



## รายงานวิจัยฉบับสมบูรณ์

โครงการ ผลกระทบของประชาคมเศรษฐกิจอาเซียนต่อตลาดทุนไทย

The Effect of ASEAN Economic Community on the Thai Capital Market

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สนับสนุนโดยสำนักงานกองทุนสนับสนุนการวิจัย

(ความเห็นในรายงานนี้เป็นของผู้วิจัย สกว. ไม่จำเป็นต้องเห็นด้วยเสมอไป)

## Acknowledgements

กิตติกรรมประกาศ

The author wishes to thank Thailand Research Fund for financial support. The research has also benefited from comments from participants at workshop seminars at the Thailand Research Fund and Stock Exchange of Thailand. The author is grateful for wonderful research assistance from Chayapol Sirinonthak and Krittanut Chaithawiwat.

# **The Effect of ASEAN Economic Community on the Thai Capital Market**

## **Executive summary**

The ASEAN Economic Community (AEC) is the newest and largest integration effort attempted in the developing world. When realized, it creates an economic zone that allows free movement of capital among nearly 600 million people which currently produce \$US1800 Billion in GDP. The plan is set to proceed slowly and be implemented by 2015 (Petri, Plummer, and Zhai, 2011). The other two largest economic zones are the north American free trade zone (NAFTA) and the EU (European) union zone.

The goal of the AEC's integration encompasses aspects of traded good and services, human capital, and financial capital. While there is existing literature that investigates the economic side, little has been investigated on the effects on the capital market. This study aims at understanding the advantages and disadvantages in establishing the AEC from the capital markets' perspective. Conventional wisdom (Henry 2000) tells us liberalization is beneficial to the country opening up. However, this year in 2012, from the EU union we learned that there are both benefits and cost to establishing an economically and financially integrated zone. It is more complicated as we have recently learned from the European Union. For the AEC, we need to ask the question whether an integrated financial zone is beneficial. Even though there is no currency unification there is usually some expectation of coordination of currency exchange rate which takes away a little autonomous financial policy from participating countries. Research that provides a glimpse, prior to the event, at the possibility of the future which potentially help policy makers decision making and, more importantly, a follow up feedback to policy success after the event.

Specifically this research addresses the following questions: 1) What is the impact to the cost of equity (cost of doing business) to the Thai capital market? and 2) What is the impact to the liquidity in the Thai stock market and cost of trading to Thai investors?

To answer the first question, we analyze the choices between investing in ASEAN countries through mutual funds and investing directly. The countries participating are Singapore, Indonesia, Malaysia, Thailand, and Vietnam. Previously to this time the easiest way for investors in ASEAN countries to invest in ASEAN members' equity markets is to invest in foreign investment funds. Currently investors can invest more easily and inexpensively in individual stocks listed in each market through ASEAN Link. As a result, investors can diversify with more local choices directly. This study analyzes diversification benefits of directly choosing individual stock investments in the AEC rather than investment constraint in country funds as currently applies. Emerging market stock returns show skewness. Therefore we use portfolio optimization with skewness technique to analyze our data. It incorporates skewness in the optimization by employing the Polynomial Goal Programing ("PGP"). Our study finds that there is a parameter instability problem in correlation structure, unlike the previous papers which report the estimated results only once, the rolling window method is used to mitigate the problem and the actual returns are presented. We perform both in-sample and out of sample analysis using a rolling window of 5 years analyzing data of 10

years. Our results show that the ability to invest directly in individual stocks will benefit ASEAN investors from most countries. A numbers of cross-broader investment are expected. Stocks of Malaysian market are perceived as a good investment choice for Sharpe-ratio-concerning investors, while Stocks of Indonesian market are for Skewness-coefficient-concerning investors.

To answer the second question in a forward looking manner, we analyze the implementation of ASEAN Linkage and ASEAN STARS index which provides unique opportunity to study the effect of index inclusion on stocks that are not easily accessible prior to the effective inclusion. The aim is to investigate the index inclusion effect of ASEAN STARS index on stock liquidity. The research investigates both short term (2.5 months) and long term (one year) changes of stock liquidity up on index inclusion. A significant improvement of transaction cost during the two months period following index inclusion was observed. Tests of other long term liquidity changes found significant improvement in price impact (illiquidity decreased by 17.43 percent), volume (increased by 29.89 percent), and free float adjusted turnover (increased by 6.82 percent) during one year period after index inclusion and ASEAN Linkage implementation.

In sum, the financial integration of the AEC, at first glance, that is using the data before the integration, supports benefits to many countries. AEC financial liberalization affords investors in many countries to better diversify their portfolios. Using current data also suggest that financial integration would lower cost of trading and increase liquidity. The challenge, however, lies in investigating if ex-ante methods can predict and anticipate actually happens due to policy and how policy adjusts to emerging situations.

**Keywords :** Financial integration; International Finance; General Financial Markets; Emerging markets; Portfolio diversification, liquidity in emerging markets

## ผลกระทบของผลกระทบของประชาคมเศรษฐกิจอาเซียนต่อตลาดทุนไทย

### บทคัดย่อ

การรวมกลุ่มประชาคมเศรษฐกิจอาเซียน (AEC) เป็นการรวมตัวทางเศรษฐกิจล่าสุดที่เกิดขึ้นในกลุ่มประเทศอาเซียน เพื่อให้เกิดผลประโยชน์จากการค้าและการลงทุนเสรีระหว่างกัน จากการคาดการณ์ของ Petri, Plummer, and Zhai, (2011) การรวมกลุ่มทางเศรษฐกิจดังกล่าวคาดว่าจะทำให้ผลผลิตมวลรวมรวมของกลุ่มสูงถึง 1,800 พันล้านดอลลาร์สหรัฐและสร้างตลาดผู้บริโภคและแรงงาน 600 ล้านคน ซึ่งย่อมทำให้กลุ่มสมาชิก AEC เพิ่มอำนาจการต่อรองกับกลุ่มประชาคมความตกลงการค้าเสรีอเมริกาเหนือ (NAFTA) และ สหภาพยุโรป (EU)

ปัจจุบันการศึกษาเกี่ยวกับ AEC นั้นเน้นหนักด้านผลกระทบด้านเศรษฐกิจแต่การศึกษาด้านผลกระทบต่อตลาดทุนนั้นมีจำกัดทั้งที่วัตถุประสงค์ของ AEC มีทั้งด้านการค้า การเคลื่อนไหวของแรงงาน และเงินทุนที่เสรีระหว่างกัน ในด้านการเปิดเสรีด้านเงินการลงทุนนั้น ส่วนหนึ่งของแผนงาน คือ การเชื่อมโยงการลงทุนในตลาดหลักทรัพย์ของประเทศสมาชิกเข้าด้วยกัน หรือที่เรียกว่า “ASEAN Linkage” ที่จะทำให้การระดมทุนและการลงทุนแบบข้ามชาติในภูมิภาคทำได้ง่ายขึ้น งานวิจัยของ Henry (2000) ได้แสดงผลเชิงประจักษ์ของประโยชน์จากการเปิดตลาดทุนให้นักลงทุนต่างชาติเข้าร่วมลงทุนอันมีผลให้ค่าของทุนของบริษัทจดทะเบียนต่ำลงจากการเพิ่มขึ้นของระดับราคา อย่างไรก็ตามเหตุการณ์ในสหภาพยุโรปในปัจจุบันได้แสดงให้เห็นถึงปัญหาที่อาจเกิดขึ้นจากการผนวกรวมตลาดเงินตลาดทุนและอัตราแลกเปลี่ยน แม้ว่า AEC มิได้มีวัตถุประสงค์ที่จะใช้เงินสกุลร่วมกันดังกลุ่มสหภาพยุโรปแต่การรวมตัวทางเศรษฐกิจและเปิดเสรีด้านการค้าและเงินทุนมักต้องอาศัยการกำหนดนโยบายอัตราแลกเปลี่ยนที่สอดคล้องกัน ซึ่งจะนำไปสู่ความสูญเสียเสรีภาพในการกำหนดนโยบายการเงินระดับประเทศไปบางส่วน งานวิจัยนี้มีวัตถุประสงค์เพื่อ ศึกษาผลกระทบของ การเชื่อมโยงการลงทุนในตลาดทุนที่มีต่อ 1) ค่าของทุนของส่วนผู้ถือหุ้นของบริษัท และ 2) สภาพคล่องและต้นทุนการลงทุนในหลักทรัพย์จดทะเบียน

ในประเด็นแรกผู้วิจัยศึกษาผลของการเชื่อมโยงการลงทุนในตลาดหลักทรัพย์ของประเทศสมาชิกที่ทำให้การลงทุนในกลุ่มประเทศสมาชิกสามารถกระจายความเสี่ยงในการลงทุนโดยตรงในหลักทรัพย์ในตลาดกลุ่มประเทศ AEC แทนการลงทุนโดยอ้อมผ่านกองทุนเป็นประโยชน์ต่อนักลงทุนใน AEC เนื่องจากตลาดหลักทรัพย์ใน AEC มีลักษณะผลตอบแทนที่มีความเบ้ (skewness) ในอัตราผลตอบแทนค่อนข้างสูง งานวิจัยนี้จึงได้นำวิธีการนำ Polynomial Goal Programing (“PGP”) มาใช้ในการเลือกน้ำหนักการลงทุนในตลาดหลักทรัพย์ AEC ต่างๆ ที่ทำให้

ระดับผลตอบแทนที่ปรับความเสี่ยงสูงสุด สำหรับนักลงทุนที่คำนึงถึงความเสี่ยงจากค่าเบี่ยงเบนมาตรฐานและในขณะเดียวกันต้องการเพิ่มผลตอบแทนจากการกระจายแบบเบี่ยงเบนของอัตราผลตอบแทน การศึกษาที่ทดสอบผลที่ได้ทั้งในกลุ่มตัวอย่าง และนอกกลุ่มตัวอย่างจากข้อมูลอนุกรมเวลาราคาหลักทรัพย์ 10 ปี นอกจากนี้ผู้วิจัยยังพบว่าตลาดหลักทรัพย์มาเลเซียมีความโดดเด่นในการสร้างอัตราส่วนผลตอบแทนต่อความเสี่ยง (ค่าเบี่ยงเบนมาตรฐาน) Sharpe ratio มากที่สุด ในขณะที่ตลาดหลักทรัพย์อินโดนีเซียมีความโดดเด่นในการสร้างความอัตราผลตอบแทนจากความเบี่ยงเบนสำหรับนักลงทุนมากที่สุด โดยสรุปผลของการที่นักลงทุนใน AEC สามารถ สร้างกลุ่มหลักทรัพย์ลงทุนที่มีประสิทธิภาพสูงขึ้นน่าจะนำไปสู่การเพิ่มของระดับราคาหลักทรัพย์ในตลาดกลุ่มสมาชิกและลดค่าของทุนของบริษัทจดทะเบียนในที่สุด

ในประเด็นที่สองผู้วิจัยศึกษาผลกระทบทางสภาพคล่องในการซื้อขายหลักทรัพย์ในระยะสั้น (2.5 เดือน) และ ระยะยาว (1 ปี) หลังการประกาศรวมหลักทรัพย์ในดัชนี ASEAN Stars ที่ประกอบด้วยหุ้นที่มีขนาดใหญ่โดยพิจารณาจากมูลค่าของหลักทรัพย์ตามราคาตลาดและสภาพคล่องของหลักทรัพย์จำนวน 30 หลักทรัพย์ต่อประเทศใน AEC รวม 180 หลักทรัพย์ งานวิจัยพบว่าสภาพคล่องที่วัดโดยมาตรวัดต่างๆ เพิ่มขึ้นอย่างมีนัยสำคัญ ซึ่งการเพิ่มขึ้นของสภาพคล่องต่างๆ เป็นตัวบ่งชี้การลดลงของต้นทุนในการทำธุรกรรมซื้อขายหลักทรัพย์

โดยสรุปงานวิจัยชิ้นนี้ได้แสดงให้เห็นว่าการเชื่อมโยงการลงทุนในตลาดหลักทรัพย์ของประเทศสมาชิกทำให้นักลงทุนในกลุ่มประเทศสมาชิกสามารถกระจายการลงทุนได้อย่างมีประสิทธิภาพมากกว่า และยังเป็นการเพิ่มสภาพคล่องและลดต้นทุนในการทำธุรกรรมซื้อขายหลักทรัพย์ อย่างไรก็ตามการศึกษานี้ควรจะมีการติดตามอย่างต่อเนื่องเพื่อพิจารณาการตอบสนองของตลาดที่อาจแปรผันตามนโยบายและสถานการณ์ในตลาดเงินตลาดทุนที่มีการปรับเปลี่ยนอยู่ตลอดเวลา

## **Part I Does AEC help diversification among ASEAN stock market?**

### **Portfolio optimization with skewness**

#### **Abstract**

In the end of 2015 the ASEAN equity market liberalization went into effect. The countries participating are Singapore, Indonesia, Malaysia, Thailand, and Vietnam. Previously to this time the easiest way for investors in ASEAN countries to invest in ASEAN members' equity markets is to invest in foreign investment funds. Currently investors can invest more easily and inexpensively in individual stocks listed in each market through ASEAN Link. As a result, investors can diversify with more local choices directly. This study analyzes diversification benefits of directly choosing individual stock investments in the AEC rather than investment constraint in country funds as currently applies. Emerging market stock returns show skewness. Therefore we use portfolio optimization with skewness technique to analyze our data. It incorporates skewness in the optimization by employing the Polynomial Goal Programming ("PGP"). We distinguish investors who have utility functions of only mean-variance and mean-variance-skewness. Skewness matters significantly for selection of ASEAN stocks. Our study finds that there is a parameter instability problem in correlation structure, unlike the previous papers which report the estimated results only once, the rolling window method is used to mitigate the problem and the actual returns are presented. We perform both in-sample and out of sample analysis using a rolling window of 5 years analyzing data of 10 years. Our results show that the ability to invest directly in individual stocks will benefit ASEAN investors. A numbers of cross-broader investment are expected. Stocks of Malaysian market are perceived as a good investment choice for Sharpe-ratio-concerning investors, while Stocks of Indonesian market are for Skewness-coefficient-concerning investors.

JEL classification F36; F3; G1

Keywords: ASEAN financial integration; International Finance; General Financial Markets; Emerging markets; Portfolio diversification



## I. INTRODUCTION

At present, the easiest way for investors in ASEAN countries to invest in ASEAN members' equity markets is to invest in foreign investment funds. These funds often set an investment policy to track benchmark indices which normally are market indices. Then, looking at diversification perspective, the available investment choices for investors are limited. However, due to the coming ASEAN equity market liberalization in 2015, investors can invest more easily and inexpensively in individual stocks listed in each market through ASEAN Link. As a result, investors have more diversifying investment choices. Therefore, this paper, based on diversification perspective, attempts to study and illustrate the difference of investment allocation when (1) investors in each ASEAN members can only invest in country index funds and (2) when investing in individual stocks in ASEAN is possible.

To complete the objective, this paper is going to do the optimization on two sets of securities. The first set represents the case that investors can invest in their own country individual securities and invest in other country index funds. This consists of top-rank individual stocks of a country, ASEAN equity market indices and other-region country indices. The second set represents the case when investing in individual ASEAN stocks is possible. It consists of ASEAN top-rank individual stocks and other-region country indices. For instance, looking from Thai investors' perspective, the first portfolio is a set of Thai top-rank individual stocks with MSCI of Indonesia, Malaysia, Philippines and Singapore (Vietnam is excluded due to a limitation of information) and MSCI of other-region. The second is a set of the top-rank individual stocks from Thai market, the top-rank individual stocks from Indonesia, Malaysia, Philippines and Singapore, and MSCI of other-region. We perform the same analysis for other ASEAN countries. In this paper, MSCI indices are used as country indices to represent the country index funds. Finally, the results of the optimizations are compared (the portfolio formed from the first set is called "Before Portfolio" and another is called "After Portfolio").

ASEAN countries in this study are Indonesia, Malaysia, Philippines, Singapore, and Thailand which are the first countries joining the ASEAN Link. Vietnam is excluded due to a limitation of information. For other-region MSCI indices, only the ones which are available in USD are chosen.

After obtaining the time series of return, it is found that the returns of most assets are skew and not normal distributed. Therefore, optimization which considers only mean and

variance in

the work of Markowitz (1952) is not appropriated. His framework argues that investors are interested in the portfolio with the maximum expected return, given a certain level of risk representing by variance. Then, one assumption underlying Markowitz's work is that the asset returns have the normal distribution pattern. However, in this case, this assumption is not true.

The finding of skew and non-normal distribution is consistent with many previous studies. Fama (1965), Arditti and Levy (1971) and Simkowitz and Beedles (1987) indicate that the return of individual stocks are not normally distributed. Haque (2004) shows that the distributions of country MSCI indices are skew and not normal, especially in emerging markets.

Another assumption under Markowitz (1952) is that the investor's utility function is quadratic trading off between only marginal return and risk. However, there are many studies which indicate that skewness is important for investors' decision and it cannot be ignored. Arditti (1967, 1971), Jean (1971, 1973), and Levy and Sarnat (1972) demonstrate that one of the important factors explaining security and portfolio returns is skewness. Samuelson (1970) illustrates that

the higher moment is relevant to the investor's decision on portfolio selection. Other than that, Hanoch and Levy (1970) and Levy and Sarnat (1972) point out that there is some serious drawback to assuming investors' utility function are quadratic function. More recently, some researchers demonstrate the relationship between the portfolios expected return and higher moments. Harvey and Siddique (1999, 2000) show that, in the presence of high positive skewness, investors may be willing to accept a negative expected return due to the higher probability to obtain the profit in

an investors' perspective. Fang and Lai (1997) show evidence that investors forego the expected excess return for taking the benefit of increasing the systematic skewness. Also, investors would prefer high (low) values of odd (even) moments.

Consequently, instead of using Markowitz (1952)'s mean-variance optimization, this paper incorporate skewness in the optimization by employing the Polynomial Goal Programing (PGP) applied by many previous studies, i.e., Lai (1991), Chunhachinda et al. (1997), Prakash et al. (2003), and Sun and Yan (2003). This method allows us to add skewness maximization into the optimization objective, along with the expected return maximization. When expected return and skewness are simultaneously taken into account, there will be two objective functions to be optimized which cannot be satisfied by a single solution. However, PGP link those two objectives

into one new minimization objective by introducing investors' preference function into the process. More detail is discussed in the methodology section.

This paper has three main contributions; (1) this paper provides a good picture of ASEAN cross-equity-market investment after the liberalization in the near future which now is the interesting event, (2) the optimization with skewness has not been used to test ASEAN return data which obviously is skewed, and (3) the ex-ante portfolios are formed on monthly-rolling basis and their results are compared with ex-post returns, unlike previous studies which report only ex-ante estimates.

The related literatures are reviewed in Section 2. Theoretical framework, methodology, and data used in this study are explained in Section 3, 4, and 5. Section 6 describes how the stocks are screened for optimization. Section 7 and 8 are the results of normality and parameter stability tests. Section 9 is the comparison of result between two data sets. Finally, Section 10 is the conclusion.

## **II. LITERATURE REVIEW**

### *Skewness in the asset return and investor's preference to higher moments*

Harvey and Siddique (1999, 2000) illustrate that single factor asset pricing model, whose systematic risk measured by the covariance (or the beta) with the market, does not satisfactorily explain the cross-sectional variation of expected excess return. They then incorporate the coskewness in the cross-sectional test and find that the explanatory power of the variation increases. They intuitively interpret that if investors know that the asset returns have conditional coskewness at time  $t$ , expected returns are partially attributed to coskewness.

Harvey et al. (2003) construct the port of four assets and provide the difference of possible space portfolio when skewness is taken and not taken into account. Moreover, they show that the optimal portfolio is pushed up further along the efficient frontier. This means that for the same level of risk aversion, an investor can get a higher return if they consider skewness in the decision process, especially positive skewness.

Fang and Lai (1997) show that investors forego the expected excess return for taking the benefit of increasing the systematic skewness. Also, investors would prefer high (low) values of odd (even) moments because the high (low) value of an odd moment can be interpreted as

an increasing (decreasing) in the gain (loss) side probability. Conversely, even moments are taken as measures of volatility (risk) of the returns which investors do not prefer. As a result, we can conclude that investors' decision on portfolio selection is subject to their preference on both expected return and skewness.

