THE LIQUIDITY EFFECT OF INTRODUCTION OF TDEX ON SET50 CONSTITUENTS

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MASTER OF SCIENCE PROGRAM IN FINANCE

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Thatree Ananpattanakul

An Independent Study
Submitted in Partial Fulfilment of the Requirements
For the Degree of Master of Science (Finance)

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Thammasat University, Bangkok, Thailand

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An Independent Study

By

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(Assoc.Prof.Dr.Pantisa Pavabutr)

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ABSTRACT

This paper examines the liquidity effect of underlying stocks after introduction of the first ETF in Thailand. The study uses intraday data to compute bid-ask spread and depth to be proxies of liquidity measurement. Previous researches provide two hypotheses related to this study, arbitrage hypothesis suggested that liquidity should be increased through arbitrage process, in contrast, adverse selection hypothesis predicts uninformed trader will move away from the individual underlying stock to this new basket security. The regression analysis in this study shows that the introduction of TDEX has no significant impact on bid-ask spread but results in an increase in quoted depth.

I. INTRODUCTION

In recent years, ETFs have become very popular in investments' world. The first ETF, Standard and Poor's Depository Receipts (i.e. SPDRs), was introduced in 1993 and traded on American Stock Exchange (AMEX) after that many ETFs followed such as DIA and QQQ in 1998 and 1999, respectively. In 2008, total numbers of ETFs, collected by World Federation of Exchange (WFE), are 3,631 ETFs increased from 1,843 ETFs in 2007, in addition, net asset value (NAV) as of year 2007 equals the value of 3,601 billion USD rapidly growth by 503% from year 2003.

The ETF stands for Exchange-Traded Fund, as the word implied, it is the investment unit of fund that trades in stock exchange in the same manner as individual equity security. Normally, ETF is an index tracking, for example DIA tracks on "Dow Jones Industrial Average" or QQQ is on "NASDAQ 100 index" but it can be differed upon the objective of authorized financial institution whose promotes them. In order to create ETF units, the authorized financial institution has to deposit a basket of pre-determined underlying stocks with the trustee then they will receive ETF units in return while the redemption of it is reverse. The advantages of trading in ETF comparing to individual security is gaining diversification benefit at lower transaction cost. Comparing with index-track mutual fund, ETF has more advantages as it can be easily trade in stock market, selling on short, bought on margin, tracked price intraday and exempted tax expense. Moreover, it might occurs arbitrage opportunity whenever its price properly diverges from its underlying price. Another advantage is ETF should be used as the hedging instruments because it is the index tracking.

In Thailand, the first ETF named "TDEX" has been initially traded on September 6, 2007. It is track the SET50 index by trying to maintain the tracking error between the Net Asset Value (NAV) per unit of the fund and the SET50 index at not more than 1% per year. After introduction, TDEX is the one of popular security with average trading value of THB 52.23 million per day holding the 44th ranking by trading value or around 0.41% of total trading value of SET50 stocks during September 6, 2007 to the end of year 2008. As of the end of 2008, TDEX has value under management of THB 2.13 billion with 654 million of units increased from initial value of THB 1.04 billion with 178 million of units (see figure I). Not far from TDEX launched, the SET listed the second ETF, named ENGY, which tracks energy sector index in 11 months after TDEX with NAV of THB 316 million.

[Figure I is here]

Many of researches have studied the effect on underlining asset's liquidity after an introduction of basket securities but there are two different findings. One for the adverse selection hypothesis, says that, as information among traders is asymmetry therefore uninformed traders, who are well-diversified, will prefer to trade in basket security than in its component stocks. This would make the proportion of informed traders in underlying stocks increases, thus, the adverse selection cost compose in bid-ask spread should be increased and bid-ask spread will be wider. This hypothesis is supported by *Jegadeesh and Subrahmanyam (1993)*'s study. They used monthly spread and depth of underlying stocks to examine their liquidity effect after the advent of S&P 500 futures contract and found significantly increase in bid-ask spread of the underlying stocks by 3.70% but insignificant in the increasing of adverse selection cost. In contrast, another hypothesis, the hypothesis of the index arbitrage, suggests that whenever the price between basket security and its underlined security are properly discrepancy, the trader who observed will buy the lower one and sell another one to get definite profit. By this process, the information flows across the market thus enhance liquidity of both types of securities. Consistent to arbitrage hypothesis, *Hegde and McDermott (2003)*, who measured trading activity and liquidity cost, show that the trading liquidity in underlying stocks increased after the introduction of the two popular ETFs, DIA and QQQ, which his explanation is the declining in adverse selection cost of underlying stocks.

