also exists the negative relationship between lagged volume and absolute value of returns. For the test of relationship between

volume and return, VAR model is selected to investigate the nonlinear dynamic relationship. The result shows the causality between volume and return. The nonlinear granger causality supports the bidirectional causality. However, causality disappears as return is adjusted for conditional volatility.

Other studies about the price and volume relationship concern on the relationship between price volatility and trading volume. Foster (1995) tries to extract the relationship between price volatility and trading volume on crude oil futures market based on the data from IPE and NYMEX starting from 1990 to 1994. The relationship between volume and volatility is positive and significant but very small. The study on market size effect for volume and volatility relationship indicates that large market is less sensitive to period of illiquidity, and greater volume is associated with more price volatility. This means that as market becomes larger and more liquid, the information efficiency and volatility rise. While for volume, that volume does not explain the variability. Moreover, lag volume can explain the volatility reflecting the inefficient in oil futures price. The result also reveals the symmetric effect of trading volume and price volatility.

Malliaris (1998) focuses on the relationship between trading volume and price variability. The period of study covers the data of six agricultural futures contracts: corn, wheat, oats, soybean meal, and soybean oil from 1981 to 1995. The result reveals the interrelationship between price and volume, the relationship both from price to volume and from volume to price. For all six of the agricultural commodities, price tends to lead trading volume in the short run and long term.

Najand and Yung (1991) focus the study on the relationship between the price variability in treasury-bond futures and trading volume with Garch (1,1) evaluation model. The data is obtained from Chicago Board of Trade starting from year 1984 to 1989. The result reveals that the variability in price of treasury-bond futures can be explained mostly by the past volatility and the persistence. Moreover, there exists the positive relationship between price volatility and volume in treasury-bond futures markets.

Besides the investigation of relationship between price-volume in AFET and TOCOM, another objective of this study is to examine the dynamic relationship between spot and futures price and the relationship between futures price across market.

In case that market is efficient, arbitrage will correct the relationship between spot and futures price. In the ideal notion, the arrival of information will affect both markets simultaneously. However, the lead-lag relationship can exist due to the different market structure setting, liquidity, transaction cost and etc. Kumar (2004) investigate the price discovery function on five futures contract in India. The result of the study shows no co integration relationship between spot and futures price. The futures market is inefficiency in the sense that it can not forecasts the spot price. The result is not unexpected with the thin and infrequency trading market. Market, then, is not well integrated and matured.

Hung and Zhang (1995) investigate the price discovery in municipal bond index and the index futures with the data from CBOT during year 1985 to 1993. The result shows that cash market adjust toward long run equilibrium in first sub sample while futures market plays a predominant role in second sub sample.

Kang and Lee (2006) examine the lead lag relationship in Kospi 200 futures and option market. The result shows that futures and option lead spot market up to 10 minute in the term of return. The lead lag relation is due to the lower transaction cost in derivative that facilitates the disseminating information in futures market.

In addition the focus on the relationship between spot and futures price, price discovery also function between futures markets both on the contract with different and identical underlying asset. Malliaris and Urrutia (1996) also investigate the co-movement of futures contract on different underlying products of corn, wheat, oats, soybean meal, and soybean oil trade during period from 1981 to 1991. The data is obtained form the Chicago board of trade. The result shows long term relationship among each commodity but not short run relationship. In other word, price of each product does not move independently. The authors mention that this evidence is consistent with the economic cognitive of substitutability and complementary. The price discovery function of commodity futures contracts signals

valuable information not only to its cash market but also to other related commodity futures contracts.

Booth et al. (1996) examine the linkages and information transmission of three international exchanges, the OSE, SIMEX and CME, during the period from 1990 – 1994. By employing the error correction model, SIMEX responds more quickly than the OSE. This is probably due to the tighter regulation and higher transaction costs of the OSE that lessen the information efficient. Moreover, CME also granger causes OSE and SIMEX. There exists the bidirectional granger causality relationship between the OSE and SIMEX. Causality lead from the last trading market, CME, to SIMEX and OSE, but the relationship is less than one day.