#### *Optimization with skewness*

Lai (1991) and Chunhachinda et. al. (1997) illustrates the difference of weight investing in 14 indices of developed market when investors have different preference to expected return and skewness. The mean-variance portfolio produces highest expected return, while the skewness values of the mean-variance-skewness portfolio are higher than those from the mean-variance portfolio. This evidence implies that an investor will make a decision in such a way that maximizes their utility by trading off between maximizing expected return or maximizing skewness.

Sun and Yan (2003) and Canela and Collazo (2007) extend the method of Lai (1991) to test on the 46 industry indices which present a clear non-normal distribution pattern. The extension of these papers is the change of detail of the PGP. Unlike work of Lai (1991), these papers make some modifications to the objective function and deviational variables. The maximization objective functions are changed to be Sharp Ratio and Coefficient of Skewness (the formulas are shown in the methodology section). They also normalize the deviational variables by the value of objectives that can be achieved when optimizing them separately. They adjust the problem of PGP in order to take into account the different magnitudes of the mean and skewness and avoid the problem when deviational variables are less than one. The results are consistent with previous studies.

The weights are different in each combination of investor's preference.

### **III. THEORETICAL FRAMEWORK**

This section outlines the assumptions of the portfolio selection theory used in the analysis. All of these assumptions are generally accepted and justified in many previous literatures. Following Lai (1991), as mentioned in Chunhachinda et al. (1997), the following assumptions are necessarily under the portfolio selection theory:

1. Investors are risk-averse individuals who maximize the expected utility of their end-of-period wealth.

2. There are  $n+1$  asset and the  $(n+1)^{\text{th}}$  asset is the risk free asset.
3. All assets are marketable, perfectly divisible and have limited liability.
4. The borrowing and lending rates are equal to the rate of return  $r$  on the risk-free asset.
5. The capital market is perfect. There are no taxes and transaction costs.

In addition, to incorporate the moment higher than second, this paper assumes that only skewness is behaviorally justified, and let<sup>1</sup>

- $w_i$  = the weight investing in the  $i^{\text{th}}$  risky asset in the portfolio, for  $i=1, \dots, n$ ,
- $r_i$  = the excess rate of return of asset  $i^{\text{th}}$ , for  $i = 1, \dots, n$ ,
- $\mathbf{w} = (w_1, w_2, \dots, w_n)$  be the vector of the weights,
- $\mathbf{r} = (r_1, r_2, \dots, r_n)$  be the vector of the excess returns,
- $\boldsymbol{\mu}$  = the vector of means of the excess returns,
- $\mathbf{V}$  = the variance-covariance matrix,
- $\mathbf{I}$  = the identity matrix,
- $E$  = the expectation operator, and
- $T$  = the transpose operator.

Then, the mean, the variance and the skewness of the portfolio returns can be defined as:

$$\text{Mean} = \mathbf{w}^T \boldsymbol{\mu},$$

$$\text{Variance} = \mathbf{w}^T \mathbf{V} \mathbf{w},$$

$$\text{Skewness} = E[\mathbf{w}^T (\mathbf{r} - \boldsymbol{\mu})]^3,$$

#### IV. METHODOLOGY

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<sup>1</sup> Kraus and Litzenberger (1976) argue that any moment beyond the third are not behaviorally justified

This section describes the methodology we choose to optimize the portfolios. The original and most recent works on optimization with skewness are by Lai (1991) and Canela and Collazo (2007), respectively. They both have different ways of reducing the multi-optimization problem to a more manageable optimization problem. For our analysis we use the work proposed in Canela and Collazo (2007) for our optimization.

When we introduce the skewness in the optimization, the optimal solution is to select a portfolio component  $\mathbf{w}$  such that the expected portfolio's rate of return and skewness are maximized, while the expected portfolio's variance is minimized. Then, the portfolio selection can be formulated by solving the following multiple objective problems:

$$\begin{aligned}
&\text{Maximize} && O_1(\mathbf{w}): \mathbf{w}^T \boldsymbol{\mu}, \\
&\text{Minimize} && O_2(\mathbf{w}): \mathbf{w}^T \mathbf{V} \mathbf{w}, \\
&\text{Maximize} && O_3(\mathbf{w}): E[\mathbf{w}^T (\mathbf{r} - \boldsymbol{\mu})]^3, \\
&\text{subject to} && : \mathbf{w}^T \mathbf{I} = 1.
\end{aligned}$$

Canela and Collazo (2007) alternatively suggest dividing the first ( $O_1(\mathbf{w})$ ) and the third ( $O_3(\mathbf{w})$ ) objectives by the second objective ( $O_2(\mathbf{w})$ ). Consequently, we get the new two objectives; Sharp Ratio ( $\widetilde{O}_1(\mathbf{w})$ ) and Skewness Coefficient ( $\widetilde{O}_3(\mathbf{w})$ ). The problem is stated as follow:

$$\begin{aligned}
\text{(P1)} \quad &\left\{ \begin{array}{ll} \text{Maximize} & \widetilde{O}_1(\mathbf{w}): O_1(\mathbf{w}) * O_2(\mathbf{w})^{-\frac{1}{2}} = (\mathbf{w}^T \boldsymbol{\mu}) * (\mathbf{w}^T \mathbf{V} \mathbf{w})^{-\frac{1}{2}}, \\ \text{Maximize} & \widetilde{O}_3(\mathbf{w}): O_3(\mathbf{w}) * O_2(\mathbf{w})^{-\frac{3}{2}} = (E[\mathbf{w}^T (\mathbf{r} - \boldsymbol{\mu})]^3) * (\mathbf{w}^T \mathbf{V} \mathbf{w})^{-\frac{3}{2}}, \\ \text{subject to} & : \mathbf{w}^T \mathbf{I} = 1 \end{array} \right.
\end{aligned}$$

Normally, there is no single solution that simultaneously satisfies various objectives. Therefore, investor's preferences to objectives are introduced (or the marginal rate of substitution between the objectives) into the construction of PGP problem. Here, there are two more steps added prior to a solving of investment portion in each asset. First, before taking the investor's preferences into account, objective  $\widetilde{O}_1(\mathbf{w})$  and  $\widetilde{O}_3(\mathbf{w})$  are solved for maximum value ( $\widetilde{O}_1^*(\mathbf{w})$  and  $\widetilde{O}_3^*(\mathbf{w})$ ) separately. Then, the investor's preferences ( $p_1$  and  $p_3$ ) are incorporated

in

the programing in order to allow the objectives' achievement.

In PGP, the objective function contains deviational variables, but not choice variables. These deviational variables represent deviations between goals ( $\widetilde{O}_1^*(w)$  and  $\widetilde{O}_3^*(w)$ ) and what can be achieved ( $\widetilde{O}_1(w)$  and  $\widetilde{O}_3(w)$ ) under some set of constrains. Therefore, the objective function causes deviational variables to determine the values of choice variables. As a result, the objective of PGP ( $O(w)$ ) is to minimize the sum of the deviational variables which can be different when

the investor's preferences are changed. Noticeably, if the goals are at the same priority level, the relative amount of deviational variables from the goals is always positive.

As mentioned above that in order to take into account the different magnitudes of the mean and skewness, unlike Lai (1991), Canela and Collazo (2007) normalize the deviational variables ( $\widetilde{O}_1^* - \widetilde{O}_1(w)$  and  $\widetilde{O}_3^* - \widetilde{O}_3(w)$ ) by the maximum values ( $\widetilde{O}_1^*(w)$  and  $\widetilde{O}_3^*(w)$ ). Moreover, to avoid the problem when the deviational variables are less than one, they use the problem as follow:

$$(P2) \left\{ \begin{array}{ll} \text{Minimize} & O(w): (1 + d_1(w))^{p_1} + (1 + d_3(w))^{p_3}, \\ \text{subject to} & : d_1(w) = (\widetilde{O}_1^*(w) - \widetilde{O}_1(w)) / \widetilde{O}_1^*(w) \\ & : d_3(w) = (\widetilde{O}_3^*(w) - \widetilde{O}_3(w)) / \widetilde{O}_3^*(w) \\ & : \mathbf{w}^T \mathbf{I} = 1 \end{array} \right.$$

where

- $O_i^*$  = the maximum values of objective  $O_i$ , when they are optimized separately,
- $d_i$  = non-negative normalized deviational variables, representing the deviations of  $O_i$  from  $O_i^*$ ,
- $p_i$  = non-negative investor's preference parameters, representing degree of preference between objectives. If  $p_3 > p_1$ , investors prefer skewness to expected return. If  $p_1 = 1$  and  $p_3 = 0$ , a result is the same as Markowitz (1952)

From the problem P2, the solution of various combination of preference  $p_i$  can be aggregated to create the efficient frontier of each investor. Jean (1973) illustrates that, even investors have homogeneous expectations about the asset returns' distribution, they will select different set of risky assets.

This paper will employ the modified PGP proposed by Canela and Collazo (2007) shown in P1 and P2 due to its advantages. Modification in P1 eliminates the weight rescaling process, so it is easier to implement. Additionally, normalizing the deviational variables by  $\tilde{\sigma}_1^*$  and changing minimization objective from  $\tilde{d}_i(w)$  to  $1 + \tilde{d}_i(w)$  in P2 can solve the problem when there is large difference in magnitudes of the mean and skewness and when  $\tilde{d}_i(w)$  are less than one, respectively.

## V. DATA

As the purpose of this paper is to illustrate the possible difference of investment allocation before and after ASEAN market liberalization in 2015, two difference situations are assumed; (1) investors in each ASEAN members can only invest in country index funds and (2) investing in individual stocks is possible (through ASEAN Link) with easier mechanism and cheaper cost. Then, this paper is going to do the optimization on two sets of portfolio.<sup>2</sup> The first portfolio consists of 30 individual stocks, obtained from screening process, of a particular ASEAN market, other ASEAN MSCI indices and other-region MSCI indices. The second portfolio consists of the 30 individual stocks of a particular ASEAN market, the 30 individual stocks from other 4 ASEAN markets, and other-region MSCI indices. For instance, looking from Thai investors' perspective, the first portfolio is a set of Thai 30 individual stocks with MSCI of Indonesia, Malaysia, Philippines and Singapore (Vietnam is excluded due to a limitation of information) and MSCI of other-region. The second is a set of the 30 individual stocks from Thai market, the 30 individual stocks from Indonesia, Malaysia, Philippines and Singapore, and MSCI of other-region. Then, obtained from DataStream, the involved data in this study are

- Total Stock Return Index, including return from dividend, of individual stocks of ASEAN countries; Indonesia (ID), Malaysia (MY), Philippines (PH), Singapore (SG), and Thailand (TH),

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<sup>2</sup> See detail of ASEAN Link's mechanism in appendix I



- **MSCIs of ASEAN countries and countries out of this region**, consisting of only 39 MSCIs available in US Dollars term are used; Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Hong Kong, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, and, USA.
- **T-bill Yield** of each ASEAN countries, representing risk-free asset return using for excess return calculation, and
- **Exchange rate of each ASEAN countries against US Dollars**, using to convert returns to local currency of a particular investor (as some exchange rate of pairs of countries quoted against each other are not available, the cross currency calculation is applied using those exchange rate quoted against US Dollars).

These data in monthly basis, covering the period from January 2003 through December 2013, are obtained (some needed data are not available before January 2003). Therefore, the complete data set of each asset cover 132 observations.

## **VI. STOCK SELECTION CRITERIA**

As there are more than 500 individual stocks in each market, stock screening process is performed with 3 criteria, which are

1. Data Available: If a stock has limited data, it is eliminated from the study because the reliable parameters cannot be obtained.
2. Market Capitalization: In portfolio selection framework, statistical stability is very important. Considering only stocks having high market capitalization prevent us from picking small stocks

being under a speculating pressure. Prices of those stocks are very volatile; the estimated parameters are not reliable.

3. Liquidity: A stock might not be liquidated at a desire price when that stock has low liquidity, especially when the amount of liquidation is high at a time. Therefore, investors are concerned about liquidity of stocks when they form a portfolio. This paper employs the illiquidity ratio in the work of Amihud (2002).

$$ILLIQ_{iy} = \frac{1}{D_{iy}} \sum_{t=1}^{D_{iy}} |R_{iyd}| / VOLD_{iyd}$$

where

- $D_{iy}$  = the number of days for which data are available for stock  $i$  in year  $y$ .
- $R_{iyd}$  = the return on stock  $i$  on day  $d$  of year  $y$
- $VOLD_{iyd}$  = the respective daily volume in dollars.

There are many measurements testing the liquidity/illiquidity of stocks. For standard-size transaction, the bid-ask spread is used as a measure of price impact resulting from order flow, whereas larger excess demand induces a greater price impact on prices.<sup>3</sup> Additionally, the quoted bid-ask spreads on stock returns<sup>4</sup>, the quotes and subsequent transactions<sup>5</sup>, and the price response to signed order flow (order size)<sup>6</sup> are used to examine the cross-section effect of illiquidity in expected stock returns. However, all of these measurements require a calculation of microstructure data on transactions and quotes which are not available and requires a lot of efforts to perform. Unlike those measurements, illiquidity ratio by Amihud (2002), while it is coarser and less accurate, is readily to implement.

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<sup>3</sup> See Kraus and Stoll (1972), and Keim and Madhavan (1996)

<sup>4</sup> See Amihud and Mendelson (1986)

<sup>5</sup> See Chalmers and Kadlec (1998)

<sup>6</sup> See Brennan and Subrahmanyam (1996)

The screening process involves 3 steps; (1) remove all stocks which have past data less than 72 month (2) rank all stocks by their market capitalization and select 50 highest ones, and, then, (3) calculate illiquidity ratio of each, and select only 30 stocks, which have lowest ratio, for optimization. This process is done at the ending of each year, starting from 2008 to 2012, in order to pick the stocks for optimization in 2009 through 2013 (the details of rolling optimization are discussed in section 9).

There are 205 stocks left from the screening process; 43 from Indonesia, 42 from Malaysia, 41 from Philippines, 36 from Singapore, and 43 from Thailand. These stocks are at least once included in the optimization.<sup>7</sup>

To check whether this process is robust enough to pick proper stocks for investment, the obtained lists of stocks (only the lists of 2013 as it is the most recent period) are compared with the lists of top 30 ASEAN Stars<sup>8</sup> (as of December 2013), screened by ASEAN Exchange. The comparison illustrates that our criteria are comparable as the ASEAN Exchange standard. The number of stocks overlapping from our list and ASEAN 30 starts are 24, 21, 25, 25, and 24 from the list of Indonesia, Malaysia, Philippines, Singapore, and Thailand, respectively.

## **VII. TESTING FOR NORMALITY OF RETURN DISTRIBUTIONS**

To confirm the need to use skewness in the optimization, we test for non-normality of the returns of our data sample. The Shapiro–Wilk test and Shapiro–Francia test are chosen in this paper as a methodology for Platykurtic sample and Leptokurtic sample, respectively. However, the rejection of normality can occur when either the distribution is asymmatric or non-mesokurtic. Then, the skewness and kurtosis test (D’Agostino et. al. (1990)) are performed to identify what actually is the cause of a non-normality. As this paper focus on the international investment among ASEAN markets, the distribution of return of stock indices and currencies are tested and the results are shown in Table I.<sup>9</sup>

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<sup>7</sup> The lists of stocks in this study are shown in appendix II

<sup>8</sup> The lists of ASEAN Stars are shown in appendix III

<sup>9</sup> The values of the test and p-values of each asset are not shown here to save the space, as there are a lot of assets under consideration.

**TABLE I:****Normality, Skewness, and Kurtosis Test**

This table reports the number of securities under this study whose returns are not normally distributed at 95% confidence level of 2-tail test. The Shapiro–Wilk test and Shapiro–Francia test ( $H_0$ : the data set are normal,  $H_1$ : the data set are non-normal) are chosen for testing normality of Platykurtic sample and Leptokurtic sample respectively. The skewness test ( $H_0$ : the data set are symmetric,  $H_1$ : the data set are asymmetric) and kurtosis test ( $H_0$ : the data set are mesokurtic,  $H_1$ : the data set are non-mesokurtic) are performed to identify the causes of non-normality. There are 205 stocks obtained from screening process; 43 from Indonesia (ID), 42 from Malaysia (MY), 41 from Philippines (PH), 36 from Singapore (SG), and 43 from Thailand (TH). There are 43 MSCIs; 5 ASEAN MACIs and 38 MSCIs for other countries. There are 25 exchange rates; particular ASEAN country against other 4 ASEAN currencies and USD.

|                                               | ID | MY | PH | SG | TH | MSCI | Ex<br>Rate | Total<br>% |
|-----------------------------------------------|----|----|----|----|----|------|------------|------------|
| No. of stocks                                 | 44 | 43 | 45 | 37 | 50 | 43   | 25         | 287        |
| No. of non-normal stocks                      | 37 | 39 | 39 | 35 | 45 | 39   | 20         | 254 89%    |
| - No. of asymmetric stocks                    | 0  | 0  | 0  | 2  | 0  | 3    | 2          | 7 2%       |
| - No. of non-mesokurtic stocks                | 13 | 18 | 10 | 12 | 20 | 1    | 1          | 75 26%     |
| - No. of asymmetric and non-mesokurtic stocks | 24 | 21 | 29 | 21 | 25 | 35   | 17         | 172 60%    |

The result in Table I shows that the return distributions of assets in this study are not normal. The non-normal return distributions are 254 from 287 (89%). This result is consistent with many previous works, i.e. Fama (1965), Arditti (1971) and Simkowitz and Beedles (1987) who indicate that the return of individual stocks are not normally distributed and Haque (2004) who shows that the distributions of country MSCI indices are skew and not normal, especially in emerging markets.

Interestingly, asymmetric (the third moment) and non-mesokurtic (the forth moment) attributes are simultaneously the main cause of a non-normality (172 from 287 (60%)). In other word, asymmetric attributes always come with non-mesokurtic attributes, but not vice versa.

Although both asymmetric and non-mesokurtic attributes are found in the samples, we neglect the non-mesokurtic attributes in our optimization because, as stated in Kraus and Litzenberger (1976), any moment beyond the third are not behaviorally justified.

## VIII. TESTING FOR INTER-TEMPORAL STABILITY OF ESTIMATED PARAMATERS

### *Permutation Test*

As mentioned earlier that the assets to be optimized is not normal distributed, nonparametric test should be applied. Permutation Tests is used following Canela and Collazo (2007). The whole data set in time series of 132 observations is equally divided into 2 sub-periods. In this case, the first sub-period is from January 2003 through June 2008 and the second sub-period is from July 2008 through December 2013. Data points of each asset between 2 sub-periods are reshuffled for 1,000 times. At each time, the difference of an interesting parameter is recorded and combined to create the distribution of differences. Then, the actual differences of an interesting parameter of those 2 sub-periods are compared with the value at confidence level of 95% and 90% (2-tails test) to show whether or not they are significant from zero.

### *Tests of correlation structure among countries*

Under the portfolio framework, the correlation matrix is assumed to contain all the information about the statistical dependence among the assets to be optimized. Therefore, the correlation matrix of the assets is the fundamental importance in the portfolio selection process, given that the matrix is involved in the calculation of the first three moments in the portfolio optimization. The change in the correlation structure indicates that the efficient frontier is not stable over time, which is something to bear in mind when using past pattern of co-movement to predict the future co-movement of the assets. If there are changes in correlation coefficient, there are increasing or diminishing diversification benefits between those assets across time.

For the purpose of investigating the benefits of investment across countries, although individual stocks are involved in our study, only MSCI of each interesting countries are used in this section in order to illustrate the changing structure in country-level. In the case of using permutation test to test changed in correlation, data points of each pairs of asset, not an individual, between 2 sub-periods are reshuffled. While we are looking from ASEAN investors' perspective, only the results between ASEAN countries and others are shown in Table II.