This study examines the liquidity effect of TDEX's underlying stocks. The liquidity is measured by trading activity, bid-ask spread and depth. Bid-ask spread and depth are computed in 10-minute interval using intraday data provided by the Stock Exchange of Thailand (SET). To study the change in liquidity, Univariate test and Multivariate cross-sectional regression are applied. Several researches find decreasing in bid-ask spread is coordinated with increasing in tick size and trading volume but with decreasing in volatility, while depth is positively related to volume and market capitalization but has negative relationship with volatility. Additionally, followed *Pavabutr and Prangwattananon (2008)*, spread and depth are endogenous variables which have positive impact on each other, thus, 2SLS method is used to account for endogeneity effect. Therefore, to investigate the change in spread and depth after TDEX launched, these four factors are controlled in Multivariate model.

The findings of this study seem to support previous literatures on liquidity effect of ETFs launching, which are *Hegde and McDermott (2003)* and *Richie et al. (2007)*, as bid-ask spreads are decline, as well as, the increasing of depth, however, the results are insignificant.

The remainder of this paper is constructed as follow; section II provides previous findings and related hypothesis regarding basket securities' introduction on liquidity of underlying asset. Section III describes trading background in the Stock Exchange of Thailand and the first two ETFs in Thailand. The section IV describes data and methodology used in this study, then, section V analyzes the empirical results of Univariate test and Multivariate regression. Lastly, section VI concludes the findings and further study.

II. LITERATURE REVIEW

Several research papers have conducted studies on the effect of many basket security types in many perspectives one would be liquidity effect on underlying asset. Two different findings are reported, one finds liquidity increased through arbitrary, and however, another group finds some investor types ran away from individual asset to the new diversified product, as adverse selection cost is lower.

Arbitrage hypothesis

Whenever two or more securities being mispriced relative to each other, the observed trader will engage to buy lower one and sell another to receive definite profit, this process called arbitrage. Several researches agree with this theory. *Fremault A. (1991)* shows that index futures improved liquidity of their underlying stocks through arbitrage opportunity between underlying stocks and their futures contract. As index futures significantly contributed price discovery to their underlying by eliminating information asymmetry across the markets. *Hegde and McDermott (2003)* find the same results when examine the effect on ETFs introduction, DIA and QQQ. They use intraday data, bid-ask spread and depth, as proxy of liquidity. After conducted Univariate and Multivariate cross-sectional test using SUR technique, they find trading of these ETFs significant reduce bid-ask spread but insignificant decrease in depth. Moreover, result of MRR model[1] corporate with increasing of DJIA 30 futures contracts suggest the declining adverse selection cost in bid-ask spread, which result from competition among informed traders in doing inter-market arbitrage. The similar findings can be found in *Kumar et al. (1998) and Richie et al. (2007)* who use similarly SUR

[1] *Madhavan et al. (1997)* induce MRR model to estimate four parameters governing the behavior of transaction prices and quotes, which are θ for asymmetric information parameter, ϕ for cost of supplying liquidity of market maker, λ for probability that the trade will occur inside bid-ask spread, and the last one, ρ for the first-order autocorrelation of the trade initiation variable. The equation is;

$$p_t - p_{t-1} = (\phi + \theta)\, x_t - (\phi + \rho\theta)x_{t-1} + \varepsilon_t + \xi_t - \xi_{t-1}$$

technique in liquidity's observation of options trading and QQQ on underlying stocks, respectively.

Adverse selection hypothesis

In economics, adverse selection arises when information is asymmetry, general example, insurance companies have inequivalent information among customers who deciding to purchase insurance policy. Therefore, the company has to quote high price for all customers, thus only high accident probability's customers shall buy this policy while low risk customers shall not involved-in. Apply to basket traded, trading in an individual stock comprises of high and low informational trader and, normally, high informational trader gain more profit than lower one. Thus, whenever, a basket stock come to trade an uninformed trader tend to trade in this basket security because of more risk diversification. Consistent with this hypothesis, *Subrahmanyam A. (1991)* examine the choices of traders between dealing in a basket of underlying stocks and in a tracking security of those underlying. His main conclusion was that traders preferred to trade in a tracking security than in its underlying stocks, resulting in reducing liquidity in underlying stocks. This is because of the lower of adverse selection cost in the transaction cost of the tracking security, compared to those of the underlying stocks. The results consistent with the finding of *Subrahmanyam and Jegadeesh (1993)* that test for the change in bid-ask spread of S&P500 stocks and non-S&P 500 stocks after New York Stock Exchange (NYSE) traded S&P 500 index futures contract. They use three stages to perform the test, firstly, testing for the change in mean spread, secondly, regression analysis using panel data by testing the shift in spread after controlling for the effect of price level, trading volume and volatility variables, and lastly, examining the change of adverse selection. They found significantly higher of the bid-ask spread by 3.7% in the simple mean test and by 3% in the cross-sectional test, however, the change in adverse selection component is insignificant and not economically reasonable value.

III. MARKET BACKGROUND AND ETF IN THAILAND

This section provides information of trading environment and related rules and regulations in the Stock Exchange of Thailand (the SET) for better understanding of Thai stock market, especially, order quotes and matching procedure. Additionally, ETFs specification and creation and redeem process are provided for conceiving how arbitrage opportunity is possibility.