Booth and Ciner (2001) also examine the co-movement in futures price of corn, redbean and sugar during period 1993 – 1998. The authors explain that long run co-movement has its root either form the common economics fundamental which leads to commodity substitutability or complementary or from the excess co-movement hypothesis which mentions that raw price of several unrelated commodities tends to move together due to herding in market. The analysis uses co integration technique to test on the data from Tokyo Grain Exchange. The results show no evidence of co-movement due to herding trend in commodities market but not the co-movement due to common fundamental variables.

Bhar and Hamori (2006) investigate the Tokyo grain exchange for corn, red bean, soybean and sugar starting from year 1994 to 2003. The test of co integration exhibits that the market dose not has the long run relationship or no co integration. The futures price of four products, then, moves independently for the whole sample period test. However, during the period from 2000 to 2003, the market shares some long run relationship in price. The authors mention that price discovery signal information on other related contract during year 2000 to 2003, as the time that markets are more developed. The author concludes that price mechanism works better and the long run relations among price of futures products exist in the developed market.

Beside the investigation of co-movement of futures price based on different underlying, Booth, Brockman and TSE (1998) examine the price discovery and co-movement

of the wheat futures price which implies the information transmittal process between US and Canadian wheat market. The tests of the moving together through time of the wheat price between two futures markets covers the periods of study during year 1980 – 1994 and employs the error correction model. The result reveals the existence of long run dynamics in only US market. The ARCH test shows that the variance of US wheat price is greater than Canadian wheat. The authors explain that US market takes into account of information at a faster speed than the Canadian market under the assumption that variance is directly related to the same or different information flow. The authors also mention that such long run relationship exists even though market base on different grade of wheat. US wheat contract granger causes CD wheat contract with no feedback. The source of the causality transmit form US to Canadian stems form the long run relationship not short run due to the insignificant short run coefficient.

The possible explanation of relationship or co movement of futures price with identical underlying across market is Law of one price (LOP) which states that under the economy where there exist no transaction cost and barrier free, the identical goods sold in different economy must sell in same price (price that quoted in same currency). The price difference will be removed by arbitrage transaction. The holding of LOP has been widely investigated. Giorgio Ardeni (1989) mentions in his paper (p. 662, 663) that price arbitrage is regularly as being imperfect. The deviation of price can occur in commodity market due to import quotas, tariff and other. His study employs the co integration technique and the data of commodity market such as wheat, tea, beef, sugar, wool, zinc and tin. The result shows that not even in the long run that law of one price holds but the imperfect arbitrage of goods appears to hold. The counter fact of LOP is asserted by Haskel and Wolf (2001) who implement the test of LOP on products in IKEA stores located in 29 countries during 1995-1998 and Baffes (1991) who examines seven commodities related to four countries. Baffes (1991) also mentions that the failure of LOP is due to the transportation costs.

Asche et al. (2004) test the market integration on whitefish in France. The results show that a causality and co integration yield similar economics information for the LOP test.

The causality is proper as prices are stationary and co integration is appropriate as prices are nonstationary. In the long run, prices will return to equilibrium across the different fish prices. The relative prices of frozen fillets of cod, haddock, and saithe are consistent with LOP. One market segments of fish species can represent all others as a single market. The investigation of market integration is based on the LOP.

Bachmeier and Griffin (2006) mention that with integrated market, the price changes in one market will be linked with the changes in price of another market due to the common demand and supply variables that determined price. The different in price will be instantly arbitraged on corresponding periods. By employing the error correction model, the price of substitute product is linked in a long run relationship with the possible different due to transportation costs or qualities differentials. Their study investigates the oil, coal and natural gas market by employing the error correction model. The result shows the highly integrated market of crude oil and the long run relationship between western and eastern coal market. The authors mention that there exists the relationship between oil and natural gas but the relationship is weaker compare to the relationship between crude oil and western coal.

III. METHODOLOGY

In order to investigate the relationship between price and volume and relationship between futures price and spot price, vector autoregressive (VAR) based on OLS estimation is employed. With OLS estimation, the data series must be stationary that is its mean and variance are constant over time and the covariance between two time periods depend on the lag between two time periods. By plug in the nonstationary, OLS will yield the spurious result. First test, then, is to test for stationary data series by employing the augmented dickey-fuller (ADF).