**TABLE II:**

**Parameters Stability Test Using Permutation Method**

*(January 2003 – December 2013)*

The table reports the result of the parameters stability test using permutation test with the MSCI data starting from January 2003 – December 2013. The permutation test is the non-parametric tests which divides the data series into 2 parts and randomly reshuffle the series for 1,000 times. Each time, the difference of interesting parameters, in this case is correlation and skewness, of those two periods are recorded. Finally, the distributions of differences are drawn. For 95% (90%) confidence level, if the actual difference is higher than the difference at 97.5% (95%) or lower than the difference at 2.5% (5%) of the distribution, it is marked with \* (\*\*) as significant change.

**Panel A:**

This panel reports the changes in correlation between MSCI indices (January 2003 – December 2013)

|                    | 1. INDONESIA | 2. MALAYSIA | 3. PHILIPPINES | 4. SINGAPORE | 5. THAILAND |
|--------------------|--------------|-------------|----------------|--------------|-------------|
| 1. INDONESIA       |              | 0.42 *      | 0.31 **        | 0.31 **      | 0.39 *      |
| 2. MALAYSIA        | 0.42 *       |             | 0.27           | 0.23         | 0.40 *      |
| 3. PHILIPPINES     | 0.31 **      | 0.27        |                | 0.40 *       | 0.39 *      |
| 4. SINGAPORE       | 0.31 **      | 0.23        | 0.40 *         |              | 0.22        |
| 5. THAILAND        | 0.39 *       | 0.40 *      | 0.39 *         | 0.22         |             |
| 6. AUSTRALIA       | 0.30         | 0.19        | 0.36 *         | 0.07         | 0.19        |
| 7. AUSTRIA         | 0.33 **      | 0.35 *      | 0.32 **        | 0.25         | 0.27        |
| 8. BELGIUM         | 0.34 *       | 0.33 **     | 0.22           | 0.20         | 0.29        |
| 9. BRAZIL          | 0.35 **      | 0.42 *      | 0.49 *         | 0.24         | 0.25        |
| 10. CANADA         | 0.36 *       | 0.28 **     | 0.50 *         | 0.16         | 0.24        |
| 11. CHILE          | 0.27         | 0.30 **     | 0.37 *         | 0.25         | 0.31 **     |
| 12. CHINA          | 0.34 *       | 0.23        | 0.37 *         | 0.03         | 0.13        |
| 13. COLOMBIA       | 0.29 **      | 0.35 *      | 0.36 *         | 0.33 *       | 0.40 *      |
| 14. CZECH REPUBLIC | 0.36 *       | 0.41 *      | 0.48 *         | 0.22         | 0.12        |
| 15. DENMARK        | 0.22         | 0.38 *      | 0.33 **        | 0.24         | 0.22        |
| 16. EGYPT          | 0.22         | 0.39 *      | 0.10           | 0.38 *       | 0.22        |
| 17. FINLAND        | 0.23         | 0.20        | 0.35 **        | 0.20         | 0.37 *      |
| 18. FRANCE         | 0.23         | 0.35 **     | 0.27           | 0.20         | 0.19        |
| 19. GERMANY        | 0.25         | 0.34 **     | 0.19           | 0.25         | 0.21        |
| 20. HONG KONG      | 0.28         | 0.19        | 0.45 *         | 0.03         | 0.34 **     |
| 21. HUNGARY        | 0.40 *       | 0.39 *      | 0.48 *         | 0.28 **      | 0.31 **     |
| 22. INDIA          | 0.23         | 0.12        | 0.33 **        | 0.10         | 0.19        |
| 23. IRELAND        | 0.26         | 0.26        | 0.08           | 0.19         | 0.18        |
| 24. ISRAEL         | 0.25         | 0.38 *      | 0.39 *         | 0.42 *       | 0.33 **     |
| 25. ITALY          | 0.13         | 0.30 **     | 0.29           | 0.18         | 0.22        |
| 26. JAPAN          | 0.44 *       | 0.29        | 0.36 *         | 0.20         | 0.22        |
| 27. KOREA          | 0.34 *       | 0.25        | 0.29           | 0.09         | 0.19        |
| 28. MEXICO         | 0.36 *       | 0.39 *      | 0.33 *         | 0.46 *       | 0.51 *      |
| 29. NETHERLANDS    | 0.30 **      | 0.33 *      | 0.24           | 0.20         | 0.20        |
| 30. NEW ZEALAND    | 0.32 **      | 0.08        | 0.19           | 0.18         | 0.23        |
| 31. NORWAY         | 0.37 *       | 0.29 **     | 0.42 *         | 0.14         | 0.27        |
| 32. PERU           | 0.43 *       | 0.14        | 0.51 *         | 0.15         | 0.16        |
| 33. POLAND         | 0.37 *       | 0.33 *      | 0.35 **        | 0.23         | 0.11        |
| 34. PORTUGAL       | 0.19         | 0.23        | 0.14           | 0.23         | 0.17        |
| 35. RUSSIA         | 0.33 **      | 0.50 *      | 0.51 *         | 0.33 *       | 0.36 *      |
| 36. SOUTH AFRICA   | 0.42 *       | 0.22        | 0.56 *         | 0.07         | 0.30 **     |
| 37. SPAIN          | 0.16         | 0.23        | 0.14           | 0.11         | 0.00        |
| 38. SWEDEN         | 0.29         | 0.37 *      | 0.33 **        | 0.26         | 0.26        |
| 39. SWITZERLAND    | 0.18         | 0.40 *      | 0.27           | 0.30 **      | 0.23        |
| 40. TAIWAN         | 0.44 *       | 0.25        | 0.37 *         | 0.09         | 0.14        |
| 41. TURKEY         | 0.29         | 0.20        | 0.34 **        | 0.03         | 0.09        |
| 42. UK             | 0.19         | 0.34 **     | 0.32 **        | 0.15         | 0.17        |
| 43. USA            | 0.35 *       | 0.24        | 0.24           | 0.13         | 0.29 **     |

**Panel B:**

This panel reports the changes in correlation between exchange rate (January 2003 – December 2013)

|            | 1. IDR/MYR | 2. IDR/PHP | 3. IDR/SGD | 4. IDR/THB | 5. IDR/USD |
|------------|------------|------------|------------|------------|------------|
| 1. IDR/MYR |            | 0.07       | 0.09       | 0.20       | -0.15      |
| 2. IDR/PHP | 0.07       |            | 0.24       | 0.33 **    | 0.11       |
| 3. IDR/SGD | 0.09       | 0.24       |            | 0.11       | -0.07      |
| 4. IDR/THB | 0.20       | 0.33 **    | 0.11       |            | 0.19       |
| 5. IDR/USD | -0.15      | 0.11       | -0.07      | 0.19       |            |

|            | 1. MYR/IDR | 2. MYR/PHP | 3. MYR/SGD | 4. MYR/THB | 5. MYR/USD |
|------------|------------|------------|------------|------------|------------|
| 1. MYR/IDR |            | -0.06      | -0.22      | -0.15      | 0.02       |
| 2. MYR/PHP | -0.06      |            | 0.44 *     | 0.47 *     | 0.45 *     |
| 3. MYR/SGD | -0.22      | 0.44 *     |            | -0.21      | -0.07      |
| 4. MYR/THB | -0.15      | 0.47 *     | -0.21      |            | 0.37 *     |
| 5. MYR/USD | 0.02       | 0.45 *     | -0.07      | 0.37 *     |            |

|            | 1. PHP/IDR | 2. PHP/MYR | 3. PHP/SGD | 4. PHP/THB | 5. PHP/USD |
|------------|------------|------------|------------|------------|------------|
| 1. PHP/IDR |            | -0.06      | -0.20      | -0.22      | -0.35 *    |
| 2. PHP/MYR | -0.06      |            | 0.00       | -0.12      | -0.66 *    |
| 3. PHP/SGD | -0.20      | 0.00       |            | -0.35 **   | -0.60 *    |
| 4. PHP/THB | -0.22      | -0.12      | -0.35 **   |            | -0.12      |
| 5. PHP/USD | -0.35 *    | -0.66 *    | -0.60 *    | -0.12      |            |

|            | 1. SGD/IDR | 2. SGD/MYR | 3. SGD/PHP | 4. SGD/THB | 5. SGD/USD |
|------------|------------|------------|------------|------------|------------|
| 1. SGD/IDR |            | 0.02       | -0.15      | 0.00       | -0.03      |
| 2. SGD/MYR | 0.02       |            | -0.40 *    | 0.20       | -0.52 *    |
| 3. SGD/PHP | -0.15      | -0.40 *    |            | 0.39 *     | 0.04       |
| 4. SGD/THB | 0.00       | 0.20       | 0.39 *     |            | 0.45 *     |
| 5. SGD/USD | -0.03      | -0.52 *    | 0.04       | 0.45 *     |            |

|            | 1. THB/IDR | 2. THB/MYR | 3. THB/PHP | 4. THB/SGD | 5. THB/USD |
|------------|------------|------------|------------|------------|------------|
| 1. THB/IDR |            | -0.13      | -0.27      | -0.17      | -0.44 *    |
| 2. THB/MYR | -0.13      |            | -0.32 **   | 0.01       | -0.75 *    |
| 3. THB/PHP | -0.27      | -0.32 **   |            | -0.02      | -0.37 *    |
| 4. THB/SGD | -0.17      | 0.01       | -0.02      |            | -0.59 *    |
| 5. THB/USD | -0.44 *    | -0.75 *    | -0.37 *    | -0.59 *    |            |

Expectedly, the change in correlation between ASEAN countries and others in Panel A are all positive and many of them are significant, especially for Indonesia, Malaysia, and Philippines. However, Singapore does not share the instability of correlations like other ASEAN countries most likely because the stock market is more integrated with other develop world countries.<sup>10</sup>

While investment is made across country, currency is also an asset held by investor. Thus, the test is also performed on the exchange rate. The results in Panel B consistently show that exchange rate correlation structures are also changing overtime.

<sup>10</sup> This paper also extendedly investigates whether correlations are gradually increasing or dynamically fluctuating overtime. The result is presented in appendix IV



These results indicate that the diversification benefit to ASEAN investors is changing overtime and the stability of variance of the portfolio derived from these assets should be considered.

#### *Skewness of each asset*

Stability of skewness is a key issue in the portfolio selection process when the skewness is taken into account. Individual stocks having high skewness tend to be included in the portfolio. If the skewness of a particular stock is less persistent than that of other stocks with lesser weight in the portfolio, the whole approach is flawed.

Consequently, the Permutation Test is also applied, but this time the interesting parameter between 2 sub-periods is skewness.

The results of the test, performing with individual stocks and MSCIs, indicate that skewness, for the sample data, only 37 from 205 stocks and 3 from 43 MSCIs are unstable. The exchange rates are also tested, but all of them are stable.<sup>11</sup> In conclusion, the problem of inter-temporal instability of estimated parameters seems to occur more seriously with only the correlation structure.

## **IX. COMPARISONS OF OPTIMIZATION RESULTS**

In this section, the comparisons of the optimal solutions, in-sample estimates, and out-of-sample actuals between portfolios optimizing from available investment choice before market liberalization (called “Before”) and portfolios optimizing from available investment choice after market liberalization (called “After”) are presented.

Because many ASEAN markets are in developing stage and have restrictions on short sale transactions or have high cost on short sale transactions, this paper constrains the investment weight in each asset to be non-negative. That is the weights are constrained  $w_i \geq 0$  in the optimization. There is a point to note here. There is a probability that the optimal solutions obtained from the optimizing algorithm might not be the global, but local minimum, when the set of initial points are not adequate. To avoid that problem, at the beginning of every year where the set of stocks is decomposed according to the screening criteria, 20 initial points are randomly

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<sup>11</sup> To save the space, the results are not shown here.

generated to find an optimal solution set. Then, for the rest of the year, the optimal solution set is used as initial points for next period.

Theoretically, an investor's utility is the function of the realized return, not the parameter estimates. Unlike the previous papers; Chunhachinda et al. (1997) and Canela and Collazo (2007), which do the optimization only once and report only the in-sample estimated results, but not the actual out-of-sample performance of the optimal solutions, this paper also analyzes out-of-sample performance of the optimum portfolio.

As per the discussion in the earlier section resulting that the estimated parameter is not stable overtime, the results of the previous papers are arguable. Chunhachinda et al. (1997) tests the stability of correlation matrix of developed country MSCIs by utilizing Sen and Puri (1968) methodology and illustrates that there exists stability of correlation between assets. Thus, the efficient frontier can be considered relatively stable overtime and the results of the test are accuracy. However, in the real world, especially in the emerging market, data stability rarely occurs. Canela and Collazo (2007), consistent with many studies, illustrates that the correlation structure is not stable, some of them are significant. This issue makes the optimal solutions reported in this study less convincing.

Moreover, when Chunhachinda et al. (1997) and Canela and Collazo (2007) report only the in-sample estimated portfolio parameters, Expected Return and Skewness, and Sharpe Ratio and Skewness Coefficient, respectively, their results can be arguable. As the reward to investors is the realized future return of their portfolio, not the parameters, this paper test whether investors can achieve those estimates when they bring the optimal solutions to do a real investment.

Consequently, this paper decides to use the rolling window and form a portfolio follow the optimal solution obtained from optimization on monthly basis to mitigate the parameter instability problem and make the result more convincing. Each asset in each window consists of 72 monthly observations. The estimated parameters of each asset from each window are optimized to find the optimal solutions and the expected in-sample portfolio parameters, Sharpe Ratio and Skewness Coefficient. For example, to find the optimal solution for January 2009, monthly data covering January 2003 – December 2008 are used, for February 2009, monthly data covering February 2003 – January 2009 are used, and so on. Total of 60 expected in-sample portfolio parameters for each different investor preference set ( (1)  $p_1 = 1, p_3 = 0$ , (2)  $p_1 = 0, p_3 = 1$ , (3)  $p_1 = 1, p_3 = 1$ , (4)  $p_1 = 2, p_3 = 1$ , and (5)  $p_1 = 1, p_3 = 2$ ) are obtained and, then averaged. Finally, the portfolio is formed following the solutions of each month, series of returns are recorded, and

the actual out-of-sample portfolio parameters are compared with the averaged expected in-sample portfolio parameters. This process is applied to both portfolios (“Before” and “After”). Results are compared in Table III.

Panel A presents the monthly averaged estimated in-sample parameters of “Before” and “After” portfolio looking from each ASEAN countries’ perspectives, given different sets of investor’s preferences. The results of this paper are consistent with the previous paper. Precisely, optimization with  $p_1 = 1$  and  $p_3 = 0$  ( $p_1 = 0$  and  $p_3 = 1$ ) get highest SR (SC) while optimization with  $p_1 = 2$  and  $p_3 = 1$  ( $p_1 = 1$  and  $p_3 = 2$ ) get 2<sup>nd</sup>-highest SR (SC). Optimization with  $p_1 = 1$  and  $p_3 = 1$  give the result in between those cases. This ensures that our process is right.

Most of the results in Panel A indicate that investors will benefit from market liberalization in term of both Sharpe Ratio (“SR”) and Skewness Coefficient (“SC”) regardless the different preferences. There are some exceptions that investors are worst off; for instance, Investors from Malaysia, Philippines, and Singapore who prefer only the SR ( $p_1 = 1$ ,  $p_3 = 0$ ) get lower SC and investors from Singapore who prefer SR to SC ( $p_1 = 2$ ,  $p_3 = 1$ ) get lower SC. However, the investors are worst off in the factor which is not or less relevant to them. So that, from in-sample estimates, it can be concluded that investor will benefit from market liberalization.

Panel B reports the actual parameters calculated from the series of 60 actual out-of-sample returns. It is obvious that the actual results are quite different from the estimates; investors do not benefit for all cases.

The actual performance of the investors having one preference ( $p_1 = 1$ ,  $p_3 = 0$  and  $p_1 = 0$ ,  $p_3 = 1$ ) is in line with the estimates. To be specific, all of investors with SR-only preference get highest SR. Conversely, most of investors with SC-only preference get highest SC. However, when the two preferences are combined into an optimization, the clear pattern cannot be seen.

There are some investors who obtain less benefit in both SR and SC with After portfolio, or, in other word, they do not gain any benefit from market liberalization. For example, Investors from Malaysia who prefer SR to SC ( $p_1 = 2$ ,  $p_3 = 1$ ), Investors from Singapore who prefer SC to SR ( $p_1 = 1$ ,  $p_3 = 2$ ), and Investors from Singapore, Philippines and Thailand who prefer SR and SC equally ( $p_1 = 1$ ,  $p_3 = 1$ ) do not benefit from liberalization.

From these two panels, it is clear that the actual out of sample results are quite different from the in sample estimates. The instability of the estimated parameters might be the main causes of this result. This issue is also a controversial topic studied by many papers, including Harvey et. al. (2003). However, it is out of scope of this paper.

Although it cannot be made a strong conclusion that market liberalization will benefit all ASEAN investors, from the repeatedly experiment of out-of-sample investment, at least most of Indonesian, Malaysian, Singaporean, and Thai investors can expect gains from cross-border investment.

Panel C show the asset allocation to the stocks of each country, given that investors expect the benefit from investing aboard. The results are consistent with many previous papers, using PGP for optimizing with skew. The weight allocation is different when the skewness is incorporated into investors' preference.<sup>12</sup> Obviously, from the table, there are 5 main points to be noted.<sup>13</sup>

1. Before market opening, investing in ASEAN county funds (ASEANs' MSCIs) cannot help investor to diversify, so weights are mainly allocated within a country where investors are living in and a few to foreign fund.
2. After market opening, only ASEAN stocks are enough for ASEAN investors to diversify their portfolio and no need to invest in foreign fund anymore.
3. The weight investing in a certain country reduces a lot, which means that there will be a remarkable fund flow moving between ASEAN markets (assuming that other difficulties are minimized, such as, information a symmetry between country, communication language skill, and etc.).
4. For investors who prefer only the SR ( $p_1 = 1, p_3 = 0$ ), in the past five years, Stocks of Malaysia (i.e. Petronas Dagangan and Telekom Malaysia) are always considered as a good source of expected return with less variance. Consequently, Malaysian investors with  $p_1 = 1, p_3 = 0$  gain less benefit (from 0.58 to 0.63). While Thai Stock (i.e. Advance Info Ser. and

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<sup>12</sup> See 3 of highest-weighted stocks from each ASEAN country in appendix V

<sup>13</sup> Only the cases of  $p_1 = 1, p_3 = 0$  and  $p_1 = 0, p_3 = 1$  are shown to save the space as the solutions of other cases are actually in combination of these two case.

CP All) is becoming more interesting, Philippines and Singapore shows a downward trend in weight.

5. For investors who prefer only the SC ( $p_1 = 0, p_3 = 1$ ), no very clear pattern is found.

The weights are sometime allocated to Indonesian, Malaysian, Philippines, and Singaporean stocks. However, for the most recent year, it is obviously that Indonesian stocks are a good source of skewness with less variance. Then, compared to other countries except Philippines, Indonesian investors with  $p_1 = 0, p_3 = 1$  gain less benefit (from 0.05 to 0.14).

From the five noticeable points above, we can do a summary in two perspectives; (1) perspective of investors and (2) perspective of country stock market. However, while there is no certain pattern in the result of the combination set of preferences ( $p_1$  and  $p_3$ ), the summary is focusing on the case  $p_1 = 1, p_3 = 0$  and  $p_1 = 0, p_3 = 1$ .

1. Perspective of investors: Malaysian investors who have  $p_1 = 1, p_3 = 0$  will get less benefit, compared to investors who have the same preference in other ASEAN countries, because Malaysian stocks provide highest SR already. On the other hand, Indonesian, Philippines, and Singaporean investors who have  $p_1 = 0, p_3 = 1$  will get relatively less benefit, because they already obtain high SC from investing in their own country. Thai investors are the highest-benefited ones because Thai stocks generate relatively lowest SR and SC.
2. Perspective of country stock market: The main fund flows are believably expected to be moved to Malaysia stock market due to its benefit in term of both SR and SC. The rest, depending on the investor preferences, will be moved to Indonesia, Philippines, Singapore, and Thailand.

## X. CONCLUSION

This paper, based on diversification perspective, attempts to study and illustrate the difference of investment allocation when (1) investors in each ASEAN members can only invest in country index funds and (2) when investing in individual stocks is possible. Two sets of data, representing available assets to investor before and after market liberalization in 2015.