Trading in the Stock Exchange of Thailand

Thailand has only one stock market (the SET) and newly established derivatives market (the TFEX). Trading in SET is computerized order management and classified as a pure order driven market. Investors are categorized into four groups; local investor, local institution, foreign investor and brokerage, hence local investor is majority in term of trading volume participated around 60% of overall. Trading boards are used to separate different types of trade; (i) Main board, the most common board, is used for trade local security at minimum volume of a board lot or 100 shares, (ii) Foreign board is used for trade foreign security[2], (iii) Big lot board is used for support large negotiation trade[3] only, (iv) Odd lot board used to trade only trading volume less than one board lot. In normal trading period, orders can be matched by two approaches, first, Automatic Order Matching (AOM), orders are matched by under priority of price then time, most of the trades occurred in this method. Second, Put-through (PT) is used for the pre-negotiated deal. Trading session are divided into two major sessions; session I (during 10.00 – 12.30) and session II (during 14.30 – 16.30), however, there are pre-open periods for 30 minutes in each session and pre-close for 10 minutes after the end of session II. The orders can be sent during pre-open and pre-close periods without matching.

[2] The word local and foreign security are used because most of Thai companies' shares cannot be held by foreign shareholders at more than 50%, as desired by policy of companies. By the way, foreign investors are not prohibited to trade local shares unless the companies offer any rights, for example, voting rights, dividend or right offering, such that foreign investors shall not be reserved for them.

[3] Large trade means trading volume or value not less than 1 million shares or THB 3 million per trade.

During last 5 minutes of every pre-open and pre-close period, orders will be matched at the end of each period using auction criteria[4] to determined opening and closing price. On March 30, 2009, the SET has imposed new tick size rule by combining levels from totally 10 levels to become 8 levels, to be incorporate, the depth level has been shown more from 3 levels to 5 levels.

ETF in Thailand

Exchange-Traded Fund "ETF" is likely opened-end fund that can be easily traded in stock exchange. Normally, ETFs usually track the movement of indices, eventually, many financial institutions have induced ETFs that track a basket of their own selected stock.

In Thailand, ThaiDex SET50 Exchange Traded Fund or TDEX is the first ETF, which tracks the SET50 index, introduced by One Asset Management (One AM) and KGI Securities (Thailand) Plc. (KGI). The fund management follows the fully replicated approach, hold all of 50 stocks of SET50 index, and the tracking error is desired to be at 1%. TDEX has another two participants; market maker, performs by KGI, has to provide liquidity under wide spread concept, and Participant Dealers (PD) who are authorized brokers to buy and sell ETF's unit with One AM. The creation and redemption unit has been set at minimum of 2 million units of TDEX approximated of THB 8 million, thus only large investors or institution investors can be cooperated. The procedures of creation, starting from investors inform PDs to buy a pre-determined basket of stocks plus amount of cash or transfer this basket of stocks and cash to PDs. Thus, PDs will inform One AM of this creation, at the same time, deposit these stocks to clearing house and get new units of TDEX in return (see Figure II Panel A), while redemption process is vice versa (see Figure II Panel B). This process called 'in kind' which the return security can be sold right after the fund approved the creation or redemption

[4] Auction criteria defines opening and closing price by using the price that highest volume can be matched. In some cases, if more than one price are determined the auction price will be the price that closest to the prior traded price.

instruction, generally, within a day. Thus, arbitrage opportunity between TDEX and SET50 index occurred can be eliminated through this process.

[Figure II is here]

Another ETF is MTrack Energy ETF or ENGY, tracks the energy sector index, introduced by TMB asset management (TMBAM). The fund policy is also fully replicate. Phatra Securities Plc. plays the role of market maker and also participant dealer. By the way, the fund perform unsatisfied in term of size and return as the result of energy sector index dropped sharply, precisely, the unit of fund dropped from starting by 1 million units to 74 million units.

IV. DATA AND METHODOLOGY

Data description

As TDEX has the SET50 index as underlying asset, therefore the data will include only stocks that constitute in SET50 index throughout 130 days before and 130 days after TDEX launched or February 23, 2007 to March 14, 2008. Thus, there are 47 stocks left in sample. The period of study excludes 5 days before and 5 days after TDEX traded, therefore the pre-TDEX period is day -130 to day -5 and post-TDEX is day +5 to day +130. The reason of period selection are; (i) objective of the study is to observe long-term effect, (ii) longer period provides more reliability of data and, (iii) avoid massive impact of the listing period, for example, a few days before trade the TDEX's management fund has to buy those SET50 stocks to create units of TDEX.