III.I The augmented dickey-fuller (ADF)

The ADF is used to measure the unit root of time series data. The test consists of the estimation of the following regression:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t$$

where ε_t is a pure white noise error term and m is number of lagged differences , α is constant, β is the coefficient on a time trend, The test compare the t-ratio of the lagged level term δY_{t-1}, with the critical value under the null hypothesis of unit root. The ADF control for the higher order of serial correlation by adding the lagged difference terms on the right side of equation or dependent variable. The number of lagged different terms is included until it enough for error term to be serially uncorrelated. The test compare the t-statistics of the coefficient of lagged level term, δ , with the critical value under the null hypothesis of unit root, δ is equal to 0, whereas the alternative is that δ is not equal to 0. In case that t-statistics is less than the critical value, the null hypothesis of unit root can not be accepted. The series, then, is stationary. After testing the stationary, the nonstationary data is transformed into stationary data by applying the natural logarithm. The granger causality test, then, is implemented.

III.II Price volume relationship, Granger Causality test

In order to understand the information arrival process, the price volume relationship is examined. There are two main explanations for the information arrival process. The sequential arrival of information model mentioned about the information that is sent consecutively to trader until all traders are informed. Market, then, return to equilibrium. There exists either one way or two way causality relations between price and volume. However, the non existence of any causality relationship would support the notion of mixture of distribution hypothesis which suggests a joint response to the information due to their common distribution or the immediate adjust as the arrival of information. The return and volume, then, simultaneously incur due to joint distribution. The causality relation between volume and return is not expected to exist. To investigate the relationship between price and volume, the analysis employs the granger causality test which is based on vector autoregressive model. The granger causality test is the bivariate test on the coefficient of the lagged variable. It helps

measure the precedence and information content. Since VAR analysis requires the stationary plug in variables, the natural logarithm is applied to price series. The return series, then, is used in the study. The regression of the granger causality is as follows;

$$RET_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1,i} RET_{t-i} + \sum_{i=1}^{m} \alpha_{2,i} VOL_{t-i} + \varepsilon_t$$

$$VOL_t = \beta_0 + \sum_{i=1}^{m} \beta_{1,i} VOL_{t-i} + \sum_{i=1}^{m} \beta_{2,i} RET_{t-i} + \upsilon_t$$

where both RET_t and VOL_t are stationary time series, m is number of lagged which is determined by employing the Schwarz information criteria, and ε_t and υ_t are white noise stochastic error terms of RET_t and VOL_t respectively.

The coefficient of $\alpha_{1.i}$ and $\alpha_{2,i}$ represent the granger causality of lagged return and lagged volume on current return, while $\beta_{1,i}$ and $\beta_{2,i}$ explain the causality of lagged volume and lagged return on current volume. T-statistics determines whether each coefficient is statistically significant. The null hypothesis of the t-statistics test is that each coefficient of $\alpha_{1.i}$, $\alpha_{2,i}$, $\beta_{1,i}$ and $\beta_{2,i}$ is equal to zero. F-statistics, a joint test, is tested with the null hypothesis whether all of the slope coefficients (excluding the constant, or intercept) in a regression are zero. If the t-statistics are statistically significant but weak, the F-statistic can be highly insignificant. The test of granger causality based on VAR model is estimated by OLS.

Either one way or two way causality supports the sequential arrival of information model, while the non existence of any causality relationship supports the mixture distribution hypothesis. The result of the granger causality test on price and volume also provides another implication beyond the information arrival process analysis. In case that the result yields the granger causality from past volume to return, there appears some level of market inefficiency. Since lag terms of volume have some predictive power to the current return, traders can employ the technical analysis to form trading strategy. The granger causality running from return to volume also implies the positive-feedback trading strategies of noise traders. Positive feedback traders buy as price rise and sell as price fall. The traders will form the extrapolative

expectation of future price based on the past price trend. The emerging of demand of those traders relies on the expectation. Trading volume, then, is up to the past price trend.