We found that series of return of such assets are not normal, which breach the assumption of Markowitz (1952). As an any moments more third moment are not justified in the practical, PGP method, introduced by Lai (1991) with some adjustment by Canela and Collazo (2007), is used to incorporate the skewness into the optimization.

As the stability of the parameters is the concern the parameter estimates, the permutation test is used to perform stability test. The result shows that the correlation structure is changing overtime, unlike skewness which is quite stable. These results are in line with Canela and Collazo (2007). Consequently, we decide to do the rolling optimization for 60 monthly periods and report both portfolio in-sample estimated and actual out-of-sample parameters in order to mitigate the parameter instability problem.

The results show that, even though the actual parameters are not equal to all estimates, most of them are reported in the same direction (most investor will gain the benefit from market liberalization). Therefore, our results show that there will be benefits to ASEAN investors. Moreover, the numbers of cross-broader investment are expected be higher. Stocks of Malaysian market are perceived as a good investment choice for Sharpe-ratio-concerning investors, while Stocks of Indonesian market are for Skewness-coefficient-concerning investors.

**TABLE III:**

**Comparisons of Optimization Results**

This table reports the comparisons of results between portfolios assuming investors can only invest in individual securities in their countries and can invest in index in other countries around the world (“Before”) and portfolios assuming investors can invest in individual securities in their countries, individual securities in ASEAN countries, and can invest in index in other countries around the world (“After”).  $P_1 = 1$  and  $P_3 = 0$ ,  $P_1 = 0$  and  $P_3 = 1$ ,  $P_1 = 1$  and  $P_3 = 1$ ,  $P_1 = 2$  and  $P_3 = 1$ , and  $P_1 = 1$  and  $P_3 = 2$  represent the case that investors prefer SR only, SC only, SR and SC equally, SR to SC, and SC to SR, respectively. The stock markets include Indonesia (ID), Malaysia (MY), Philippines (PH), Singapore (SG), and Thailand (TH), Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Hong Kong, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, and, USA. The arrows up and down indicate parameter difference between Before and After.

**Panel A:**

This panel reports the averaged in-sample estimates of Sharpe Ratio and Skewness Coefficient of Before and After portfolio, resulting from 60 monthly rolling-windows optimization. There are 72 historical data in each monthly rolling-windows; i.e. January 2003 to December 2008, December 2007 to November 2013, and so on.

| Sharpe Ratio          | ID investors |       | MY investors |       | PH investors |       | SG investors |       | TH investors |       |
|-----------------------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|
|                       | Before       | After | Before       | After | Before       | After | Before       | After | Before       | After |
| $P1 = 1 \quad P3 = 0$ | 0.38         | 0.64  | 0.55         | 0.69  | 0.44         | 0.61  | 0.37         | 0.66  | 0.36         | 0.61  |
| $P1 = 0 \quad P3 = 1$ | 0.13         | 0.14  | 0.12         | 0.17  | 0.18         | 0.18  | 0.17         | 0.17  | -0.02        | 0.15  |
| $P1 = 1 \quad P3 = 1$ | 0.21         | 0.30  | 0.28         | 0.28  | 0.25         | 0.28  | 0.22         | 0.28  | 0.03         | 0.27  |
| $P1 = 2 \quad P3 = 1$ | 0.30         | 0.54  | 0.45         | 0.55  | 0.38         | 0.49  | 0.28         | 0.53  | 0.05         | 0.49  |
| $P1 = 1 \quad P3 = 2$ | 0.16         | 0.23  | 0.17         | 0.20  | 0.21         | 0.21  | 0.18         | 0.20  | 0.13         | 0.18  |

| Skewness Coefficient  | ID investors |       | MY investors |       | PH investors |       | SG investors |       | TH investors |       |
|-----------------------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|
|                       | Before       | After | Before       | After | Before       | After | Before       | After | Before       | After |
| $P1 = 1 \quad P3 = 0$ | -0.68        | -0.41 | -0.18        | -1.01 | -0.61        | -0.72 | -0.61        | -0.79 | -1.06        | -0.92 |
| $P1 = 0 \quad P3 = 1$ | 1.24         | 2.37  | 1.39         | 2.24  | 1.03         | 2.31  | 1.55         | 2.29  | 0.65         | 2.31  |
| $P1 = 1 \quad P3 = 1$ | 1.18         | 2.21  | 1.29         | 2.03  | 0.95         | 1.80  | 1.49         | 2.07  | 0.21         | 2.01  |
| $P1 = 2 \quad P3 = 1$ | 0.75         | 0.86  | 0.85         | 0.87  | 0.48         | 1.11  | 1.02         | 0.87  | 0.10         | 0.78  |
| $P1 = 1 \quad P3 = 2$ | 1.18         | 2.31  | 1.35         | 2.16  | 1.03         | 2.20  | 1.53         | 2.27  | 0.64         | 2.29  |



**Panel B:**

This panel reports the actual Sharpe Ratio and Skewness Coefficient of Before and After portfolio, calculated from series of 60 actual returns which are an out-of-sample prediction of portfolio construction. The actual out-of-sample returns are obtained from using the in-sample optimal weights, optimized from 72 historical data, to construct an optimum portfolio for the next month. The 60 rolling-windows start from January 2003 to December 2008 through December 2007 to November 2013. So that, the actual monthly portfolio returns are from January 2009 through December 2013.

| Sharpe Ratio          | ID investors |       | MY investors |       | PH investors |       | SG investors |       | TH investors |       |
|-----------------------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|
|                       | Before       | After | Before       | After | Before       | After | Before       | After | Before       | After |
| $P1 = 1 \quad P3 = 0$ | 0.17         | 0.55  | 0.58         | 0.63  | 0.44         | 0.53  | 0.43         | 0.51  | 0.26         | 0.50  |
| $P1 = 0 \quad P3 = 1$ | 0.10         | 0.33  | 0.19         | 0.21  | 0.13         | 0.16  | 0.36         | 0.18  | 0.15         | 0.19  |
| $P1 = 1 \quad P3 = 1$ | 0.07         | 0.33  | 0.12         | 0.27  | 0.27         | 0.17  | 0.34         | 0.32  | 0.25         | 0.20  |
| $P1 = 2 \quad P3 = 1$ | 0.03         | 0.38  | 0.50         | 0.49  | 0.38         | 0.40  | 0.38         | 0.39  | 0.21         | 0.35  |
| $P1 = 1 \quad P3 = 2$ | 0.00         | 0.23  | 0.26         | 0.18  | 0.15         | 0.16  | 0.36         | 0.19  | 0.27         | 0.20  |

| Skewness Coefficient  | ID investors |       | MY investors |       | PH investors |       | SG investors |       | TH investors |       |
|-----------------------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|
|                       | Before       | After | Before       | After | Before       | After | Before       | After | Before       | After |
| $P1 = 1 \quad P3 = 0$ | -0.19        | -0.88 | 0.31         | -0.03 | 0.15         | -0.19 | -0.17        | 0.19  | -0.93        | -0.50 |
| $P1 = 0 \quad P3 = 1$ | 0.05         | 0.14  | -0.02        | 0.35  | 1.29         | 0.57  | 0.27         | 0.39  | -0.64        | 0.25  |
| $P1 = 1 \quad P3 = 1$ | -0.24        | -0.07 | -0.50        | -0.06 | 0.51         | -0.74 | 0.37         | 0.27  | -0.28        | -0.47 |
| $P1 = 2 \quad P3 = 1$ | -0.25        | -0.89 | 0.02         | -0.09 | -0.12        | -0.03 | -0.07        | -0.25 | -0.43        | -0.43 |
| $P1 = 1 \quad P3 = 2$ | -0.03        | 0.13  | -0.53        | 0.16  | 0.07         | -0.08 | 0.32         | 0.09  | -0.93        | 0.09  |

**Panel C:**

This panel reports the yearly averages of monthly optimal weights of Before and After portfolio, resulting from optimization of 60 rolling-windows which start from January 2009 to December 2013. Each table report the yearly averaged optimal weights looking from investors from each ASEAN country starting from Indonesia, Malaysia, Philippines, Singapore, and Thailand. Only the weights of investor preference set with  $P_1 = 1$  and  $P_3 = 0$  and  $P_1 = 0$  and  $P_3 = 1$  are shown while the weights of the other sets are actually in between these two sets. The weighted stock markets include Indonesia (ID), Malaysia (MY), Philippines (PH), Singapore (SG), and Thailand (TH), Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Hong Kong, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, and, USA. All of the non-ASEAN stock markets are reported as “Other Region”.

**Indonesia Investors' Perspective**

| P1 = 1<br>P3 = 0 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 76%    | 23% ↓ | 0%     | 36% ↑ | 0%     | 20% ↑ | 0%     | 21% ↑ | 0%     | 0%    | 24%          | 0% ↓  |
| 2010             | 88%    | 26% ↓ | 0%     | 31% ↑ | 0%     | 24% ↑ | 0%     | 14% ↑ | 0%     | 5% ↑  | 12%          | 0% ↓  |
| 2011             | 100%   | 16% ↓ | 0%     | 39% ↑ | 0%     | 20% ↑ | 0%     | 12% ↑ | 0%     | 13% ↑ | 0%           | 0%    |
| 2012             | 100%   | 21% ↓ | 0%     | 48% ↑ | 0%     | 16% ↑ | 0%     | 5% ↑  | 0%     | 10% ↑ | 0%           | 0%    |
| 2013             | 99%    | 19% ↓ | 0%     | 38% ↑ | 0%     | 19% ↑ | 0%     | 4% ↑  | 0%     | 20% ↑ | 1%           | 0% ↓  |

| P1 = 0<br>P3 = 1 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 79%    | 24% ↓ | 0%     | 4% ↑  | 0%     | 42% ↑ | 0%     | 0%    | 0%     | 30% ↑ | 20%          | 0% ↓  |
| 2010             | 69%    | 26% ↓ | 0%     | 7% ↑  | 0%     | 46% ↑ | 0%     | 20% ↑ | 0%     | 0%    | 30%          | 1% ↓  |
| 2011             | 100%   | 44% ↓ | 0%     | 38% ↑ | 0%     | 0%    | 0%     | 15% ↑ | 0%     | 2% ↑  | 0%           | 0%    |
| 2012             | 99%    | 11% ↓ | 1%     | 6% ↑  | 0%     | 6% ↑  | 0%     | 76% ↑ | 0%     | 0%    | 0%           | 0%    |
| 2013             | 94%    | 49% ↓ | 0%     | 27% ↑ | 0%     | 0%    | 0%     | 11% ↑ | 0%     | 13% ↑ | 6%           | 0% ↓  |

### Malaysia Investors' Perspective

| P1 = 1<br>P3 = 0 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 11%   | 90%    | 55%   | 0%     | 21%   | 0%     | 13%   | 0%     | 0%    | 10%          | 0%    |
| 2010             | 0%     | 5%    | 96%    | 61%   | 0%     | 22%   | 0%     | 8%    | 0%     | 5%    | 4%           | 0%    |
| 2011             | 0%     | 2%    | 100%   | 67%   | 0%     | 13%   | 0%     | 7%    | 0%     | 11%   | 0%           | 0%    |
| 2012             | 0%     | 5%    | 100%   | 64%   | 0%     | 16%   | 0%     | 3%    | 0%     | 12%   | 0%           | 0%    |
| 2013             | 0%     | 6%    | 100%   | 57%   | 0%     | 16%   | 0%     | 5%    | 0%     | 15%   | 0%           | 0%    |

| P1 = 0<br>P3 = 1 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 8%    | 95%    | 9%    | 0%     | 50%   | 0%     | 0%    | 0%     | 32%   | 5%           | 0%    |
| 2010             | 0%     | 23%   | 100%   | 0%    | 0%     | 31%   | 0%     | 46%   | 0%     | 0%    | 0%           | 0%    |
| 2011             | 0%     | 31%   | 99%    | 68%   | 0%     | 0%    | 0%     | 0%    | 0%     | 0%    | 1%           | 0%    |
| 2012             | 0%     | 11%   | 89%    | 4%    | 0%     | 16%   | 0%     | 61%   | 0%     | 9%    | 11%          | 0%    |
| 2013             | 0%     | 52%   | 92%    | 42%   | 0%     | 0%    | 0%     | 6%    | 0%     | 0%    | 8%           | 0%    |

### Philippines Investors' Perspective

| P1 = 1<br>P3 = 0 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 14%   | 0%     | 47%   | 76%    | 30%   | 0%     | 10%   | 0%     | 0%    | 24%          | 0%    |
| 2010             | 0%     | 8%    | 0%     | 46%   | 78%    | 28%   | 0%     | 12%   | 0%     | 6%    | 22%          | 0%    |
| 2011             | 0%     | 2%    | 0%     | 43%   | 93%    | 25%   | 0%     | 16%   | 0%     | 14%   | 7%           | 0%    |
| 2012             | 0%     | 7%    | 0%     | 55%   | 100%   | 22%   | 0%     | 1%    | 0%     | 16%   | 0%           | 0%    |
| 2013             | 0%     | 7%    | 0%     | 46%   | 100%   | 24%   | 0%     | 2%    | 0%     | 22%   | 0%           | 0%    |

| P1 = 0<br>P3 = 1 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 8%    | 0%     | 2%    | 87%    | 54%   | 0%     | 0%    | 0%     | 36%   | 13%          | 0%    |
| 2010             | 0%     | 23%   | 0%     | 7%    | 93%    | 30%   | 0%     | 39%   | 0%     | 0%    | 7%           | 1%    |
| 2011             | 0%     | 25%   | 0%     | 75%   | 63%    | 0%    | 0%     | 0%    | 0%     | 0%    | 37%          | 0%    |
| 2012             | 0%     | 37%   | 0%     | 45%   | 85%    | 11%   | 0%     | 5%    | 0%     | 1%    | 15%          | 0%    |
| 2013             | 0%     | 57%   | 0%     | 34%   | 95%    | 0%    | 0%     | 7%    | 0%     | 2%    | 5%           | 0%    |

### Singapore Investors' Perspective

| P1 = 1<br>P3 = 0 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 11% ↑ | 0%     | 52% ↑ | 0%     | 20% ↑ | 84%    | 18% ↓ | 0%     | 0%    | 16%          | 0% ↓  |
| 2010             | 0%     | 6% ↑  | 0%     | 58% ↑ | 0%     | 20% ↑ | 91%    | 11% ↓ | 0%     | 5% ↑  | 9%           | 0% ↓  |
| 2011             | 0%     | 3% ↑  | 0%     | 61% ↑ | 0%     | 13% ↑ | 99%    | 10% ↓ | 0%     | 12% ↑ | 1%           | 0% ↓  |
| 2012             | 0%     | 8% ↑  | 0%     | 61% ↑ | 0%     | 16% ↑ | 100%   | 3% ↓  | 0%     | 13% ↑ | 0%           | 0%    |
| 2013             | 0%     | 8% ↑  | 0%     | 53% ↑ | 0%     | 16% ↑ | 97%    | 7% ↓  | 0%     | 16% ↑ | 3%           | 0% ↓  |

| P1 = 0<br>P3 = 1 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 8% ↑  | 0%     | 3% ↑  | 0%     | 53% ↑ | 100%   | 0% ↓  | 0%     | 35% ↑ | 0%           | 0%    |
| 2010             | 0%     | 24% ↑ | 0%     | 0%    | 0%     | 29% ↑ | 100%   | 47% ↓ | 0%     | 0%    | 0%           | 0%    |
| 2011             | 0%     | 34% ↑ | 0%     | 62% ↑ | 0%     | 0%    | 100%   | 4% ↓  | 0%     | 0%    | 0%           | 0%    |
| 2012             | 0%     | 8% ↑  | 0%     | 0%    | 0%     | 13% ↑ | 100%   | 71% ↓ | 0%     | 7% ↑  | 0%           | 0%    |
| 2013             | 0%     | 59% ↑ | 0%     | 30% ↑ | 0%     | 0%    | 100%   | 10% ↓ | 0%     | 0%    | 0%           | 0%    |

### Thailand Investor Perspective

| P1 = 1<br>P3 = 0 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 11% ↑ | 0%     | 43% ↑ | 0%     | 24% ↑ | 0%     | 19% ↑ | 38%    | 2% ↓  | 62%          | 0% ↓  |
| 2010             | 0%     | 6% ↑  | 0%     | 40% ↑ | 0%     | 23% ↑ | 0%     | 16% ↑ | 63%    | 14% ↓ | 37%          | 0% ↓  |
| 2011             | 0%     | 2% ↑  | 0%     | 39% ↑ | 0%     | 22% ↑ | 0%     | 16% ↑ | 91%    | 21% ↓ | 9%           | 0% ↓  |
| 2012             | 0%     | 7% ↑  | 0%     | 53% ↑ | 0%     | 17% ↑ | 0%     | 1% ↑  | 100%   | 23% ↓ | 0%           | 0%    |
| 2013             | 0%     | 6% ↑  | 0%     | 43% ↑ | 0%     | 19% ↑ | 0%     | 2% ↑  | 100%   | 30% ↓ | 0%           | 0%    |

| P1 = 0<br>P3 = 1 | ID     |       | MY     |       | PH     |       | SG     |       | TH     |       | Other Region |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------------|-------|
|                  | Before | After | Before | After | Before | After | Before | After | Before | After | Before       | After |
| 2009             | 0%     | 7% ↑  | 0%     | 4% ↑  | 0%     | 47% ↑ | 0%     | 0%    | 100%   | 42% ↓ | 0%           | 0%    |
| 2010             | 0%     | 23% ↑ | 0%     | 0%    | 0%     | 32% ↑ | 0%     | 45% ↑ | 100%   | 0% ↓  | 0%           | 0%    |
| 2011             | 0%     | 31% ↑ | 0%     | 63% ↑ | 0%     | 0%    | 0%     | 0%    | 94%    | 6% ↓  | 6%           | 0% ↓  |
| 2012             | 0%     | 6% ↑  | 0%     | 0%    | 0%     | 16% ↑ | 0%     | 65% ↑ | 97%    | 13% ↓ | 3%           | 0% ↓  |
| 2013             | 0%     | 65% ↑ | 0%     | 28% ↑ | 0%     | 0%    | 0%     | 7% ↑  | 66%    | 0% ↓  | 34%          | 0% ↓  |

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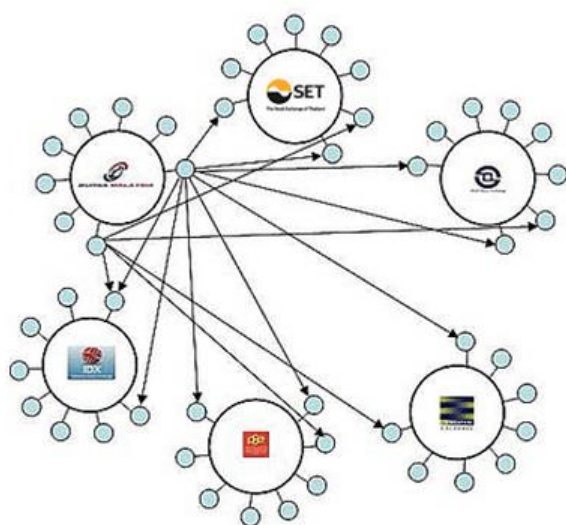
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## APPENDIX I: NEW TRADING MECHANISM OF ASEAN LINK

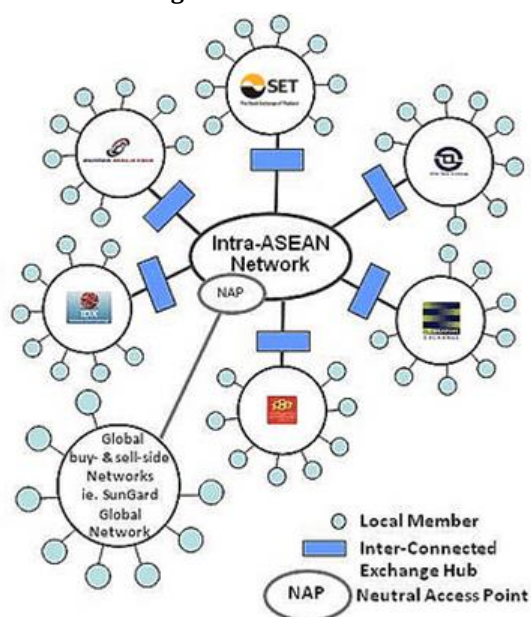
New mechanism of ASEAN Link is established in order for increasing the easiness of cross-border investment, the efficiency of the trading, settling and data distributing process. Investors can buy or sell stocks in every market of ASEAN.