Bid-ask spread, depth and trade frequency are observed from the order book that acquired by managing of *Order and Deal files* provided by the SET. The order book in this study means only the best bid and best ask level. Spread and depth are observed every 10 minutes in *Open session* only, starting from 10.10 to 12.30 for *Open session I* and 12.40 to 16.30 for *Open session II*, the basic rule of study only *Open session* is to avoid *"Pre-open (I, II) and Pre-close session"*[5]. Thus, 27 observations per day per stock will be observed. Some bid-ask spreads are ineligible as the matching process is occurring at the observation time which caused the negative or zero spread, so these spreads are treated as missing value, by the way, the number of these observations are insignificant. Then the 10-minute interval will be computed to daily average in order to incorporate with other daily trading activities, which are trading volume and trading value, that acquired from SETSMART.

The spreads are calculated by several followed methods;

Quoted spread = Best ask price – Best bid price

%Quoted spread = 100 * (Quoted spread / Midpoint price)

Effective spread = 2 * |Matched price - Midpoint price|

%Effective spread = 100 * (Effective spread / Midpoint price)

where Midpoint price = (Best bid price + Best ask price) / 2

Different spreads indicate different meanings and provide robustness check. Quoted spread is simply difference of seeable best-ask and best-bid price, but provides meaningless when comparing between different stock price ranges, as different price ranges have different regulated tick size. Therefore, percentage quoted spread is computed for feasible comparison as it is normalized by the price. Effective spread indicates actual trading cost that investor paid to buy or sell stock, again to be able to compare percentage effective spread is computed.

[5] As the Pre-open (I, II) and Pre-close session is the session of order flow without matching. Investor can submit order at any prices within price range, thus the bid price can be higher than the ask price or vice versa. At the end of each session, submitted orders will be matched under auction system.

For depth, it is computed as follow;

Quoted depth = (No. of share in best bid + No. of share in best bid) / 2

Depth value = [(No. of share in best bid * Best-bid price)

+ (No. of share in best-ask * Best-ask price)] / 2

The pattern of spreads and depth are showed in figure III. Percentage quoted and percentage effective spreads indicate higher difference from daily mean in the opening of each trading session and in the ending of the day, like U-shaped. While quoted depth shows negative related to spread as its pattern follows reverse U-shaped (lower in the opening of each session and in the ending of the day). Moreover, this pattern is corresponding to the change of trading activities, which follow U-shaped. This figure suggests that investors are most likely trade in the opening of each session and in the ending of the day that affect lesser in liquidity, the pattern found is consistent to the findings of *Lee et al. (1993)*.

[Figure III is here]

Methodology

Firstly, Univariate analysis is employed to measure the change in trading activities and liquidity measurements of the underlying stocks by comparing mean and median of pre- and post-TDEX . Trading activities are measured by daily trading volume, daily trading value and daily trade frequency while liquidity measurements are indicated by daily average spreads and daily average depths. The t-test and Wilcoxon rank sum test are used to test the null hypothesis that there are no difference in mean and median of pre- and post-TDEX traded on each measurement.

Next, the Multivariate cross-sectional regression is used to measure the change in bid-ask spread and depth after control other effects. Several previous literatures have established explanatory variables corresponding to the change in bid-ask spread and depth. One of the most importance factors that influence spread is depth and depth is also determined by spread. In *Pavabutr and Prangwattananon (2008)*'s paper shows that spread and depth are endogenous variables of each other and move together in the same direction. Meanwhile, the findings are contrary against *Harris (1994)*, who shows depth and spread are negatively related because depth can be proxy as trading activity like trading volume, hence higher depth accord with lower spread, while spread be a measure of asymmetric information, hence narrowed spread is correspond to thickly depth. Moreover, bid-ask spread is found as a binding constraint of tick size in paper of *Harris (1994), Pavabutr and Prangwattananon (2008), Boonvorachote et al. (2006)*. They study the effect of tick rule change on liquidity measurement and show that tick size is a strong binding constraint in positive related to spread because it is the lower bound for price quote. These papers also show that depth should positively correlate with market value of the firm.

Another set of variables are trading volume and volatility. These variables can be found in *Harris (1994), Pavabutr and Prangwattananon (2008), Boonvorachote et al. (2006), Chordia et al. (1999), Kumar et al. (1998), Hegde, and McDermott (2003)*, which show that a decreasing in spread coordinates with the increasing in trading volume but decreasing in volatility. Meanwhile, depth increases with an increasing in trading volume but a decreasing in volatility. The intuition behinds these relations are explained by *Jegadeesh and Subrahmanyam (1993)* that a higher of trading volume provides market makers more flexibility to offset inventory imbalance then they can provide a quoted at lower spread and higher depth, more precisely the liquid stock is most likely has narrowed bid-ask spread and greater volume quoted than illiquid stock. For return volatility, it is also be a measure of risk and degree of information asymmetry so the higher the risk, the higher the expected profit, hence spread should be widen while depth should be thinned.