III.III AFET Rubber Price discovery; Johanson co integration test and granger causality test

In an efficient market, futures and spot prices on the same underlying asset price is expected to be perfectly correlated and there is no lead-lag relationship. The information that arrives will affect both spot and futures price simultaneously. Futures price and spot price do not deviate without bound in long run even if prices may drift apart in short run. The deviation from long run equilibrium will not persist. Both Prices, then, move together in the long run. The co integration test by Johanson test is implemented to test whether long run equilibrium between two price series exists.

Johanson test is the maximum likelihood analysis used for testing co-integration relations. Johanson suggests two alternative methods to identify the appropriate number of co integration relations. First one is trace test. The LR test statistics for the null hypothesis of at most r co integrating vectors is $\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$ where $\hat{\lambda}_{r+1}, \ldots, \hat{\lambda}_n$ are the (n-r) smallest eigenvalue of the determinant equation. The alternative hypothesis is r+1 co integrating vectors. Second one is maximum eigenvalue test. The null hypothesis is co-integration of r and the alternative hypothesis is co-integration of r+1. The LR test statistics is $\lambda_{\max} = -T \ln(1 - \hat{\lambda}_{r+1})$.

The existence of co integration relations represents the long run equilibrium as mentioned above. In case that there is no long run equilibrium, the vector autoregressive analysis is employed to see the causality relationship.

Since vector autoregressive analysis helps measure the precedence and information content, and both spot and futures price are the price of identical underlying. Both prices will be driven by same set of information. The running of granger causality between spot and

futures price will reveal the interaction of two prices. The one way direction causality would imply one market leads another. The regression of the granger causality is as follows;

$$FRET_t = \delta_f + \sum_{i=1}^{l} \beta_{fi} SRET_{t-i} + \sum_{i=1}^{l} \gamma_{fi} FRET_{t-i} + e_{,t}$$

$$SRET_t = \delta_s + \sum_{i=1}^{l} \beta_{si} FRET_{t-i} + \sum_{i=1}^{l} \gamma_{si} SRET_{t-i} + e_t$$

where FRET and SRET are futures price return and spot price return, l is number of lagged which is determined by employing the Schwarz information criteria. The number of appropriate lagged length of independent variable on VAR is obtained by the Schwarz information criterion (SIC).

III.IV Price discovery between AFET and TOCOM; Error correction Model (ECM)

With two futures price of same underlying asset, there should have long run equilibrium between two prices since prices in two markets will reflect the arrival of same information set at the same time. The deviation of one market from another will be arbitraged. The existence of co integration relation is measured by Johanson test. The result of the test will show whether two prices move together in the long run. After testing for the co integration relations, the error correction model is used in order to examine the causality relationship between lag deviation form equilibrium and futures prices, and relationship between futures prices in two markets.

Vector auto regressive (VAR) model with the stationary series that is known to be co integrated is the error correction model (ECM). ECM, then, is VAR with restriction. An error correction model consists of the co integration relations in the equation so that long run movement of endogenous variables returns to equilibrium while allowing for short term movement. The error correction model (ECM) is shown below.

$$FAFET_t = \partial_1 + \tau_2 \hat{u}_{t-1} + \sum_{i=1}^{m} \alpha_i FAFET_{t-i} + \sum_{i=1}^{m} \delta_i FTOCOM_{t-1} + \varepsilon_t$$

$$FTOCOM_t = a_1 + b_2 \hat{u}_{t-1} + \sum_{i=1}^{m} \beta_i FTOCOM_{t-i} + \sum_{i=1}^{m} \upsilon_i FAFET_{t-1} + \varepsilon_t$$

where FAFET and FTOCOM are futures price of AFET and TOCOM respectively, m is number of lagged which is determined by employing the Schwarz information criteria, the equation of $u_{t-1}^{\wedge} = (FAFET_{t-1} - \delta FTOCOM_{t-1} - \alpha)$ is the linear combination of the futures price between AFET and TOCOM or the error correction representation, and τ_2 and b_2 represent the speed of adjustment of the error correction.

In case of the deviation from long run equilibrium, the error correction term will be nonzero. But in the condition that long run equilibrium exists, the moment of $u_{t-1}^{\wedge}$ will equal to zero. In long run equilibrium that two prices are the same, the coefficient of δ is expected to be one and α equal to zero. The difference can exist due to the transaction cost or arbitrage cost which corresponds to the non zero of α .