This mechanism allows investor to buy or sell stock of other countries even they have no trading account in those countries. They can send orders to brokers, who register to use this system, in their country with certain brokerage fees.

**Present Cross-border Trading Mechanism**



**New Trading Mechanism of ASEAN Link**



Source of data: [www.set.or.th/th/asean\\_exchanges/asean\\_link.html](http://www.set.or.th/th/asean_exchanges/asean_link.html)

**APPENDIX II: LIST OF STOCKS IN THIS STUDY** (obtained from the 3 criteria; (1) data availability, (2) market capitalization, and (3) illiquidity ratio)

| No. | Indonesia Stock Market     | Malaysia Stock Market      | Philippines Stock Market  | Singapore Stock Market   | Thailand Stock Market     |
|-----|----------------------------|----------------------------|---------------------------|--------------------------|---------------------------|
| 1.  | * AKR CORPORINDO           | AFFIN HOLDINGS             | * ABOITIZ EQUITY VENT.    | ASCENDAS REAL ESTATE IT. | * ADVANCED INFO SER.      |
| 2.  | ANEKA TAMBANG              | AIRASIA                    | * ALLIANCE GLOBAL GP.     | CAPITACOMMERCIAL TRUST   | * AIRPORTS OF THAILAND    |
| 3.  | * ASTRA AGRO LESTARI       | ALLIANCE FINANCIAL GP.     | ATLAS CONS.MNG.& DEV.     | * CAPITALAND             | AP (THAILAND)             |
| 4.  | BAKRIE & BROTHERS          | * AMMB HOLDINGS            | * AYALA                   | * CAPITAMALL TRUST       | BANGCHAK PETROLEUM        |
| 5.  | BAKRIE SUMATERA PLTNS.     | BERJAYA                    | * AYALA LAND              | * CITY DEVELOPMENTS      | * BANGKOK BANK            |
| 6.  | BAKRIELAND DEVELOPMENT     | BERJAYA SPORTS TOTO        | * BANK OF THE PHILP.ISLE. | * COMFORTDELGRO          | * BANGKOK DUSIT MED.SVS.  |
| 7.  | * BANK CENTRAL ASIA        | BOUSTEAD HOLDINGS          | * BDO UNIBANK             | COSCO (SING.)            | BANGKOK EXPRESSWAY        |
| 8.  | * BANK DANAMON INDONESIA   | * BRIT.AMER.TOB.(MALAYSIA) | BELLE                     | * DBS GROUP HOLDINGS     | * BANK OF AYUDHYA         |
| 9.  | BANK INTL.INDONESIA        | BURSA MALAYSIA             | BERJAYA PHILIPPINES       | * FRASER AND NEAVE       | * BANPU                   |
| 10. | * BANK MANDIRI             | * CIMB GROUP HOLDINGS      | CHINA BANKING             | * GENTING SINGAPORE      | * BEC WORLD               |
| 11. | * BANK NEGARA INDONESIA    | DIALOG GROUP               | * DMCI HOLDINGS           | * GOLDEN AGRI-RESOURCES  | BERLI JUCKER              |
| 12. | * BANK RAKYAT INDONESIA    | * DIGI.COM                 | * ENERGY DEVELOPMENT      | * HONG KONG LAND HDG.    | * BIG C SUPERCENTER       |
| 13. | BARITO PACIFIC             | DRB-HICOM                  | FILINVEST LAND            | INDOFOOD AGRI RESOURCES  | BTS GROUP HDG.            |
| 14. | * BUMI RESOURCES           | GAMUDA                     | * FIRST GEN               | * JARDINE CYC.& CARR.    | * CENTRAL PATTANA         |
| 15. | * CHAROEN POKPHAND INDO.   | * GENTING                  | FIRST PHILIPPINE HDG.     | * JARDINE MATHESON HDG.  | * CHAROEN POKPHAND FOODS  |
| 16. | CIPUTRA DEVELOPMENT        | * GENTING MALAYSIA         | * GLOBE TELECOM           | * KEPPEL                 | * CP ALL                  |
| 17. | DELTA DUNIA MAKMUR         | GENTING PLANTATIONS        | * INTL.CTNR.TERM.SVS.     | KEPPEL LAND              | * ELECTRICITY GENERATING  |
| 18. | ENERGI MEGA PERSADA        | * HONG LEONG BANK          | ISM COMMUNICATIONS        | NEPTUNE ORIENT LINES     | HOME PRODUCT CENTER       |
| 19. | * GLOBAL MEDIACOM          | IGB                        | * JG SUMMIT HDG.          | * NOBLE GROUP            | * IRPC                    |
| 20. | * GUDANG GARAM             | IJM                        | * JOLIBEE FOODS           | * OLAM INTERNATIONAL     | ITALIAN-THAI DEVELOPMENT  |
| 21. | * HOLCIM INDONESIA         | * IOI                      | LEPANTO CONS.MNG.A        | * OVERSEA-CHINESE BKG.   | * KASIKORNBANK            |
| 22. | * ICT.TUNGGAL PRAKARSA     | KNM GROUP                  | LOPEZ HOLDINGS            | * SEMBCORP INDUSTRIES    | * KRUNG THAI BANK         |
| 23. | INDAH KIAT PULP & PAPER    | * KUALA LUMPUR KEPONG      | MANILA ELECTRIC           | * SEMBCORP MARINE        | LAND AND HOUSES           |
| 24. | * INDOFOOD SUKSES MAKMUR   | KULIM (MALAYSIA)           | * MANILA WATER            | * SINGAPORE AIRLINES     | LIVE                      |
| 25. | INDOSAT                    | * MALAYAN BANKING          | * MEGAWORLD               | * SINGAPORE EXCHANGE     | MINOR INTERNATIONAL       |
| 26. | * KALBE FARMA              | * MISC BHD.                | * METRO PACIFIC INVS.     | SINGAPORE POST           | PRECIOUS SHIPPING         |
| 27. | * LIPPO KARAWACI           | MMC                        | * METROPOLITAN BK.& TST.  | * SINGAPORE PRESS HDG.   | PRUKSA REAL ESTATE        |
| 28. | MEDCO ENERGI INTL.         | PARKSON HOLDINGS           | * PETRON                  | * SINGAPORE TECHS.ENGR.  | * PTT                     |
| 29. | MITRA ADIPERKASA           | * PETRONAS DAGANGAN        | * PHILEX MINING           | * SINGAPORE TELECOM      | * PTT EXPLORATION & PRDN. |
| 30. | MNC INVESTAMA              | * PETRONAS GAS             | PHILIPPINE NATIONAL BANK  | SMRT                     | QUALITY HOUSES            |
| 31. | PAKUWON JATI               | * PPB GROUP                | PHILP.LONG DSN.TEL.       | * STARHUB                | * RATCHABURI ELECTRICITY  |
| 32. | * PERUSAHAAN GAS NEGARA    | * PUBLIC BANK              | PHILWEB                   | SUNTEC RLST.IT.          | * SHIN                    |
| 33. | PP LONDON SUMATRA INDO.    | * RHB CAP.                 | RIZAL COML..BKG.          | UMW HOLDINGS             | * SIAM CEMENT             |
| 34. | * SEMEN GRESIK             | * SIME DARBY               | * ROBINSONS LD.           | * UNITED OVERSEAS BANK   | * SIAM COMMERCIAL BANK    |
| 35. | SINAR MAS MULTIARTHA       | SP SETIA                   | * SAN MIGUEL              | VENTURE CORP.            | SRI TRANG AGRO-INDUSTRY   |
| 36. | SUMMARECON AGUNG           | * TELEKOM MALAYSIA         | SECURITY BANK             | * WILMAR INTL.           | THAI AIRWAYS INTL.        |
| 37. | * TAMBANG BTBR.BUKIT ASAM  | * TENAGA NASIONAL          | * SEMIRARA MINING         |                          | * THAI OIL                |
| 38. | * TELEKOMUNIKASI INDONESIA | TOP GLOVE                  | * SM INVESTMENTS          |                          | * THAI UNION FROZEN PRDS. |
| 39. | TIMAH                      | * UMW HOLDINGS             | * SM PRIME HOLDINGS       |                          | THANACHART CAPITAL        |
| 40. | * UNILEVER INDONESIA       | WCT HOLDINGS               | UNION BK.OF THE PHILPS.   |                          | THORESEN THAI AG.         |
| 41. | * UNITED TRACTORS          | YTL                        | * UNIVERSAL ROBINA        |                          | TISCO FINANCIAL GROUP     |
| 42. | * VALE INDONESIA           | * YTL POWER INTERNATIONAL  |                           |                          | * TMB BANK                |
| 43. | * XL AXIATA                |                            |                           |                          | TRUE CORPORATION          |



**APPENDIX III: ASEAN STARS LIST (as of December 2013)**

| No. | Indonesia Stock Market   | Malaysia Stock Market    | Philippines Stock Market | Singapore Stock Market | Thailand Stock Market   |
|-----|--------------------------|--------------------------|--------------------------|------------------------|-------------------------|
| 1.  | ASTRA INTERNATIONAL      | CIMB GROUP HOLDINGS      | AYALA LAND               | CAPITALAND             | ADVANCED INFO SER.      |
| 2.  | BANK CENTRAL ASIA        | PUBLIC BANK              | AYALA                    | CAPITAMALLS ASIA       | AIRPORTS OF THAILAND    |
| 3.  | TELEKOMUNIKASI INDONESIA | SIME DARBY               | ABOITIZ EQUITY VENT.     | COMFORTDELGRO          | BANPU                   |
| 4.  | UNILEVER INDONESIA       | TENAGA NASIONAL          | ALLIANCE GLOBAL GP.      | CAPITAMALL TRUST       | BANK OF AYUDHYA         |
| 5.  | BANK MANDIRI             | AXIATA GROUP             | ABOITIZ POWER            | CITY DEVELOPMENTS      | BANGKOK BANK            |
| 6.  | BANK RAKYAT INDONESIA    | MAXIS                    | BANK OF THE PHILP.ISLE.  | DBS GROUP HOLDINGS     | BEC WORLD               |
| 7.  | GUDANG GARAM             | PETRONAS CHEMICALS GP.   | SM PRIME HOLDINGS        | FRASER AND NEAVE       | BANGKOK DUSIT MED.SVS.  |
| 8.  | SEMEN GRESIK             | PETRONAS GAS             | SM INVESTMENTS           | GOLDEN AGRI-RESOURCES  | BIG C SUPERCENTER       |
| 9.  | UNITED TRACTORS          | GENTING                  | BDO UNIBANK              | GENTING SINGAPORE      | CP ALL                  |
| 10. | INDOFOOD SUKSES MAKMUR   | MALAYAN BANKING          | GLOBE TELECOM            | GLOBAL LOGISTIC PROPS. | CHAROEN POKPHAND FOODS  |
| 11. | KALBE FARMA              | DIGI.COM                 | UNIVERSAL ROBINA         | HONG KONG LAND HDG.    | CENTRAL PATTANA         |
| 12. | ASTRA AGRO LESTARI       | IOI                      | DMCI HOLDINGS            | JARDINE MATHESON HDG.  | TOTAL ACCESS COMMS.     |
| 13. | BANK DANAMON INDONESIA   | GENTING MALAYSIA         | INTL.CTNR.TERM.SVS.      | JARDINE CYC.& CARR.    | ELECTRICITY GENERATING  |
| 14. | MEDIA NUSNT.CITRA        | HONG LEONG BANK          | LT GROUP                 | JARDINE STRATEGIC HDG. | GLOW ENERGY             |
| 15. | XL AXIATA                | IHH HEALTHCARE           | GT CAPITAL HOLDINGS      | KEPPEL                 | SHIN                    |
| 16. | ADARO ENERGY             | PETRONAS DAGANGAN        | JOLLIBEE FOODS           | NOBLE GROUP            | IRPC                    |
| 17. | CHAROEN POKPHAND INDO.   | KUALA LUMPUR KEPONG      | METROPOLITAN BK.& TST.   | OVERSEA-CHINESE BKG.   | INDORAMA VENTURES       |
| 18. | VALE INDONESIA           | AMMB HOLDINGS            | PETRON                   | OLAM INTERNATIONAL     | KASIKORNBANK            |
| 19. | AKR CORPORINDO           | SAPURA-KENCANA PETROLEUM | SAN MIGUEL               | SEBICORP INDUSTRIES    | KRUNG THAI BANK         |
| 20. | BANK NEGARA INDONESIA    | MISC BHD.                | BLOOMBERRY RESORTS       | SEBICORP MARINE        | LH FINANCIAL GP.        |
| 21. | BUMI RESOURCES           | RHB CAP.                 | ENERGY DEVELOPMENT       | SINGAPORE EXCHANGE     | PTT                     |
| 22. | INDOFOOD CBP SUKSES MKM. | BRIT.AMER.TOB.(MALAYSIA) | MEGAWORLD                | SIA ENGINEERING        | PTT EXPLORATION & PRDN. |
| 23. | ICT.TUNGGAL PRAKARSA     | TELEKOM MALAYSIA         | METRO PACIFIC INVS.      | SINGAPORE AIRLINES     | PTT GLOBAL CHEMICAL     |
| 24. | INDO TAMBANGRAYA MEGAH   | HONG LEONG FINL.GP.      | SEMIRARA MINING          | SINGAPORE PRESS HDG.   | RATCHABURI ELECTRICITY  |
| 25. | JASA MARGA               | ASTRO MALAYSIA HOLDINGS  | ROBINSONS LD.            | STARHUB                | SIAM COMMERCIAL BANK    |
| 26. | LIPPO KARAWACI           | PPB GROUP                | FIRST GEN                | SINGAPORE TECHS.ENGR.  | SIAM CEMENT             |
| 27. | PERUSAHAAN GAS NEGARA    | UMW HOLDINGS             | MANILA WATER             | SINGAPORE TELECOM      | SIAM CITY CEMENT        |
| 28. | TAMBANG BTBR.BUKIT ASAM  | YTL POWER INTERNATIONAL  | SAN MIGUEL PURE FOODS    | THAI BEVERAGE PUBLIC   | TMB BANK                |
| 29. | HOLCIM INDONESIA         | FELDA GLOBAL VENT.HDG.   | JG SUMMIT HDG.           | UNITED OVERSEAS BANK   | THAI OIL                |
| 30. | GLOBAL MEDIACOM          | UEM SUNRISE              | PHILEX MINING            | WILMAR INTL.           | THAI UNION FROZEN PRDS. |

Source of data: [www.aseanexchanges.org/Default.aspx](http://www.aseanexchanges.org/Default.aspx)

#### APPENDIX IV: TESTING FOR FLUCTUATION OF ESTIMATED PARAMETERS

Extended to the section 8, this paper investigate whether correlations are steadily increasing or dynamically fluctuating overtime, the whole data sets are divided into 5 rolling-period ; (1) January 2003 to December 2009, (2) January 2004 to December 2010, (3) January 2005 to December 2011, (4) January 2006 to December 2012, and (5) January 2007 to December 2013. Then, permutation test are performed to each rolling-periods.

The test results of the first 2 rolling-periods illustrate the notable increasing correlation structure, except Singapore as expected. For the third rolling-periods, the result shows the slightly increasing structure, only some of them are significant at 90% confidence level. Surprisingly, for the last two rolling-periods, the differences of correlation are all negative, including Singapore, or, in other word, the correlation structure is decreasing, which some of them are statistical significant. The significant values of the 5<sup>th</sup> rolling-periods are shown in Table IV.<sup>14</sup>

**TABLE IV:**  
**Parameters Stability Test Using Permutation Method**  
*(January 2007 – December 2013)*

The table reports the result of the parameters stability test using permutation test with the MSCI data starting from January 2007 – December 2013. The permutation test is the non-parametric tests which divides the data series into 2 parts and randomly reshuffle the series for 1,000 times. Each time, the difference of interesting parameters, in this case is correlation and skewness, of those two periods are recorded. Finally, the distributions of differences are drawn. For 95% (90%) confidence level, if the actual difference is higher than the difference at 97.5% (95%) or lower than the difference at 2.5% (5%) of the distribution, it is marked with \* (\*\*) as significant change.

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<sup>14</sup> To save the space, the only the result of the 5<sup>th</sup> rolling-periods are shown here.

|                   | 1. INDONESIA | 2. MALAYSIA | 3. PHILIPPINES | 4. SINGAPORE | 5. THAILAND |
|-------------------|--------------|-------------|----------------|--------------|-------------|
| 1. CZECH REPUBLIC | -0.42 **     | -0.01       | -0.14          | -0.12        | -0.15       |
| 2. DENMARK        | -0.42 **     | -0.28       | -0.16          | 0.00         | -0.22       |
| 3. EGYPT          | -0.49 *      | -0.27       | -0.15          | -0.12        | -0.31       |
| 4. FINLAND        | -0.38 **     | -0.06       | 0.00           | 0.05         | -0.12       |
| 5. ITALY          | -0.45 *      | -0.21       | -0.18          | -0.09        | -0.35 **    |
| 6. JAPAN          | -0.42 **     | -0.39 **    | -0.22          | -0.33        | -0.29       |
| 7. PORTUGAL       | -0.39 **     | -0.27       | -0.27          | -0.11        | -0.35       |
| 8. SPAIN          | -0.45 *      | -0.27       | -0.25          | -0.21        | -0.39 **    |

However, when the test is performed on the exchange rate, like what have been done for correlation, no concrete pattern; some are positive or negative, is found.