Therefore, the Multivariate cross-section regressions are modeled as follow;

$$lnSpread_j = \beta_{S0} + \beta_{S1}lnDepth_j + \beta_{S2}lnRelTick_j + \beta_{S3}lnVolume_j + \beta_{S4}lnStdRet_j + \varepsilon_{Sj} \quad (1)$$

$$lnDepth_j = \beta_{D0} + \beta_{D1}lnSpread_j + \beta_{D2}lnMkCap_j + \beta_{D3}lnVolume_j + \beta_{D4}lnStdRet_j + \varepsilon_{Dj} \quad (2)$$

where $lnSpread_j$ is the natural log of daily average post- to pre- (%quoted and %effective) spread ratio of each stock

$lnDepth_j$ is the natural log of daily average post- to pre- depth (in number of share) ratio of each stock

$lnRelTick_j$ is the natural log of daily average post- to pre- relative tick size[6] ratio of each stock

$lnMkCap_j$ is the natural log of daily average pre-market capitalization of each stock

$lnVolume_j$ is the natural log of post- to pre- daily average trading volume ratio of each stock

$lnStdRet_j$ is the natural log of post- to pre- daily average return standard deviation ratio of each stock

Both models are estimated by using OLS and, because spread and depth are endogenous variables in each equation (1) and (2), the Two Stage Least Squares (2SLS) is employed to solve endogeneity problem that leads to biased OLS.

The intercept term in each equation is the answer of liquidity effect. If β_{S0} shows negative value, it means that, when other things being controlled, bid-ask spread declines after TDEX traded, suggested liquidity increase but by one dimension. Another dimension is depth, to be incorporate with increasing liquidity, the β_{D0} should indicates positive value, otherwise,

[6] Relative tick size = Tick size / Bid price.

hardly to point-out. For other coefficients, in order to consistent with previous literatures, the coefficient of trading volume in spread equation (1) should be negative while relative tick size and return standard deviation should provide positive value. In the depth equation (2) standard deviation should be negative while market capitalization and trading volume should gives positive value.

V. EMPIRICAL FINDINGS

In this section, the analyses of consequent of TDEX's introduction are reported. Univariate analysis shows the change in trading activities and liquidity measurements, then effect on bid-ask spread and depth after control variables are shown in Mutivariate equation, both OLS and 2SLS.

Univariate analysis

The change in trading activities and liquidity measurements are shown in table I. The average trade frequency and trading value are significant increase by 35.75% and 34.74% respectively. For instance, the mean of trade frequency of underlying stock increase from 567 transactions per day to 796 transactions per day. It seem to be incorporate with arbitrage hypothesis, as the both spread measures (%quoted and %effective spread) decline by around -0.60% and -4.60% for mean and median respectively but they are insignificant. In another dimension of liquidity, depth, it shows contrary results to the improving liquidity as the change of average depths are significantly decline for -20.77% for quoted volume and -17.91% for quoted value, the direction are also the same for median.

The outcomes of spreads and depths are unable to summarize the liquidity effect, by the way, this is the primary results, as there might be other effects influenced these results.

[Table I is here]

Multivariate regression

Primarily, the Pearson correlation metric is reported in table II. The results show that there is no perfect collinearity which leads to bias in OLS. Meanwhile, relative tick size shows significant highly correlation with depth at 0.4515, while, trading volume shows significant highly correlation with depth, market capitalization and standard deviation at 0.5037, 0.3445 and 0.4908 respectively. Thus, Multicollinearity has been checked by observing the TOL and VIF value and finds no Muticollinearity problem, by the way, it is not reported here.

[Table II is here]

The results of Multivariate regressions are shown in table III. First, the results in OLS and 2SLS are compared, thus, most of them show similarity, which means there are no significant bias in OLS estimators. In addition, there are no significant different between the results in percentage quoted and percentage effective spread. In percentage quoted spread and percentage effective spread equations, tick size shows significant positive relationship of 1.0641 and 1.0068 at 99% significant level, respectively as expected, consistent to several studies that find tick size is strong binding constraint of spread. Meanwhile, other independent variables show insignificant value. For the depth equations, coefficient of endogenous variables are consistent to *Pavabutr and Prangwattananon (2008)* literature as spreads come out with the significant positively relationship with depth. For instance, a 1% increased of %quoted spread (%Effective spread) leads to increase in depth of 1.0598% (1.0624%). The coefficient of trading volume and standard deviation of return are also significant and consistent to previous suggestions. To be precisely, when trading volume (standard deviation) increase by 1% the depth tend to increase (decrease) by 0.73% (0.60%). Meanwhile, market capitalization variables contradict to previous literatures, as they show negative value of around 0.06.

[Table III is here]

The effect of introduction of TDEX on liquidity of SET50 index stocks can be investigated at the intercept terms. The results seem increased liquidity as the value of β_{S0} are -0.0166 and -0.0050 or narrower in bid-ask spread coordinate with the positive value of β_{D0}, as imply increased of number of volume quote, which equal 1.4959 and 1.4073, however, all of them are insignificant. Consequently, it should not be concluded that the liquidity of SET50 stocks have affected from the introduction of TDEX.