For the short run relationship, the coefficient of α_i and δ_i represent the short run effect of lagged futures price to current futures price. If all parameters are statistically significant, there exhibits the bidirectional granger causality of futures price between AFET and TOCOM futures price or the causality between futures and spot price. The statistically significant of either lag of AFET futures price on TOCOM futures price or lag of TOCOM futures price on AFET futures price represents the one directional granger causality. ECM is estimated under the notion that lag length is constrained to be symmetry among regressors.

IV. DATA

IV.I Overview

The agricultural future exchange started trading on May 28, 2004 with the start-trading product of Ribbed Smoked Sheet no. 3 (RSS3) and White rice 5% (WR) contract as shown in table 1. The market launched new product of Tapioca starch premium grade (TS) on march 25, 2005, followed by Standard Thai Rubber 20 (STR20) on September 27, 2005, concentrated Latex (Latex) on march 31, 2006, and Tapioca Chip (TC) on 18 August 2006.

The analysis through out the study employs the daily data of ribbed smoked sheet no.3 futures price, trading volume, open interest, and time to maturity gathered from AFET and

TOCOM during the period from May 28, 2004 to December 30, 2007. With 6 products available to trade in AFET, both products of Standard Thai Rubber 20 (STR20) and Concentrated Latex (LATEX) stop trading on September, 3 2007. Table I exhibits the summary of all 6 products both listing and already-delisted products. With the new establish of AFET, the lack of trading volume is the issue to be concerned and lead to no available data of open interest and closing price on some particular products as shown in table II. The analysis, then, focuses on the product that contains the appropriated-to-study data or Ribbed Smoked Sheet no. 3 (RSS3). The data of the exchange rate is obtained form the Bank of Thailand.

[Table I is here]

[Table II is here]

After the collecting process, the particular observations are selected in order to generate the series. The generated series will contain one month holding of the highest trading volume contract on that particular month. The series, then, will contain high trading volume contract and keep away from the contracts that are about to expire in order to avoid the expiration effect or bias intervention. This fashion of capturing the high trading volume contract to generate the series is applied to data of the same contract at particular time in AFET price series in order to obviate the problem of no trading period. In TOCOM, the data exactly stems from same maturity contract used in AFET. Due to some different holidays in different markets, the data is synchronized to common date by linearly interpolation. The dependent variable of price is adjusted by linear interpolation to correspond with the observed independent variable of price. Bachmeier and Griffin (2006) cite the benefit of relegating any measurement error to the dependent variable is that as long as the measurement error is random, the estimated underlying parameters will retain the property of consistency

IV.II Return and volume relationship and AFET rubber price discovery

Table III reports the summary statistics of price and volume in AFET. Since mean of futures price, 68.73, is the average price over the entire period. The mean, then, is much

different from the present average price due to the increasing price path. The volume traded in unit of contract peak at 551 contracts a day. The Jarque-bera tests report the probability close to zero. All series, then, are non normal distribution.

[Table III is here]

[Table V is here]

Table V reports the result of the unit root test by employing the augmented dickey fuller. The test of stationary is the condition for the running of OLS regression. Nonstationary data run by OLS will cause the spurious regression. The results of the test with intercept and trend show that both AFET and TOCOM futures price series are statistically insignificant. This means that both series contain nonstationary. However, both series are stationary after do the first different, the general process to make data stationary. In the other hand, the tests on volume series report statistically significant t-statistics meaning that volume series are stationary. Since the analysis of causality between return and volume based on vector autoregressive model requires the plug-in variables that are nonstationary. The return series is constructed by applying the natural logarithm on futures prices, return t = ln (Ft / Ft-1) where F t is the closing price on day t. Table VI exhibits the appropriate lag length selection by Schwarz information criterion (SIC). The appropriated lag lengths for return-volume analysis based on vector autoregressive are three in AFET and four in TOCOM.

[Table VI is here]

IV.III The relationship between AFET and TOCOM futures price

Table IV shows the summary statistics of futures price series of both AFET and TOCOM. By interpolating the AFET price series to match with TOCOM price series, the total observations are 879 observations. The mean of AFET price increases a bit from the original price on table III. The large difference between max and min of futures price stems from the upward price path during the period of study. The TOCOM futures price in baht is a bit higher than AFET price. The results of Jarque-bera test report the probability close to zero which is consistent with nonzero skewness, all series exhibit non-normal distribution.