### APPENDIX V: 3 HIGHEST-WEIGHTED STOCKS FROM EACH ASEAN COUNTRY

#### Indonesia Investors' Perspective

| Country | Stock                 | P1 = 1, P3 = 0 |       |       |       |       |
|---------|-----------------------|----------------|-------|-------|-------|-------|
|         |                       | 2009           | 2010  | 2011  | 2012  | 2013  |
| ID      | UNILEVER INDONESIA    | 11.3%          | 11.5% | 10.1% | 14.8% | 15.9% |
|         | BANK CENTRAL ASIA     | 3.2%           | 5.2%  | 2.5%  | 0.0%  | 0.9%  |
|         | GUDANG GARAM          | 0.0%           | 0.0%  | 0.5%  | 1.8%  | 0.7%  |
| MY      | TELEKOM MALAYSIA      | 7.8%           | 10.8% | 17.5% | 24.4% | 25.1% |
|         | PETRONAS DAGANGAN     | -              | -     | -     | 9.0%  | 8.5%  |
|         | DIGI.COM              | 5.3%           | 5.1%  | 20.2% | 14.9% | 3.3%  |
| PH      | ABOITIZ EQUITY VENT.  | 0.0%           | 2.7%  | 7.7%  | 9.6%  | 11.2% |
|         | SM PRIME HOLDINGS     | 0.0%           | 0.1%  | 0.0%  | 0.5%  | 2.8%  |
|         | SEMIRARA MINING       | -              | -     | -     | 1.0%  | 2.2%  |
| SG      | JARDINE MATHESON HDG. | 16.9%          | -     | -     | 4.7%  | 3.7%  |
|         | STARHUB               | -              | -     | 4.1%  | 0.0%  | 0.0%  |
|         | SINGAPORE TELECOM     | 0.0%           | 0.0%  | 0.0%  | 0.0%  | 0.0%  |
| TH      | ADVANCED INFO SER.    | 0.0%           | 0.0%  | 1.9%  | 8.2%  | 10.6% |
|         | HOME PRODUCT CENTER   | -              | -     | -     | 0.8%  | 4.6%  |
|         | CP ALL                | -              | 0.0%  | 0.2%  | 0.5%  | 4.1%  |

| Stock                    |
|--------------------------|
| MITRA ADIPERKASA         |
| TELEKOMUNIKASI INDONESIA |
| GUDANG GARAM             |
| BRIT.AMER.TOB.(MALAYSIA) |
| AIRASIA                  |
| TELEKOM MALAYSIA         |
| SAN MIGUEL               |
| ENERGY DEVELOPMENT       |
| METRO PACIFIC INVS.      |
| GENTING SINGAPORE        |
| STARHUB                  |
| JARDINE MATHESON HDG.    |
| HOME PRODUCT CENTER      |
| CP ALL                   |
| PTT                      |

#### Malaysia Investors' Perspective

| Country | Stock                    | P1 = 1, P3 = 0 |       |       |       |       |
|---------|--------------------------|----------------|-------|-------|-------|-------|
|         |                          | 2009           | 2010  | 2011  | 2012  | 2013  |
| ID      | UNILEVER INDONESIA       | 0.7%           | 2.2%  | 0.9%  | 4.7%  | 6.4%  |
|         | LIPPO KARAWACI           | 7.7%           | 3.1%  | 0.0%  | 0.0%  | 0.0%  |
|         | MITRA ADIPERKASA         | -              | -     | -     | -     | 0.0%  |
| MY      | TELEKOM MALAYSIA         | 10.2%          | 13.2% | 18.1% | 26.2% | 22.6% |
|         | PETRONAS DAGANGAN        | -              | -     | -     | 19.7% | 20.4% |
|         | BRIT.AMER.TOB.(MALAYSIA) | 6.5%           | 0.0%  | 12.8% | -     | 4.7%  |
| PH      | ABOITIZ EQUITY VENT.     | 0.0%           | 4.7%  | 4.4%  | 6.7%  | 7.0%  |
|         | SM PRIME HOLDINGS        | 0.0%           | 0.0%  | 0.8%  | 4.7%  | 4.1%  |
|         | SEMIRARA MINING          | -              | -     | -     | 1.0%  | 2.5%  |
| SG      | STARHUB                  | -              | -     | 3.1%  | 1.1%  | 3.2%  |
|         | JARDINE MATHESON HDG.    | 8.5%           | -     | -     | 1.9%  | 2.1%  |
|         | SINGAPORE PRESS HDG.     | 0.0%           | 0.0%  | 0.0%  | 0.0%  | 0.0%  |
| TH      | ADVANCED INFO SER.       | 0.0%           | 0.0%  | 3.7%  | 7.5%  | 9.0%  |
|         | CP ALL                   | -              | 0.0%  | 0.2%  | 1.6%  | 5.0%  |
|         | BERLI JUCKER             | -              | -     | -     | -     | 0.8%  |

| Stock                    |
|--------------------------|
| MITRA ADIPERKASA         |
| LIPPO KARAWACI           |
| TELEKOMUNIKASI INDONESIA |
| BRIT.AMER.TOB.(MALAYSIA) |
| AIRASIA                  |
| YTL POWER INTERNATIONAL  |
| ENERGY DEVELOPMENT       |
| FIRST GEN                |
| METRO PACIFIC INVS.      |
| GENTING SINGAPORE        |
| STARHUB                  |
| SINGAPORE EXCHANGE       |
| CP ALL                   |
| THANACHART CAPITAL       |
| LAND AND HOUSES          |

### APPENDIX V: 3 HIGHEST-WEIGHTED STOCKS FROM EACH ASEAN COUNTRY (continue)

**Philippines Investors' Perspective**

| Country | P1 = 1, P3 = 0         |      |      |       |       |       |
|---------|------------------------|------|------|-------|-------|-------|
|         | Stock                  | 2009 | 2010 | 2011  | 2012  | 2013  |
| ID      | UNILEVER INDONESIA     | 0.3% | 3.6% | 1.7%  | 6.9%  | 7.1%  |
|         | MITRA ADIPERKASA       | -    | -    | -     | -     | 0.0%  |
|         | CHAROEN POKPHAND INDO. | 0.0% | -    | 0.0%  | 0.0%  | 0.0%  |
| MY      | TELEKOM MALAYSIA       | 7.1% | 5.5% | 12.5% | 21.4% | 22.8% |
|         | PETRONAS DAGANGAN      | -    | -    | -     | 18.8% | 19.6% |
|         | DIGI.COM               | 6.9% | 9.6% | 17.9% | 14.2% | 1.9%  |
| PH      | ABOITIZ EQUITY VENT.   | 0.0% | 4.0% | 10.0% | 8.9%  | 10.0% |
|         | SEMIRARA MINING        | -    | -    | -     | 4.7%  | 5.0%  |
|         | SM PRIME HOLDINGS      | 0.0% | 0.0% | 0.0%  | 2.9%  | 4.9%  |
| SG      | STARHUB                | -    | -    | 4.2%  | 0.7%  | 1.7%  |
|         | JARDINE MATHESON HDG.  | 6.7% | -    | -     | 0.0%  | 0.0%  |
|         | COMFORTDELGRO          | -    | 0.0% | -     | -     | 0.0%  |
| TH      | ADVANCED INFO SER.     | 0.0% | 0.0% | 4.7%  | 13.8% | 12.7% |
|         | CP ALL                 | -    | 0.6% | 3.9%  | 2.2%  | 7.7%  |
|         | BERLI JUCKER           | -    | -    | -     | -     | 1.4%  |

| Stock                    |
|--------------------------|
| MITRA ADIPERKASA         |
| LIPPO KARAWACI           |
| GUDANG GARAM             |
| BRIT.AMER.TOB.(MALAYSIA) |
| AIRASIA                  |
| YTL POWER INTERNATIONAL  |
| FIRST GEN                |
| ENERGY DEVELOPMENT       |
| METRO PACIFIC INVS.      |
| GENTING SINGAPORE        |
| STARHUB                  |
| SINGAPORE EXCHANGE       |
| CP ALL                   |
| HOME PRODUCT CENTER      |
| ADVANCED INFO SER.       |

**Singapore Investors' Perspective**

| Country | P1 = 1, P3 = 0         |       |       |       |       |       |
|---------|------------------------|-------|-------|-------|-------|-------|
|         | Stock                  | 2009  | 2010  | 2011  | 2012  | 2013  |
| ID      | UNILEVER INDONESIA     | 1.1%  | 3.1%  | 2.1%  | 7.6%  | 8.0%  |
|         | MITRA ADIPERKASA       | -     | -     | -     | -     | 0.0%  |
|         | CHAROEN POKPHAND INDO. | 0.0%  | -     | 0.0%  | 0.0%  | 0.0%  |
| MY      | TELEKOM MALAYSIA       | 8.2%  | 10.2% | 14.9% | 23.0% | 20.3% |
|         | PETRONAS DAGANGAN      | -     | -     | -     | 18.9% | 18.8% |
|         | HONG LEONG BANK        | 0.0%  | 0.0%  | 0.0%  | 1.0%  | 5.6%  |
| PH      | ABOITIZ EQUITY VENT.   | 0.0%  | 1.9%  | 2.9%  | 5.7%  | 6.3%  |
|         | SM PRIME HOLDINGS      | 0.0%  | 0.0%  | 0.4%  | 3.3%  | 3.6%  |
|         | SEMIRARA MINING        | -     | -     | -     | 1.9%  | 3.3%  |
| SG      | STARHUB                | -     | -     | 3.6%  | 1.8%  | 5.2%  |
|         | JARDINE MATHESON HDG.  | 12.6% | -     | -     | 1.4%  | 1.4%  |
|         | SINGAPORE PRESS HDG.   | 0.0%  | 0.0%  | 0.0%  | 0.0%  | 0.0%  |
| TH      | ADVANCED INFO SER.     | 0.2%  | 0.0%  | 4.0%  | 9.3%  | 9.9%  |
|         | CP ALL                 | -     | 0.0%  | 0.1%  | 0.9%  | 4.7%  |
|         | BERLI JUCKER           | -     | -     | -     | -     | 1.2%  |

| Stock                    |
|--------------------------|
| MITRA ADIPERKASA         |
| TELEKOMUNIKASI INDONESIA |
| LIPPO KARAWACI           |
| BRIT.AMER.TOB.(MALAYSIA) |
| AIRASIA                  |
| MISC BHD.                |
| ENERGY DEVELOPMENT       |
| METRO PACIFIC INVS.      |
| FIRST GEN                |
| GENTING SINGAPORE        |
| STARHUB                  |
| JARDINE MATHESON HDG.    |
| CP ALL                   |
| HOME PRODUCT CENTER      |
| THANACHART CAPITAL       |

**APPENDIX V: 3 HIGHEST-WEIGHTED STOCKS FROM EACH ASEAN COUNTRY (continue)**

**Thailand Investor Perspective**

| Country | P1 = 1, P3 = 0           |       |      |       |       |       |
|---------|--------------------------|-------|------|-------|-------|-------|
|         | Stock                    | 2009  | 2010 | 2011  | 2012  | 2013  |
| ID      | UNILEVER INDONESIA       | 0.1%  | 2.3% | 1.3%  | 6.7%  | 6.2%  |
|         | MITRA ADIPERKASA         | -     | -    | -     | -     | 0.1%  |
|         | SINAR MAS MULTIARTHA     | -     | -    | -     | -     | 0.0%  |
| MY      | TELEKOM MALAYSIA         | 7.5%  | 8.8% | 15.8% | 21.4% | 22.1% |
|         | PETRONAS DAGANGAN        | -     | -    | -     | 20.3% | 19.0% |
|         | BRIT.AMER.TOB.(MALAYSIA) | 0.5%  | 0.0% | 1.0%  | -     | 0.9%  |
| PH      | ABOITIZ EQUITY VENT.     | 0.0%  | 2.6% | 6.8%  | 8.5%  | 9.1%  |
|         | SM PRIME HOLDINGS        | 0.0%  | 0.0% | 0.0%  | 1.8%  | 4.2%  |
|         | SEMIRARA MINING          | -     | -    | -     | 1.5%  | 3.1%  |
| SG      | STARHUB                  | -     | -    | 5.9%  | 0.9%  | 1.6%  |
|         | JARDINE MATHESON HDG.    | 10.8% | -    | -     | 0.0%  | 0.0%  |
|         | SINGAPORE PRESS HDG.     | 0.0%  | 0.0% | 0.0%  | 0.0%  | 0.0%  |
| TH      | ADVANCED INFO SER.       | 0.7%  | 0.0% | 4.7%  | 15.0% | 17.1% |
|         | CP ALL                   | -     | 0.9% | 5.1%  | 1.7%  | 7.0%  |
|         | HOME PRODUCT CENTER      | -     | -    | -     | 1.3%  | 3.1%  |

| Stock                    |
|--------------------------|
| MITRA ADIPERKASA         |
| LIPPO KARAWACI           |
| GUDANG GARAM             |
| BRIT.AMER.TOB.(MALAYSIA) |
| AIRASIA                  |
| GENTING MALAYSIA         |
| FIRST GEN                |
| ENERGY DEVELOPMENT       |
| JOLLIBEE FOODS           |
| GENTING SINGAPORE        |
| STARHUB                  |
| SINGAPORE EXCHANGE       |
| CP ALL                   |
| THANACHART CAPITAL       |
| LAND AND HOUSES          |

## **Part II) The Impact of AEC inclusion on equity trading of ASEAN stocks:**

### **A forward assessment before integration**

#### **Abstract**

Full financial integration of ASEAN Economic Community (AEC) development plan is taking place at the end of 2015. Provided institutional infrastructures are in place, investors across AEC member should be able to trade individual equity stocks in the region. It has been widely reported that financial openness is beneficial. However the impact to financial markets of the integrated zone is unclear since there are very few natural experiments. This paper intends to answer if the AEC will be beneficial to equity investors of the integrated zone. The implementation of ASEAN Linkage and ASEAN STARS index in 2012 provides unique opportunity to study the effect of index inclusion on stocks that are not easily accessible prior to the effective inclusion. These stocks are already in the local Thai index and MSCI indices. Thus, it is not the inclusion to the index that we test, but rather if inclusion to international index in which each stock will be traded cross-country has an impact on liquidity short-term and long-term. This research investigates short term using intraday data of 2.5 months and long term daily data of one year. We test changes of stock liquidity in event studies of inclusion day. A significant improvement of transaction cost during the two months period following index inclusion was observed. Tests of other long term liquidity changes found significant improvement in price impact (illiquidity decreased by 17.43 percent), volume (increased by 29.89 percent), and free float adjusted turnover (increased by 6.82 percent) during one year period after index inclusion and ASEAN Linkage implementation.

JEL classification F36; F3; G1

Keywords ASEAN financial integration; International Finance; General Financial Markets; Index Inclusion

## 1. INTRODUCTION

There is some evidence that financial openness spurs economic growth. For example, Bekaert, Harvey, and Lundblad (2005) and Quinn and Toyoda (2008) document strong growth effects. Prasad, Rogoff, Wei, and Kose (2009) report the evidence “mixed.” Also, there are few natural experiments of financial openness and its benefits. In the standard “neo-classical” model, a capital market liberalization lowers the cost of capital, thereby inducing additional investment and a temporary growth response. However, direct decrease in the cost of capital appears rather modest (Bekaert & Harvey, 2000; Henry, 2000). This paper employs the natural experiment of ASEAN Economic Community (AEC) development to assess if there are benefits in the financial markets for lower cost of capital in an economic zone through efficiency and higher liquidity in the capital market. Prior to year 2012, the price settling system among stock markets in ASEAN were separated resulting in a practical barrier for most retail investors to invest in cross-markets. As part of AEC development plan to be fully integrated in 2015, ASEAN Linkage, which is a system of transaction settling and clearing for stock markets of ASEAN countries, was established in early 2014. Although this platform has become fully functional for all member countries in 2014, the preliminary establishment of ASEAN Linkage between Singapore Stock Exchange (SGX) and Malaysia Bursa (MB) was firstly initiated in 2012. Later on, in October 2012, Stock Exchange of Thailand (SET) joined this stock market integration.

Before the stock market integration among the three markets in 2012, the stocks available in each country could not available for investment by retail investors from the other ASEAN countries. With the introduction of ASEAN Linkage and ASEAN STARS index, investors could trade stocks in the ASEAN STARS index even though they were listed in another country. This provided a unique opportunity to understand cross-border stock trades that have not been available before.

Accompanying this new integration, ASEAN STARS index was introduced to promote investment in cross-markets. The index consists of 30 largest as measured by market capitalization and most liquid stocks in each member market, except Vietnam where 15 stocks for each of its market were included. Similar to the case of ASEAN Linkage, the early introduction of this index was implemented along with the SGX-MB-SET initial linkage. The selection criteria is based on the size and liquidity of the stocks in each exchange.



Stock inclusion into indices usually has positive effect to its price and volume. Several studies have documented these evidences (Harris and Gurel (1986); Hegde and McDermott (2003); Liu (2006)). The main differences of these studies were in the persistency of these so called “index effect” in the longer term period. However, study has detected positive liquidity improvement accompanied the stock inclusion (Hegde and McDermott (2003)). These evidences suggested that the liquidity of stocks may be improved through inclusion into index. This improvement was also consistently observed in international index listing (Chakrabarti, Huang, Jayaraman and Lee (2005)). The stocks that we analyzed are already in local indices and in MSCI index. Thus, we investigate the promotion and actual direct trade availability across country through the ASEAN community. Is there liquidity improvement resulting from the adoption of ASEAN Linkage and ASEAN STARS index?

Understanding the potential effects of this inclusion would provide useful insights for both market participants and regulators. This may be a potential indicator of future responses to market integration within the AEC work plan. According to the AEC memorandum of understanding, the capital market would be fully opened to all ASEAN members in the end of 2015, and this research would shed some understanding on the potential outcome of the market. Hence, studying the liquidity changes of stock included in the index is not only interesting in the sense that the stocks were included in an international index, which should increase the investor attention toward the firms, it was also interesting because of the potential insights toward AEC market integration.

In this study, the target index to be studied was ASEAN STARS, which has been recently established accompanied by the implementation of ASEAN Linkage. Since similar indices have been available for a long period prior to introducing ASEAN STARS, the funds that have ability to invest in cross-border markets would have obtain their position in these stocks already. The initial introduction of this index would not attract attention of index at once since there was not any index fund following the ASEAN STARS. This study would then elucidate the effect of ASEAN STARS index stock inclusion of stock liquidity. This would provide useful information regarding to the cross-border trading activities of retail investors from other markets.

The study focused on both the short term effect and long term effect of this inclusion. Intraday percent quoted spread was used for short term liquidity study of up to 51 days before

and after the effective trading date. Other measures were also used to study the impact of ASEAN Linkage. They include price impact, daily percent quoted spread, volume, and turnover. One year study period before and after effective date was used. The period set to study the long term effect was relatively long because market participants, especially the retail investors may need time before engaging in this newly introduced platform and the index.

The main contributions of this research were (1) the study explored the index effect under a unique condition; stocks that are not easily accessible to foreign individual investors prior to the inclusion (2) this research provided useful insights about the future liquidity development after AEC integration.

The remainder of this paper is as follows. The next section provided related literature mostly on index inclusion effects. The methodology employed in this study is presented in the third section. Then we present empirical results in section 4. Section 5 presents conclusions and implications of our study.

## **2. LITERATURE REVIEW**

### **2.1 Index effect**

There are rich existing literatures supporting the increase in abnormal return of index included stocks as well as the positive index effect on stock volume. In general, consistent results on positive abnormal return and volume of the included stocks were observed widely in literatures (Harris and Gurel (1986); Hegde and McDermott (2003); Shleifer (1986)). However, the differences lied in the persistency of these outcomes once the stocks were effectively added into the indices. Harris and Gurel observed reversion of stock prices after effective date (Harris and Gurel (1986)), whereas others detected a permanent increase in stock prices instead (Dhillon and Johnson (1991); Jain (1987); Shleifer (1986)).

On the other hand, some studies found a long term increase in volume even after the effective adjustment period while other evidence the reversion of the elevated volume after added (Harris and Gurel (1986)). In addition, other dimensions of liquidity were also elucidated in literatures, and the findings were both reversion and without reversion of these liquidity measures (Hegde and McDermott (2003)). Hence, these variations in the findings

from different markets lead to different hypotheses in explaining the index effect phenomenon. Several hypotheses were proposed including price pressure, downward sloping demand, information hypothesis, attention hypothesis, and liquidity.

Study observed that the abnormal return occurred before the effective date gradually decrease afterward, thus it was hypothesized that the increase in price was resulted from the stock purchase of index funds as dictated by the index rebalancing. Since index funds mainly adjust their position according to the change of the index inclusion and exclusion, the increase in stock trading was only temporally, and a reversion of stock price level should be observed after the effective rebalancing was accomplished (Harris and Gurel (1986 )).

On the contrary, for studies with less or no return reversion after effective date, downward sloping demand curve hypothesis was proposed. The hypothesis was rather opposite of the efficient market hypothesis in which all of the current information of the stock should be priced in, and no additional change in prices should occur without new information available. Therefore, this suggests that stock price is elastic and should have a linear stock demand curve. The downward sloping demand curve hypothesis argued that the abnormal return came from the permanent elevated demand since stock is unique and imperfectly substitutable for each other. Hence, resulting in a downward sloping demand curve until the market reaches new equilibrium (Shleifer (1986 )).

Information hypothesis proposed that the index or the large funds in other cases possess superior information of the firms, and therefore select these firms to include accordingly. Hence, an index inclusion should represent hidden value of the targeted stocks, and the price should be traded at greater level (Dhillon and Johnson (1991); Jain (1987 )).

Moreover, study also argued that the abnormal return was generated from the higher liquidity of stocks included. With this increase in liquidity, the cost of carrying out a trade with the stock is reduced. According to Hedge and McDermott, although initially study observed long term abnormal return increase but not the liquidity, and hence ruled out the possibility of improved liquidity as the cause of abnormal return. However, recent study found permanent (60 days) increase of liquidity as determined by bid-asked spreads (Hegde and McDermott (2003 )). This indicated that the liquidity may not be discarded as the source of permanent price increase.

Since evidences supporting each hypothesis were observed, it should be emphasized that these mechanisms are not mutually exclusive meaning that they can collectively affect stock price at the same time. This concept has been well illustrated by the literature where no single underlying hypothesis has been proven as the sole source of abnormal return following index inclusion.