VI. CONCLUSION

Most of derivative instruments have impact on asset they underlined. ETF is one of the new derivative products in Thai stock market, its effect is not only on liquidity as study, but also on price discovery, volatility and in other perspectives that need to be studied. The result might provide lucrative evidence, which help the associated regulators to improve related rules. In this study, even the results show insignificant increase of liquidity but it can be empirical prove that the introduction of ETFs do not hurt investors in the SET by increasing liquidity cost, but they enhance investment frontier to the Thai stock market.

For further research, first, a real-time observed of spread and depth should be used as it can provide superior observations than a discrete-time spread and depth. Second, spread decomposition should be analyzed as it can answer whether there is the change of adverse selection cost comprised in bid-ask spread or not. Last, adding a regression model that capture the change in trading activity could be interested to a wide market.

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Table I

Change in trading activity and liquidity measurement of SET50 index stocks following the introduction of TDEX

This table reports the change in mean and median of daily average trading activity measurements and liquidity measurement of underlying SET50 index' stocks, according to the introduction of TDEX. Panel A shows the window period of study of 125 days before and 125 days after TDEX traded, meanwhile, Panel B shows the window period of 45 days before and 45 days after event. The trade frequency and liquidity measurement are acquired from intraday data then convert to daily average, while trading volume and trading value are acquired from SETSMART as daily data. The calculation method of %quoted spread, %effective spread and depth are as follow; %Quoted spread = 100*[(Offer price - Bid price) / Midpoint price], %Effective spread = 100 * (Effective spread / Midpoint price), Depth = (Best bid volume + Best offer volume) / 2.

(N before = 5,875 and N after = 5,875)

	Mean				Median			
	Before	After	%change (After - Before)	t-test	Before	After	%change (After - Before)	Wilcoxon
Trading activity								
Trade frequency	586.53	796.23	35.75	-12.32***	332.00	412.00	24.10	11.0164***
Trading volume ('000)	7,710	7,454	-3.32	0.72	2,333	2,451	5.04	0.2788
Trading value ('000 THB)	190,000	256,000	34.74	-8.30***	68,949	62,393	-9.51	0.0639
Liquidity measurement								
%Quoted spread	0.7096	0.7056	-0.56	1.26	0.7185	0.6846	-4.72	-1.5530
%Effective spread	0.6936	0.6894	-0.61	1.33	0.7034	0.6716	-4.52	-1.3253
Depth	545,368	432,097	-20.77	6.83***	217,896	176,002	-19.23	-10.8828***
Depth ('000 THB)	20,100	16,500	-17.91	5.45***	5,513	4,137	-24.95	-8.9734***

***,** and * indicate significance at 1%, 5% and 10% level, in a two-tailed test.

t-test and Wilcoxon rank sum test used to test for the null hypothesis that there is no difference between before-event and after-event for mean and median respectively.

Table II

The Pearson correlation metric of independent variables

This table provides correlation metric among independent variables in equation (1) and (2).

$$\ln Spread_j = \beta_{S0} + \beta_{S1}\ln Depth_j + \beta_{S2}\ln RelTick_j + \beta_{S3}\ln Volume_j + \beta_{S4}\ln StdRet_j + \varepsilon_{Sj} \quad (1)$$

$$\ln Depth_j = \beta_{D0} + \beta_{D1}\ln Spread_j + \beta_{D2}\ln MkCap_j + \beta_{D3}\ln Volume_j + \beta_{D4}\ln StdRet_j + \varepsilon_{Dj} \quad (2)$$

	%Quoted spread	%Effective spread	Depth	RelTick	MkCap	Volume	Standard deviation
Relative tick size	0.9834***	0.9951***	0.4515***	1			
Market capitalization	-0.0839	-0.0937	-0.0388	-0.0909	1		
Trading volume	-0.0939	-0.0670	0.5037***	-0.0349	0.3445**	1	
Standard deviation	0.0005	0.0053	-0.0851	0.0253	0.2145	0.4908***	1

***,** and * indicate significance at 1%, 5% and 10% level, in a two-tailed test.

Table III
Multivariate regression using OLS and 2SLS on the change in liquidity measurements of SET50 index stocks following the introduction of TDEX

This table reports the Multivariate regression using OLS and 2SLS methods to analyze the change in %Quoted spread, %Effective spread and Quoted depth (in share) of the 47 stocks constituent in SET50 index when taking into account of TDEX. The dependent variables (%Quoted spread, %Effective spread and Quoted depth) are in form of natural log of daily average of post-TDEX to pre-TDEX ratio for the period of day -130 to day -5 as pre-TDEX and day +5 to day +130 as post-TDEX. While, independent variables are construct similarly using Endogenous variable (spreads or depth), relative tick size, trading volume (in share) and standard deviation of daily return.