[Table IV is here]

[Table VIII is here]

Table VIII, the test of unit root based on the augmented dickey fuller shows that futures price in AFET and TOCOM, and spot price are statistically insignificant by the series itself, at level. The further tests on the first different show statistically significant for futures price in both markets. Table IX provides the proper lag length selected by Schwarz information criterion (SIC). The number of appropriated lag for relationship between AFET and TOCOM price analysis, and between spot and futures price analysis are one and two respectively.

[Table IX is here]

V. EMPIRICAL RESULT

V.I Return and volume relationship, AFET and TOCOM

The investigation on the relationship between return and volume both in AFET and TOCOM reveal that the information arrival process is based on two main hypotheses of sequential information, price moves in sequence of information flow, and mixture distribution, price and volume simultaneously incur. Table VII Panel A shows the result of granger causality test on AFET. The result exhibits that only lag one period of return can explain return while all lag of volume can not explain return. The results of t-statistics show that only $\alpha_{1,1}$ is statistically significant while other $\alpha_{1,i}$ and $\alpha_{2,i}$ are statistically insignificant for all. The f-statistics test is not statistically significant. The influence of Lag one period return on present return is not strong enough to make F-statistics statistically significant. In the other hand, only lag three of volume can explain the current volume while all lag period return can explain the current volume. Since only $\beta_{1,3}$ and all three lag of $\beta_{2,i}$ are statistically significant. The f-statistics is statistically significant. The result shows that only return granger causes volume in AFET implying the sequential information arrival.

[Table VII.I Panel A and B are here]

Panel B shows the relationship between return and volume in TOCOM. The result shows that no any lag of volume or even lagged return itself can explain the current period return. The f-statistics is statistically insignificant. This means that volume does not granger cause return. However, the second column of panel b exhibits the different result. The lag of return form one up to four is statistically significant while only the fourth lag of volume explain current volume. The f-statistics is statistically significant. There exists only one way granger causality from return to volume in TOCOM implying the sequential information arrival as in AFET.

In sum, the evidence from AFET (Panel A) and TOCOM (Panel B) shows one-way granger causality from return to volume and the effect is less strong in TOCOM. This one way causality can be explained by sequential information arrival (SIH). Since SIH mentions about the sequential adjustment back to equilibrium is due to the arrival of information to each specific trader. The market reaches equilibrium as all traders are informed. Price, then, move in sequence of information flow. The one way causality form return to volume is consistent with Hiemstra and Jones (1994) and Lee and Rui (2002).

Besides the sequential information arrival, the result of one way causality form return to volume also implies the positive feedback trading strategy. In the presence of positive feedback trading, as rational speculators receive good news and trade on the news. The rational speculators realized that the increase in initial price will stimulate buying by positive feedback traders tomorrow. The informed rational speculators, then, buy more today and drive price up today. Tomorrow, the positive feedback traders buy in response to today's price increase, while rational speculators are selling out and stabilizing prices. Positive feedback investors are those persons who buy securities as prices rise and sell as price fall. Positive feedback traders form extrapolative expectations about futures price based on past price trend, the pick up of demand will rely on that expectation. The current trading volume, then, can be explained by past prices. This explains the evidence that lag returns granger cause current volume.

V.II The relationship between spot and futures price, AFET

In efficient market, futures and spot price will not drift apart without bound in long run. The long run equilibrium, then, is tested by johanson co integration. Table X panel A exhibits the result of johanson test of co-integration relations between futures and spot price. The result reports that there exists no co-integration relation or long run equilibrium between spot and futures price in AFET. This means that as futures or spot price drifts apart, price does not converge back to trend as it should if market is efficient. The result implies that AFET is not matured and does not do price discovery role efficiently.