## **2.2 Effect of index rebalancing on stock price, volume, and liquidity**

### **2.2.1 Effect of index rebalancing in developed markets**

In the US, early investigation of the index effect of Standard and Poor's 500 (S&P500) index was conducted and abnormal return or abnormal wealth effect was observed (Shleifer (1986)). Positive abnormal return was detected for the stock inclusion, and the positive effect persisted within the study period of 20 days. Furthermore, research focus was extended to include the volume effect of index inclusion (Harris and Gurel (1986)). Beside the observed abnormal return, a non-persistent significant positive volume effect was observed during the index rebalancing. More recent studies also observed both increase asset prices as well as volume during the rebalancing period; nonetheless, they differed in the persistency of the price and volume index effect. Some studies found persistent wealth effect while other observed only short term increase of return with a price reversion after stock addition (Lynch and Mendenhall (1995)).

For other developed countries beside the US, positive index effect on both price and volume was consistently observed. In Japan, effect of index rebalancing of Nikkei500 and Nikkei225 were thoroughly investigated (Liu (2000); Liu (2006); Okada, Isagawa and Fujiwara (2006)). The studies revealed increase in abnormal return and temporally increase in volume. Interestingly, a study in Nikkei500 revealed a persistent increase in return(Liu (2000)). It is noteworthy that this study focused solely on the announcement date as the event date without considering the effective date. Thus, the same researcher later on focused on the Nikkei225, which was claimed to be more closely watched by investors in order to confirm the previous study as well as to study the arbitrage effect during the announcement and effective date (Liu (2006)). Results indicated a more pronounce temporally volume effect of the index comparing to the finding from Nikkei500. As for the price level, the increase in price, although

was accompanied by a significant reversal due to the arbitrage activities, still remained persistently at elevated level after index addition. Similar finding but with different conclusion in terms of return persistency was observed. A study also detected the return reversal presumably due to the arbitrage effect between the announcement date and effective date was detected (Okada, Isagawa and Fujiwara (2006 )).

Index effect on international country indices was examined (Chakrabarti, Huang, Jayaraman and Lee (2005 )). The study determined effect of index inclusion and exclusion of 29 country indices. The results were consistent with previous studies where positive abnormal return and increase in volume were detected accompanying the index rebalancing. However, part of the gain in prices declined after the effective change date. As for the volume, a permanent increase of up to 10 days after the effective date was observed. Interestingly, the study noted that this significant permanent volume effect was observed mainly in the developing markets and other non-US markets but not in the US stocks.

In contrast to the price and volume effect of index inclusion and exclusion, which was well-studied, study regarding to the changes in other liquidity measures following an index rebalancing is rather limited. A research focused on the liquidity changes of stocks included and deleted from S&P500 stock index during 1993 to 1998 (Hegde and McDermott (2003 )). Permanent liquidity improvement (3-month period as the study window) of stock included into the index was observed, whereas stock deleted from the index faced gradual decline in liquidity. The mean and median of both the quoted and effective spreads were found to be significantly decreased as well as the quoted dollar dept, trading volume, and trading frequency. These changes were found to resulting from the decrease in direct-price of trades as indicated by the decrease in both time-weighted absolute and relative spreads. Highest period of spread decrease was observed after the stock addition. This study suggested that the long term liquidity did improve after index inclusion, and the improvement in liquidity may not be totally excluded from explaining abnormal return.

#### 2.2.2 Effect of index rebalancing in emerging markets

Index rebalancing effect in emerging markets was also examined by studies (Bildik and Gülay (2008); Yun and Kim (2010 )). In Turkey, a study was conducted to evaluate the stock

inclusion and exclusion effects on the Istanbul Stock Exchange (ISE) index (Bildik and Gülay (2008)). The aim of the research was to determine the potential cause of the index effect because the ISE index at that time was argued by the author to be free of information effect and contain limited price pressure effect from the index funds due to the small size of those institutions. The result of ISE-100 and ISE-30 confirmed the existence of abnormal return during the announcement date, and the effect increases and persists until after the effective index adjustment date. The study therefore concluded that the index effect was due to the price pressure, downward sloping demand, and attention hypotheses.

In the case of Korea, which was in the process of moving toward being a developed country, research targeting the index effect of Korea Stock Exchange Price Index (KOSPI) 200 was carried out (Yun and Kim (2010)). The study suggested a permanent (up to 60 days) positive price effect associating with the stock inclusion as well as the observed significant short-run (around 10 days) elevated volume during the index rebalancing period.

### 2.2.3 Effect of index rebalancing in Thailand

There were a few previous studies in Thailand focusing on the index effect of SET50 index (Keratithamkul (2005); Teerapongpratya (2010); Triempanichgul (2010)). Early study of SET50 inclusion and exclusion on stock price and return was studied (Keratithamkul (2005)). Significant abnormal return of 0.33% and 0.37% was observed on the announcement date in the case of inclusion and exclusion, respectively. The positive abnormal return of the inclusion was concluded as resulting from the downward sloping demand curve, whereas the positive return of index exclusion was claimed to be from the use of private information.

The scope of SET50 study was then extended to increase the study period and include the volume effect into consideration (Teerapongpratya (2010)). Consistently with the previous research, the study detected positive abnormal return of 0.27% for inclusion and a slightly negative return of -0.02% for the exclusion on the announcement date. In addition, the long term abnormal return was still observed at 7 days after effective date. As for the volume effect, the study detected significant positive volume effect one day prior the effective date.

Furthermore, the effect of index inclusion and exclusion of SET50 was further extended to include the liquidity effect as measured by quoted spread, volume, turnover, and price impact (Triempanichgul (2010)). The permanent effect window of 30 days was implemented, and the study detected positive abnormal return of 0.48% and 0.01% based on the market model in the case of inclusion and exclusion, respectively. However, when employed the market-adjusted method the returns were 1.15% and - 0.03% for inclusion and exclusion accordingly. The study also found persistent positive and negative abnormal returns for inclusion and exclusion, respectively. Collectively, no significant volume and liquidity increase was observed at announcement date, whereas significant changes were detected around the effective date indicating the rebalancing of index funds.

### **2.3 Liquidity measures**

Liquidity is rather an elusive concept, which is hard to be measured completely by any single measure. This is mainly due to the various dimensions of liquidity including tightness, depth, and resiliency (Lesmond (2005)). Definition of being liquid may include an ability to issue large trade at ease any time without affecting the price of the asset. Hence, empirically liquidity may be measured through direct-cost of trade such as those determined by bid-asked spreads, indirect-cost as measured by market depth and price impact.

Lesmond (2005) found that volume only captures the order flow of any given stocks not exactly the cost of transactions. Amihud in 2002 has developed a volume based daily liquidity measure that captures both the order flow and the transaction cost (Amihud (2002)). Specifically, the Amihud illiquidity measure captures the price response toward order flow or price impact. The illiquidity measure has been widely employed by various studies due to its rather simple computation using mostly available data available in most markets. The effectiveness of this measure in being a proxy of illiquidity (therefore also liquidity) was tested against other volume based liquidity measures. The studies revealed high efficacy of Amihud measure over others. Lesmond found that the measure better explained the domestic liquidity comparing to other similar measures (Lesmond (2005)).

## 2. DATA AND RESEARCH METHODOLOGY

### 3.1 Data

The stocks initially included in the ASEAN STARS index on 15 October 2012 were used. The listed firms included into the ASEAN STARS index were screened for removal of any stock that had undergone major merger and acquisition within the 6-month period before index inclusion. This was to avoid observing any significant changes of liquidity due to confounding events. The list of the included stocks on 15 October 2012 was presented in the appendix A. Both intraday and daily stock data of the corresponding stocks were employed in this study.

This study collected the inter-daily submitted order from the SET. The intraday consisted of 2 and a half month period trading data (51 trading days) prior and after index effective date on 15 October 2012. Dataset included all bid and ask orders submitted to the exchange within the day. The first few minutes of each trading session as well as the pre-open and call market periods were discarded to avoid market open/close procedure, additional information arrived overnight, and dividend payout.

The daily data were retrieved from SETSMART as provided by the SET. The information of stock prices and trading volume of about one year before (235 trading days) and one year after the index effective date were collected.

These periods were chosen since the study aims to elucidate both short-term effect and long-term effect of the ASEAN STARS index and ASEAN Linkage implementation. However, due to the limited intraday data, which was available up to the end of 2012 when this research was carried out, daily liquidity measures were employed to evaluate the potential long-term liquidity change.

A one year long term liquidity changes of the included stocks were analyzed. This is included in order to determine the long term effect of index rebalancing since most literatures have consistently detected abnormal return and volume increase after the index inclusion but not collectively agree on the persistency of long term changes of liquidity (Chakrabarti, Huang, Jayaraman and Lee (2005); Hegde and McDermott (2003)). Hence, it is also important to determine whether stock inclusion into index would provide a sustainable improvement in



trading cost and other dimensions of liquidity, especially in the case of ASEAN market integration.

Moreover, the ASEAN Linkage and ASEAN STARS index might have more influences on retail investors and liquidity traders than index fund investors since the large institutional investors might already have the access to the cross-border trading. As a result, the effect of this new market connection platform and the newly introduced index may not trigger significant change in the short period of time. Thus, the long term liquidity investigation of up to one year was focused.

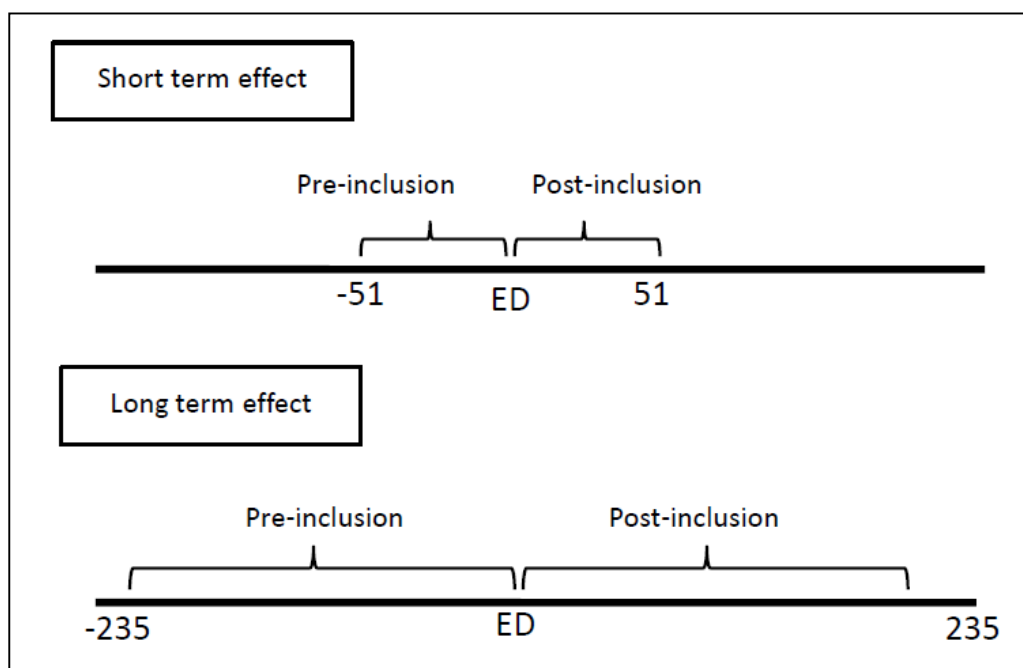
### 3.2 Event window

In the case of short term liquidity investigation using intraday short-term liquidity measure, the index effective date (ED) is 15 October 2012. Since the list of included stocks in the index was not available to investors prior to the effective date, no announcement period was setup in this study. The data available for short term effect ranges between the 51 trading days before ED (ED-51) to 51 days after ED (ED+51). The liquidity of stocks after being included in the index as indicated by the ED was compared with measure prior to the inclusion. The ending period was set to (ED+51) due to the limited intraday data available when the study was conducted. Moreover, most of the previous studies regarding to index effect in Thai stock only limited the window to 30 days, hence the selected study period should provide sufficient information. The event window for this study is illustrated in figure 3.1.

As for the long-term study period selected to evaluate the persistency of liquidity changes, the data 235 days before and after ED, (ED-235) to (ED+235) were applied. The length of this research window was around one year before and after the event date. Moreover, the ending period was set to (ED+235) which is rather long in order to capture the potential late liquidity development after the ASEAN Linkage is fully implemented.

Figure 3.1 Study periods

This study investigated both short term and long term changes in liquidity following the event date. The event date is on 15 October 2012 when the ASEAN Linkage was first implemented and the 30 stocks were initially included into the ASEAN STARS index.



Although previous research studies also focused on the liquidity changes during the announcement period, in this study only the effective date were focused. This was because the ASEAN Link network was officially connected on the same effective date as ASEAN STARS index, there should be no transactions contributed from other two linked markets (e.g. SGX and MB). More importantly, the list of targeted stocks for the ASEAN STARS index was not officially available prior to the effective date when the index was newly established. As a result, only the effective date was studied in order to elucidate the liquidity effect from the establishment of this central connecting hub.

### 3.3 Intraday liquidity measures

The intraday percent quoted spread was chosen as the measure of liquidity; specifically this is to determine the direct-transaction cost of the trade. The intraday data of each day were used in creating a time-weighted average daily quoted spread. An advantage of implementing intraday measure of percent quoted spread over daily percent quoted spread was that intraday data also capture the changes of this spread within the trading hours. The short few minutes at the beginning of each session, the pre-open, and call-market were excluded in order to avoid the trading fluctuation during market open and market close procedures. For each of the 30 stocks, the trading orders were separated into different intervals of 5, 10, 15, and 20 minute interval. The interval with least missing trading interval within the day was then chosen for further study. For each interval, the highest bid price, lowest asks price, quoted spread, and the mid price were determined (eq. (1) and (2)). The percent quoted spread for each interval was computed by (3) (Ananpattanakul (2009 ));

$$\text{Quoted Spread}_{it} = \text{Best Ask Price}_{it} - \text{Best Bid Price}_{it}, \quad (1)$$

where,  $i$  = stock  $i$ , and  $t$  = time interval  $t$  of that day

$$\text{Mid Price}_{it} = \frac{\text{Best Ask Price}_{it} - \text{Best Bid Price}_{it}}{2} \quad (2)$$

$$\text{Percent Quoted Spread}_{it} = \frac{\text{Quoted Spread}_{it}}{\text{Mid Price}_{it}} \quad (3)$$

$$\text{Daily percent Quoted Spread}_i = \frac{1}{T} \sum_t^T \text{Percent Quoted Spread}_{it}, (4)$$

where,  $T$  = total number of interval of each day

All of the percent quoted spreads of each particular stock in the trading day were used in computing time-weighted average daily quoted spread of each stock at each day as in (4). The percent quoted spread of the included stocks after the ED was then compared with their levels before the index establishment. Student t-test analysis was performed in order to determine whether statistically significant change occurs in stock percent quoted spread.

### 3.4 Daily liquidity measures

#### 3.4.1 Illiquidity measure

Illiquidity measure (ILLIQ) (Amihud (2002 )), percent quoted spread, volume, and stock turnover were employed as the liquidity measures for investigating the long-term liquidity effect. The illiquidity measure was calculated in the spirit of Amihud as in (5);

$$ILLIQ_{it} = \frac{|R_t|}{THBvolume_t} \times 10^7 \quad (5)$$

where, i = stock i, t = day t, and  $R_t$  = stock return at time t

$$\text{Monthly } ILLIQ_i = \frac{1}{T} \sum_t^T ILLIQ_{it} \quad (6)$$

where, T = total number of trading day of the month

This approach provides the price impact that is normalized by each traded THB, and hence facilitates comparison. The illiquidity measure of any particular day of each stock was compared with the illiquidity measure from the period prior to the index inclusion. The comparison was achieved by using student t-test. If the liquidity was improved (illiquidity decrease) then the measure obtained following index inclusion would decrease. For the advantages of using Amihud illiquidity measure, the same daily prices are not of concern since the proxy captures both the price change and volume. However, it is also noteworthy that too many zero-return (no price change) may result in alter the measure to reflect more of the informed trader fixed cost than the price impact. For low liquidity sample, as classified by zero return and small volume, illiquidity measure maybe downward biased. This measure should not be significant in the selected dataset since the stocks included in the ASEAN STARS index were classified by their market capitalization and liquidity.

### 3.4.2 Daily percent quoted spread

Besides Amihud's illiquidity measure, this study also focused on other measurements of liquidity. Illiquidity measure represents the price impact on stocks, which is only one dimension of liquidity. Percent quoted spread helps elaborate the transaction cost when market participants take market positions. Furthermore, this was also to determine long-term change in trading cost after being included into the ASEAN STARS index, and allowed comparison with the result analyzed by intraday data. Similarly to the intraday percent quoted spread computation, the daily measure was computed as shown in eq. (6) to (8).

$$\text{Quoted Spread}_{it} = \text{Best Ask Price}_{it} - \text{Best Bid Price}_{it} \quad (7)$$

where,  $i$  = stock  $i$ , and  $t$  = day  $t$

$$\text{Mid Price}_{it} = \frac{\text{Best Ask Price}_{it} - \text{Best Bid Price}_{it}}{2} \quad (8)$$

$$\text{Percent Quoted Spread}_{it} = \frac{\text{Quoted Spread}_{it}}{\text{Mid Price}_{it}} \quad (9)$$

From the daily bid and ask prices retrieved from SETSMART, quoted spread and mid price of each stock of each day were calculated as (6) and (7), respectively. Then, the percent quoted spread was computed as in eq. (8). The percent quoted spread obtained from before and after index inclusion were compared using student t-test. If the index inclusion posts positive effect on transaction costs, the percent quoted spread measured after the inclusion would be decreased.

### 3.4.3 Volume

In order to determine whether more trading activity was induced via ASEAN STARS index inclusion, the change in trading volume after index inclusion was analyzed comparing with its level prior to the inclusion. The automatic order matching (AOM) volume, which is the volume of the orders matched by price and time priority, was used. Statistical analysis was conducted by applying student t-test.

#### 3.4.4 Turnover

Similarly to the trading volume, stock turnover indicates the trading activity of that particular stock. However, since the volume is an absolute measurement, turnover ratio in which trading volume is normalized by the outstanding shares provides information from another perspective. Moreover, the turnover ratio employed in this study was constructed such that it accounts for the tradability of the stocks. Instead of using number of outstanding shares directly, the number of shares was adjusted by the free float published by the SET. Free float level is calculated as the percentage of shares not held by strategic partners as defined by the SET. The turnover ratio was computed as shown in eq. (9).

$$\text{Percent Quoted Spread}_{it} = \frac{\text{Tarding Volume}_{it}}{\text{Free Float}_{it} \times \text{Outstanding Shares}_{it}}, \quad (10)$$

where, i=stock i, t = day t

$$\text{Monthly Volume} = \frac{1}{T} \sum_t^T \text{Volume}, \quad (11)$$

where, T = total number of trading day of the month

### 3. RESULTS AND DISCUSSION

#### 4.1 Data and liquidity measures

Liquidity of 30 stocks included in the ASEAN STAR index both before and after the inclusion on 15 October 2012 was investigated. The stock liquidity in this study was separated into long-term and short-term liquidity changes. In the case of short-term liquidity effect, intraday tick-by-tick data was applied. The data ranges from 2.5 months (51 trading days) prior to the inclusion until 2.5 after. The percent quoted spread was selected as liquidity measures. For long-term liquidity effect, daily data of up to one year before and after the index inclusion was used. Amihud's illiquidity ratio, percent quoted spread, volume, and turnover were implemented to measure the liquidity of these stocks. The t-test was applied to test the null hypothesis that there are no statistical differences in mean of the liquidity measures before and after the event date.

#### 4.2 Short-term liquidity effects of index inclusion

##### 4.2.1 Intraday percent quoted spread

The percent spread was calculated by separating each day order file data into time intervals. The highest bid and lowest asked prices of each stock within these time intervals were used for percent quoted spread calculation. The daily average of the percent quoted spread was then calculated for each stock. With this implementation, the sample size of the percent quoted spread measure would be 1530 (30 stocks x 51 trading days) as for prior and after event date accordingly.