	OLS				*2SLS*			
	%Quoted spread	**Depth**	**%Effective spread**	**Depth**	**%Quoted spread**	**Depth**	**%Effective spread**	**Depth**
Intercept	-0.0132 (-2.60)**	1.5255 (1.69)*	-0.0032 (-1.08)	1.4173 (1.64)	-0.0166 (-1.29)	1.4959 (1.65)	-0.0050 (-0.67)	1.4073 (1.63)
Endogenous variable	-0.0582 (-3.26)***	0.9362 (4.46)***	-0.0137 (-1.31)	1.0314 (5.08)***	-0.0765 (-1.15)	1.0598 (4.95)***	-0.0237 (-0.61)	1.0624 (5.20)***
Relative tick size	1.0445 (34.28)***		0.9960 (55.62)***		1.0641 (14.10)***		1.0068 (22.73)***	
Market capitalization		-0.0692 (-1.90)*		-0.0648 (-1.86)*		-0.0679 (-1.86)*		-0.0644 (-1.85)*
Trading volume	0.0133 (0.84)	0.7292 (7.30)***	-0.0026 (-0.28)	0.7174 (7.52)***	0.0253 (0.56)	0.7348 (7.32)***	0.0039 (0.15)	0.7182 (7.53)***
Standard deviation	-0.0331 (-1.66)	-0.6042 (-4.13)***	-0.0117 (-1.01)	-0.6021 (-4.31)***	-0.0445 (-1.00)	-0.6090 (-4.15)***	-0.0180 (-0.69)	-0.6032 (-4.32)***
Adjusted R-Square	0.9744	0.5849	0.9909	0.6209	0.9736	0.6002	0.9907	0.6249

t-statistics are reported in parenthesis, while, ***,** and * indicate significance at 1%, 5% and 10% level, in a two-tailed test.

Figure I

Number of TDEX units and proportional trading value between TDEX and SET50 stocks

This figure shows number of TDEX units (LHS) and trading value of TDEX divided by total trading value of SET50 stocks (RHS) during the period of September 6, 2007 to December 30, 2008. The figure shows that number of TDEX's units gradually growth from 178 million of units to 654 million of units. While, TDEX's trading value is quite stable at around 0.50% of the total trading value of SET50 stocks.

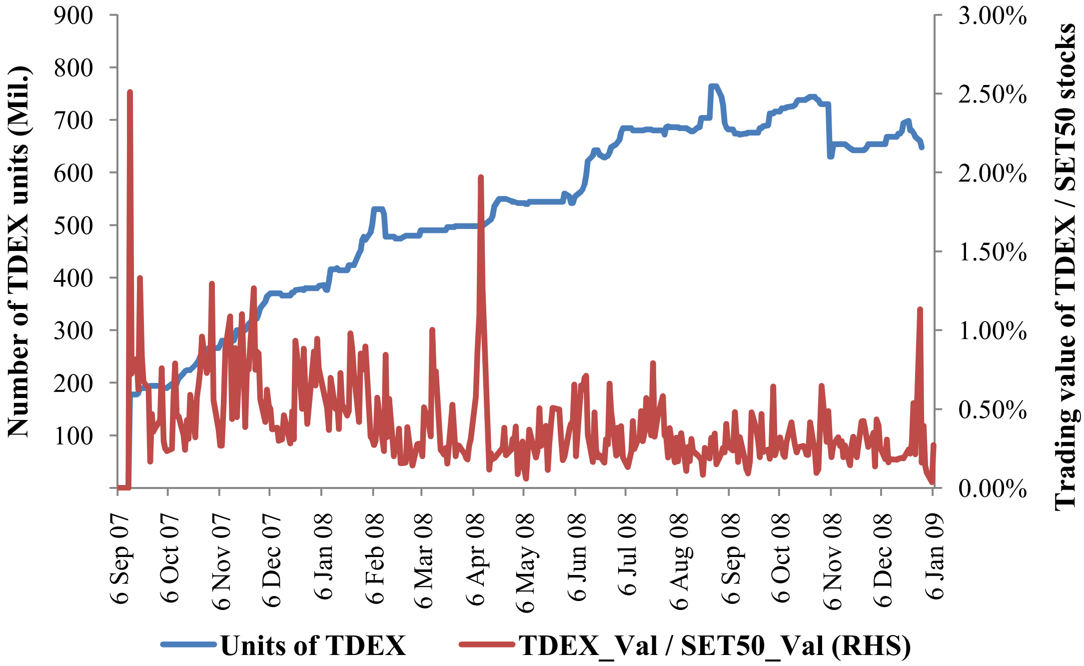
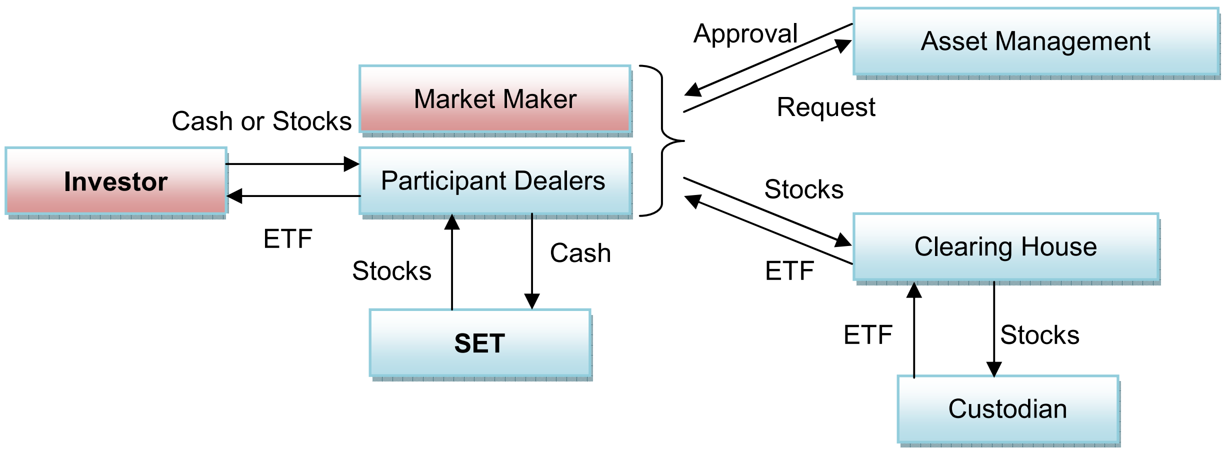