[Table X Panel A is here]

Even though two prices do not have long run relationship or do not move together, granger causality test is applied to see the interaction of two prices. Table XI Panel A shows the result of VAR analysis on the relationship between futures price and spot price. T-statistics show that spot price does not granger causes futures price, while lag one of futures price granger causes spot price. Both lag term of futures price can explain current futures price while only lag one of spot price can influence current spot price. F-statistics are statistically significant for both models. The result, then, shows only one way causality from futures price to spot price which implies that futures price lead spot price. The alternative explanation of the observed lead-lag relationship is that spot price used in the analysis is the Had Yai auction price. This spot market opens from nine o'clock and thirty to eleven o'clock for the morning round and one o'clock to two thirty in the afternoon. Spot prices do not reflect the information that is available in the afternoon since most of trading transactions normally concentrate in the morning round. Futures market also closes after spot market. Moreover, the cost of trading in futures market is lower and the degree of leverage attainable is higher. Futures market, then, incorporates information prior to spot market. The result is consistent with Silvapulee and Moosa (1999) and Kang and Lee (2006)

[Table XI panel B is here]

Since shock to variable also affect all other endogenous variables through dynamics lag. The impulse response function will draw the effect of one time shock to an innovation on

current and future values of the endogenous variables. Table XI Panel B.A shows the response of spot price to one standard deviation innovation on futures price. The one positive standard innovation on futures price or a shock on futures price impulses the spot price to build up for a period of day two before beginning to decline precipitously. Day three to four after the shock on futures price, the spot price is back to the trend for the first time. After day seven, the spot price is back fundamentally to trend. Panel B.B shows the response of futures price to one positive standard deviation innovation on futures price. Initially, the futures price rises sharply. The respond of futures price goes back to trend on day two while the respond of spot price is about to peak. The respond of futures price rises a bit in day four before converging back to fundamental on day five, while the respond of spot price rises a bit on day five before returning back to fundamental on day seven. This result asserts the aforementioned finding that futures price leads spot price. It can be implies that futures market incorporates information prior spot market.

In sum, there is no long run relation as in the case that market is efficient. AFET is not efficient in the sense that market does not perform price discovery role. The result is similar to Kumar (2004) who investigates Indian market and find that market does not perform price discovery role. Kumar explains that the result does not surprise for the market with thin trading volume and infrequency trade. The test by vector autoregressive implies that futures price incorporates information prior to spot price. This result is also asserted by the impulse respond analysis.

V.III The relationship between AFET and TOCOM futures price

With same underlying asset, two futures prices in different market will reflect information arrived at the same time. Any deviation of one market from another will be eliminated. The long run equilibrium, co integration relation, between two prices exists and can be tested by johanson test. Table X panel B shows the existence of co integration relations between AFET and TOCOM price. Even though AFET does not perform its price discovery

function in relations between spot and futures price but it does perform price discovery function across market.

[Table X Panel B is here]

[Table XII is here]

The effect of deviation from equilibrium and lag futures price on the current futures price is examined by employing the error correction model. The results are shown on table XII. The estimated parameters of long run equilibrium error in both markets are statistically significant and the parameters exhibit stronger influence in AFET relative to TOCOM. The deviation form long run equilibrium, then, can explain the differential of futures price at present time in AFET better than in TOCOM. The negative and significant sign of τ_2 suggested that an increase in previous period equilibrium error is followed by a decrease in current period AFET futures price. The futures price of TOCOM increase to meet the increase in AFET futures price while the AFET futures price falls. In the other hand, the positive sign of b_2 means that an increase in the previous period's equilibrium error leads to an increase in the current period TOCOM futures price. In sum, the result exhibits the long run equilibrium between AFET and TOCOM. AFET futures price is not insulated from TOCOM futures price or AFET price does not move independently from TOCOM price. This result implies that trader can perform the cross hedge between AFET and TOCOM.

With the existence of relationship of futures price between AFET and TOCOM, the estimated δ is 0.9925 which is close to one and asserts prior expectation that price of identical product traded in different market is expected to be the same. One baht increase in TOCOM futures price causes the 0.9925 baht increase in AFET futures price. The futures price of RSS3 in TOCOM has strong relationship with futures price of RSS3 in AFET. However, there still be the price gap between markets, α , which is consistent with Haskel and Wolf (2001). The gap could be attributable to the transaction cost or non-frictionless. The presence of close relationship between market reflects and asserts the aforementioned real economic rubber market that Japan imports 1.4% more than the total NR use in the country based on year 2006 and 96% on during January-September on year 2007. Moreover, Japan

relies about 56% and 48% of total NR use on Thailand export based on year 2006 and period during January-September 2007 respectively. The result is due to the fact that both markets share some common demand and supply variables.

For the short run dynamics which is measured by the lag different term's parameter of α_i , δ_i , β_i and υ_i , the result shows the statistically significant t-statistics with positive sign on coefficients. The f-statistics are also statistically significant as well. The AFET futures price can be explained by lagged different of TOCOM futures price and vice versa. The result reflects the bidirectional causality or two-way feedback relationship in two markets.

In sum, AFET futures price has co integration relation with TOCOM futures price. The results of the test imply that AFET is a good instrument for the cross market hedge with TOCOM. This reflects some degree of market integration which has its root from common demand and supply due to the real economics relationship between Thailand and Japan. The empirical results also reflect the benefit of employing the error correction model that embodies the co integration relationship analysis. The results from the model reveal both short run relations and the causal relationship between two markets futures price.

VI. Conclusion

Agricultural futures exchange of Thailand is the only commodity futures market in Thailand. The market is an alternative investment channel for both investor and agriculture. Due to the short life of the market, there is tiny number of research related to market. The study on AFET, then, will provide more information related to market.

The objective of this study is to examine the relationship between price and volume in AFET and TOCOM in order to see the information arrival process as well as the trading behavior of traders, the price discovery function of futures market and the interaction of futures and spot price in AFET, and the relationship between AFET and TOCOM futures price which implies some degree of market integration. The period of study is during 2004-2007. The analysis uses vector autoregressive models (VAR) and error correction model (ECM).

The results of the study show that futures price incorporates information prior to spot price but futures and spot prices do not have relationship as in the case that market is efficient. AFET does not do price discovery role efficiently. The market is not matured. The implication of the result relates to both traders and regulator. Traders should take this inefficient into account of consideration as the time they enter the position in the market since the contract hold does not provide efficient hedge against spot price risk. Kumar (2004) mentions that inefficient role of price discovery is not unexpected in the market with low trading volume and infrequency trade. With low trading volume in AFET, the market is not mature. The result of study also points out the concern on market efficient to the regulator. Regulator, then, has to correct this inefficient. According to Kumar, the boost up in trading volume and number of participant might be an alternative fashion to help increase the market efficient.

The study also shows that there is the long term relation between AFET and TOCOM futures price implying the integration of two markets. While TOCOM is acclaimed to be the most actively rubber traded futures contracts, AFET has much lower trading volume relative to the trading volume of TOCOM. The result of the study implies that traders can use AFET as an alternative investment channel beside TOCOM. Instead of going to trade in foreign market such as TOCOM, traders can enter the position in AFET with lower cost. Moreover, the result of the study also implies the chance that traders can form the cross market trading strategy. As a regulator who has role to boost up trading volume and the number of market participant, regulator can use this empirical finding to draw the investor attention so that investor will turn their investment to domestic market, AFET.

Besides the relationship between two markets, the result of the analysis on relationship between price and volume reveal that there are a number of intermediate equilibrium of price before the final complete information equilibrium can be reached, and there exist the positive feedback trading. This finding helps market participants understand more about the characteristics of trading in market. Since positive feedback trading will rely on the past information, positive feedback traders will buy as the price rise and sell as price fall. The implication of this empirical finding to speculators is that speculators can form the

strategy against the positive feedback trader by entering the long position in futures market today with the hope to sell to positive feedback trader at higher price.

Since positive feedback traders, noise trade or trend chaser, form the expectation about price and trade based on past information but the movement of futures price should base on the movement of underling asset price due to the change in various fundamental factors. Kallinterakis and Ferreira mention that positive feedback might has its root from psychological bias, overconfidence and the lack of education background or investment experience which could lead to the mispricing of futures price. Moreover, the result of the study also shows that past volume can not be used to explain return. Regulator, thus, should educate and encourage investors to form their trading strategy on the fundamental factors rather the recent trend or past information alone.