Figure II

The creation and redemption process of ETF

Panel A: **Creation process**

This figure shows ETF units can be created by two parties, investor or Market maker. The creation order initiated by investors sends to Participant Dealers (PDs) attached with either cash or basket of stocks. If cash, the PD has to primarily buy a pre-determined basket of stocks in the market. Thus, PDs will inform Asset management fund of this creation, then deposit these stocks to Clearing house and get new units of ETF in return. The process for Market maker is similar, the difference is only he can send creation order directly to the fund.



Panel B Redemption process

This figure shows Redemption process of ETF units, similarly, it can be redeemed by two parties, investor or Market maker. The redemption order initiated by investors sends ETF units to PD attached with choice of returned asset cash or basket of stocks. Thus, PDs will inform Asset management fund of this redemption, then, receive basket of stocks in return from Clearing house. If investor's choice is stocks then the process is over, but if the choice is cash, PD has to sell those given bunch of stocks through the market and receive money back sending to investor. The process for Market maker is similar, the difference is only he can send redemption order directly to the fund.

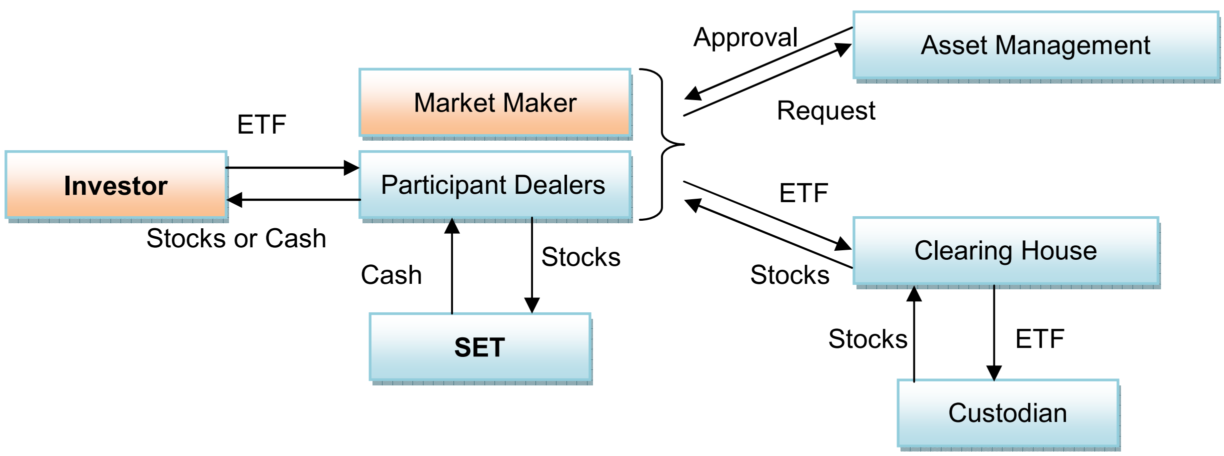


Figure III

The intraday pattern of bid-ask spreads and depth

This figure shows the percentage change of average %quoted spread, %effective spread and quoted depth in each observation time relative to the daily average. The spreads show pattern like U-shaped while quoted depth shows reverse U-shaped.