The interval for the intraday analysis was determined by examining different time intervals including 5, 10, 15, and 20 minutes. After separating the dataset into intervals, the number of days, where not all of the intervals have order submitted, was recorded as shown in table 4.1. According to table 4.1, the number of day with incomplete data decreased along with the increasing time frame. The 15-minute time frame was selected for further analysis as the larger time frame (20-minute) did not improve the data availability substantially.

Table 4.1 Number of days with missing trading in intervals

This table showed the number of days with some missing trading within the intervals. The intraday data was separated into the interval of 5, 10, 15, and 20-minute to determine appropriate value for further analysis. Since the trading may not occur all the time, some of the intervals may not be filled with orders, and hence missing. If trading information of any of the interval is missing in any day, the particular day will be counted.

| Ticker        | N   | Number of Days without Complete Trading Activity |           |           |           |
|---------------|-----|--------------------------------------------------|-----------|-----------|-----------|
|               |     | 5-minute                                         | 10-minute | 15-minute | 20-minute |
|               |     | interval                                         | interval  | interval  | interval  |
| <b>ADVANC</b> | 103 | 15                                               | 0         | 0         | 0         |
| <b>AOT</b>    | 103 | 92                                               | 35        | 16        | 9         |
| <b>BANPU</b>  | 103 | 44                                               | 8         | 3         | 2         |
| <b>BAY</b>    | 103 | 42                                               | 3         | 0         | 0         |
| <b>BBL</b>    | 103 | 49                                               | 8         | 1         | 1         |
| <b>BEC</b>    | 103 | 99                                               | 55        | 21        | 19        |
| <b>BGH</b>    | 103 | 84                                               | 11        | 1         | 1         |
| <b>BIGC</b>   | 103 | 96                                               | 56        | 16        | 16        |
| <b>CPALL</b>  | 103 | 17                                               | 1         | 0         | 0         |
| <b>CPF</b>    | 103 | 4                                                | 0         | 0         | 0         |
| <b>CPN</b>    | 103 | 88                                               | 38        | 10        | 9         |
| <b>DTAC</b>   | 103 | 59                                               | 13        | 2         | 3         |
| <b>EGCO</b>   | 103 | 102                                              | 78        | 38        | 38        |
| <b>GLOW</b>   | 103 | 103                                              | 93        | 58        | 49        |
| <b>INTUCH</b> | 103 | 18                                               | 2         | 0         | 0         |
| <b>IRPC</b>   | 103 | 54                                               | 3         | 0         | 0         |
| <b>IVL</b>    | 103 | 34                                               | 3         | 0         | 0         |



|              |     |     |    |    |    |
|--------------|-----|-----|----|----|----|
| <b>KBANK</b> | 103 | 65  | 7  | 0  | 0  |
| <b>KTB</b>   | 103 | 14  | 0  | 0  | 0  |
| <b>LH</b>    | 103 | 101 | 45 | 13 | 13 |
| <b>PTT</b>   | 103 | 13  | 0  | 0  | 0  |
| <b>PTTEP</b> | 103 | 47  | 6  | 0  | 0  |
| <b>PTTGC</b> | 103 | 13  | 1  | 0  | 0  |
| <b>RATCH</b> | 103 | 103 | 86 | 47 | 44 |
| <b>SCB</b>   | 103 | 48  | 3  | 0  | 0  |
| <b>SCC</b>   | 103 | 84  | 24 | 5  | 5  |
| <b>SCCC</b>  | 103 | 103 | 99 | 86 | 80 |
| <b>TMB</b>   | 103 | 73  | 10 | 1  | 3  |
| <b>TOP</b>   | 103 | 49  | 5  | 3  | 0  |
| <b>TUF</b>   | 103 | 101 | 44 | 15 | 10 |

The statistical analysis of the percent quoted spread before and after index inclusion was analyzed using two-tails paired student t-test. The statistical analysis of the intraday percent quoted spread along with other measurements was listed in table 4.2. The P-value of 0.0043 indicated that the percent quoted spread after index inclusion is significantly different from the level prior to the event. Following the inclusion, the percent quoted spread decreased from 0.4392 percent to 0.4142 percent, which accounted for a 5.69 percent reduction. The results suggested that stock liquidity, specifically, the trading cost, decreased after being included into the ASEAN STARS index.

Recent research studied the SET50 index effect of stock rebalancing by comparing the bid-ask spread of any particular day within the event window with the estimation period prior to the inclusion. The study observed an improvement in quoted spread one day after the index rebalancing without observing any significant long term improvement following the event (Triempanichgul (2010)). This study investigated the overall change in percent quoted spread during the two and a half months of intraday prior and after the inclusion together with the

ASEAN Linkage implementation. An improvement of 5.69 percent decrease in percent quoted spread was observed.

According to the summary statistics provided in table 4.3 as well as the computed data, some of the bid-ask spreads were negative, hence leading to some negative percent quoted spread. This is due to the higher level of the highest bid price than the lowest asked price retrieved within the time intervals. However, the occurrence of these negative spreads were limited (only 80 entries from more than 3000 samples); therefore, these data were treated as noises for the analysis. Moreover, in order to assure the robustness of the analysis, the test was repeated with the same data where negative spreads were removed. The obtained results remained the same with statistically significant decrease in percent quoted spread after index inclusion (data not shown).

**Table 4.2** Statistical analysis of the calculated intraday liquidity measures

This table presented the statistical analyses results of the computed liquidity measures employed in this study. The paired t-test analysis was carried out to examine the difference between the measures before and after index inclusion together with ASEAN Linkage implementation. The intraday percent quoted spread was calculated by computing the measure for each 15-minute interval as;  $100 \times (\text{quoted spread} / \text{mid price})$ . The daily average of the measure was calculated as the mean of measure from these intervals.

| Measure                                                       | N<br>Before | N<br>After | Mean<br>Before | Mean<br>After | % Change<br>(After-Before) | t-Statistic | P-Value |
|---------------------------------------------------------------|-------------|------------|----------------|---------------|----------------------------|-------------|---------|
| <b>Intraday measure of 51 days prior and after event date</b> |             |            |                |               |                            |             |         |
| Percent Quoted Spread (%)                                     | 1530        | 1530       | 0.4392         | 0.4142        | -5.69%                     | -2.86       | 0.0043  |
| Robustness 1 (removed all incomplete)*                        | 663         | 663        | 0.3515         | 0.3336        | -5.09%                     | -1.99       | 0.0475  |
| Robustness 2 (removed incomplete > 21)**                      | 1326        | 1326       | 0.3732         | 0.3479        | -6.78%                     | -3.44       | 0.0006  |

\*Robustness 1 tested the percent quoted spread after removing all stocks that did not have all interval filled.

\*\* Robustness 2 tested the percent quoted spread after removing all stocks with more than 20 percent of interval unfilled.

Table 4.3 Summary statistics of intraday percent quoted spread

This table presented the summary statistics of the calculated intraday percent quoted spread of the 51 trading days prior and after index inclusion and ASEAN Linkage implementation. The intraday data was separated into 15-minute intervals and the best bid and ask prices were computed. The percent quoted spread measure of each interval was then calculated as; percent quoted spread =  $100 \times \text{mid price} / \text{quoted spread}$ . Daily average of the measure was computed, and the descriptive statistics of them was presented.

| Intraday Percent Quoted Spread (%) |            |           |            |        |            |        |            |        |            |        |
|------------------------------------|------------|-----------|------------|--------|------------|--------|------------|--------|------------|--------|
| Ticker                             | N          |           | Mean       |        | SD         |        | Max        |        | Min        |        |
|                                    | Befor<br>e | Afte<br>r | Befor<br>e | After  | Befor<br>e | After  | Befor<br>e | After  | Befor<br>e | After  |
| ADVANC                             | 51         | 51        | 0.2594     | 0.1165 | 0.1109     | 0.1761 | 0.4228     | 0.5285 | 0.0007     | 0.2724 |
| AOT                                | 51         | 51        | 0.4319     | 0.1870 | 0.3459     | 0.1228 | 2.3679     | 0.5013 | 0.2419     | 0.2066 |
| BANPU                              | 51         | 51        | 0.2386     | 0.2772 | 0.2001     | 0.1310 | 0.6524     | 0.6116 | 0.6527     | 0.0008 |
| BAY                                | 51         | 51        | 0.6397     | 0.6449 | 0.2616     | 0.1560 | 1.5457     | 0.9937 | 0.1203     | 0.2317 |
| BBL                                | 51         | 51        | 0.1644     | 0.1553 | 0.0769     | 0.1034 | 0.3409     | 0.4376 | 0.0286     | 0.1900 |
| BEC                                | 51         | 51        | 0.5731     | 0.4846 | 0.2695     | 0.2356 | 1.2535     | 0.9676 | 0.1166     | 0.0676 |
| BGH                                | 51         | 51        | 0.4631     | 0.4347 | 0.2005     | 0.1169 | 1.0657     | 0.6858 | 0.0440     | 0.1263 |

|               |    |    |            |            |            |            |            |            |            |            |
|---------------|----|----|------------|------------|------------|------------|------------|------------|------------|------------|
|               |    |    |            |            |            |            |            | -          |            |            |
| <b>BIGC</b>   | 51 | 51 | 0.352<br>8 | 0.488<br>8 | 0.226<br>6 | 0.272<br>4 | 0.875<br>5 | 1.400<br>4 | 0.642<br>7 | 0.064<br>0 |
| <b>CPALL</b>  | 51 | 51 | 0.525<br>0 | 0.421<br>9 | 0.181<br>5 | 0.152<br>5 | 0.757<br>0 | 0.776<br>7 | 0.037<br>2 | 0.072<br>1 |
| <b>CPF</b>    | 51 | 51 | 0.528<br>3 | 0.554<br>8 | 0.212<br>5 | 0.156<br>6 | 0.830<br>6 | 0.760<br>5 | 0.203<br>8 | 0.042<br>2 |
| <b>CPN</b>    | 51 | 51 | 0.558<br>4 | 0.203<br>6 | 0.203<br>4 | 0.207<br>4 | 1.131<br>5 | 0.509<br>5 | 0.208<br>3 | 0.504<br>3 |
| <b>DTAC</b>   | 51 | 51 | 0.154<br>0 | 0.212<br>0 | 0.111<br>7 | 0.128<br>2 | 0.428<br>7 | 0.519<br>7 | 0.215<br>5 | 0.111<br>4 |
| <b>EGCO</b>   | 51 | 51 | 0.799<br>2 | 0.606<br>2 | 0.390<br>3 | 0.253<br>8 | 2.022<br>5 | 1.334<br>7 | 0.241<br>2 | 0.062<br>5 |
| <b>GLOW</b>   | 51 | 51 | 0.754<br>9 | 0.683<br>3 | 0.379<br>3 | 0.543<br>8 | 2.517<br>8 | 3.244<br>3 | 0.342<br>1 | 0.231<br>5 |
| <b>INTUCH</b> | 51 | 51 | 0.232<br>5 | 0.201<br>2 | 0.106<br>7 | 0.133<br>0 | 0.466<br>0 | 0.381<br>1 | 0.041<br>8 | 0.130<br>4 |
| <b>IRPC</b>   | 51 | 51 | 0.357<br>9 | 0.447<br>4 | 0.152<br>7 | 0.142<br>9 | 0.614<br>7 | 0.864<br>0 | 0.242<br>3 | 0.103<br>8 |
| <b>IVL</b>    | 51 | 51 | 0.610<br>8 | 0.601<br>8 | 0.197<br>5 | 0.343<br>7 | 0.958<br>7 | 1.150<br>5 | 0.050<br>1 | 0.161<br>3 |
| <b>KBANK</b>  | 51 | 51 | 0.210<br>7 | 0.154<br>9 | 0.280<br>3 | 0.075<br>4 | 2.104<br>6 | 0.326<br>0 | 0.015<br>2 | 0.032<br>7 |
| <b>KTB</b>    | 51 | 51 | 0.392<br>4 | 0.387<br>4 | 0.160<br>3 | 0.112<br>3 | 0.667<br>7 | 0.623<br>7 | 0.317<br>0 | 0.029<br>3 |

|                |    |    |            |            |            |            |            |            |            |            |
|----------------|----|----|------------|------------|------------|------------|------------|------------|------------|------------|
| <b>LH</b>      | 51 | 51 | 0.713<br>1 | 0.684<br>4 | 0.267<br>3 | 0.247<br>3 | 1.465<br>2 | 1.459<br>3 | 0.095<br>7 | 0.149<br>6 |
|                |    |    |            |            |            |            |            |            | -          | -          |
| <b>PTT</b>     | 51 | 51 | 0.176<br>3 | 0.187<br>9 | 0.075<br>4 | 0.084<br>8 | 0.320<br>0 | 0.384<br>6 | 0.033<br>0 | 0.035<br>2 |
|                |    |    |            |            |            |            |            |            | -          | -          |
| <b>PTTEP</b>   | 51 | 51 | 0.230<br>6 | 0.217<br>4 | 0.093<br>8 | 0.174<br>9 | 0.401<br>3 | 1.012<br>6 | 0.055<br>1 | 0.162<br>3 |
|                |    |    |            |            |            |            |            |            | -          | -          |
| <b>PTTGC</b>   | 51 | 51 | 0.196<br>6 | 0.210<br>6 | 0.149<br>0 | 0.101<br>4 | 0.383<br>0 | 0.360<br>0 | 0.564<br>2 | 0.024<br>0 |
|                |    |    |            |            |            |            |            |            |            |            |
| <b>RATCH</b>   | 51 | 51 | 0.970<br>1 | 0.822<br>9 | 0.340<br>5 | 0.348<br>8 | 2.300<br>4 | 1.655<br>8 | 0.438<br>7 | 0.212<br>5 |
|                |    |    |            |            |            |            |            |            |            | -          |
| <b>SCB</b>     | 51 | 51 | 0.209<br>6 | 0.190<br>1 | 0.086<br>9 | 0.101<br>0 | 0.432<br>5 | 0.594<br>2 | 0.049<br>6 | 0.016<br>2 |
|                |    |    |            |            |            |            |            |            |            | -          |
| <b>SCC</b>     | 51 | 51 | 0.278<br>5 | 0.280<br>6 | 0.114<br>2 | 0.153<br>2 | 0.587<br>7 | 0.710<br>5 | 0.030<br>2 | 0.182<br>4 |
|                |    |    |            |            |            |            |            |            |            |            |
| <b>SCCC</b>    | 51 | 51 | 0.947<br>4 | 1.268<br>6 | 0.569<br>7 | 0.518<br>6 | 2.816<br>7 | 2.890<br>6 | 0.196<br>7 | 0.531<br>1 |
|                |    |    |            |            |            |            |            |            |            | -          |
| <b>TMB</b>     | 51 | 51 | 0.551<br>2 | 0.544<br>4 | 0.208<br>1 | 0.233<br>4 | 1.126<br>0 | 1.423<br>9 | 0.001<br>9 | 0.292<br>0 |
|                |    |    |            |            |            |            |            |            |            |            |
| <b>TOP</b>     | 51 | 51 | 0.255<br>1 | 0.314<br>5 | 0.110<br>3 | 0.115<br>2 | 0.629<br>6 | 0.539<br>1 | 0.040<br>4 | 0.081<br>8 |
|                |    |    |            |            |            |            |            |            |            |            |
| <b>TUF</b>     | 51 | 51 | 0.399<br>5 | 0.441<br>1 | 0.187<br>8 | 0.278<br>9 | 1.116<br>0 | 2.047<br>3 | 0.126<br>1 | 0.172<br>1 |
| <b>Average</b> |    |    | 0.439<br>2 | 0.414<br>2 |            |            |            |            |            |            |

#### 4.2.2 Robustness test of intraday percent quoted spread

According to table 4.1, there were several firms lacking of complete trading activities within the intervals chosen for the study (15-minute). In order to evaluate whether these firms with incomplete trading within the days would be influential to the obtained results, robustness check using subset of data was carried out. Two other extreme scenarios including 1) excluding stock with any incomplete trading, and 2) excluding stock with more than 21 (20 percent) trading days were set up.

The statistical analyses of these sub-datasets using two-tailed paired t-test were carried out. With the full dataset exhibiting P-value of 0.0043, the smallest dataset with the exclusion of all incomplete trading stocks revealed the P-value of 0.0475, which is significant at 95% confidence interval. Consistently, with the exclusion of stocks with more than 21 incomplete trading days (about 20% of the total trading days), the obtained P-value of 0.0006 indicated significant decrease in percent quoted spread.

All of these intraday percent quoted spread analyses collectively suggested that the trading cost following index inclusion significantly decreased. Nonetheless, this study also aimed at evaluating the effect of ASEAN STARS index and ASEAN Linkage implementation in the relatively long term, thus the liquidity change within one year period was further analyzed applying daily data.

### 4.3 Long-term liquidity effects of index inclusion

#### 4.3.1 Amihud's illiquidity ratio

The sample size for this measure was 360 samples (30 monthly stocks illiquidity measure x 12 months). Statistical analysis of Amihud's illiquidity ratio and summary statistics before and after index inclusion were presented in table 4.4 and 4.5, respectively.

**Table 4.4** Statistical analysis of the calculated daily liquidity measures

This table presented the statistical analyses results of the computed liquidity measures employed in this study. The paired t-test analysis was carried out to examine the difference between the measures before and after index inclusion together with ASEAN Linkage implementation. The liquidity measures were calculated as; illiquidity ratio = absolute stock return/ THB volume\*10<sup>7</sup>, percent quoted spread = 100\*(quoted spread/ mid price), and turnover = 100\*trading volume/free float x outstanding shares. In the case of intraday percent quoted spread, the daily average of the measure was calculated as the mean of measure from each interval. For illiquidity ratio and volume analyses, the monthly average of the daily measures was calculated and tested. As for the daily percent quoted spread and turnover, daily measures were tested directly.

| Measure                                                      | N<br>Before | N<br>After | Mean<br>Before | Mean<br>After | % Change<br>(After-Before) | t-Statistic | P-Value |
|--------------------------------------------------------------|-------------|------------|----------------|---------------|----------------------------|-------------|---------|
| Daily measure of 235 trading days prior and after event date |             |            |                |               |                            |             |         |
| Illiquidity Ratio                                            | 360         | 360        | 0.0837         | 0.0691        | -17.43%                    | -3.35       | 0.0009  |
| Percent Quoted Spread (%)                                    | 7050        | 7050       | 0.5125         | 0.5213        | 1.72%                      | 2.40        | 0.0164  |
| Volume                                                       | 360         | 360        | 15507971       | 20144016      | 29.89%                     | 2.60        | 0.0098  |



|              |      |      |        |        |       |      |         |
|--------------|------|------|--------|--------|-------|------|---------|
| Turnover (%) | 7050 | 7050 | 0.5290 | 0.5651 | 6.82% | 4.09 | <0.0001 |
|--------------|------|------|--------|--------|-------|------|---------|

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The P-value of 0.0009 indicated that stock illiquidity after index inclusion was different from the liquidity before the event at  $\alpha = 0.05$ . This suggested that, upon index inclusion, stock liquidity changes. Most of the stocks, 20 out of 30 stocks revealed the decreased level of illiquidity as referred from the lower mean of Amihud illiquidity measure (table 4.5). The mean value of illiquidity decreased by 17.43 percent from 0.0838 to 0.0690, indicating the higher liquidity after entering into the index. Since the Amihud's measure of illiquidity mainly captures the price impact dimension of liquidity, the result suggested that, for most of the stocks, the price impact reduced once the stocks are included.

Comparing to previous research conducted on SET50 index adjustment, the study found immediate significant increase in illiquidity (elevated price impact) right after the event date; followed by an insignificant decrease afterward (Triempanichgul (2010)). In this study, as oppose to examining the change day by day, overall long term impact of inclusion was elucidated. As discussed previously, the obtained results indicated long term improvement of price impact after the adaptation of ASEAN Linkage as well as ASEAN STARS index.

#### 4.3.2 Daily percent quoted spread

In order to capture the long term index inclusion effect on the trading cost of stocks, percent quoted spread of the target stocks were computed from daily data, and the spread before and after index inclusion were compared. The sample size for the analysis was 7050 (30 stocks x 235 trading days) for before and after the inclusion. The percent quoted spreads of each stock prior and after the event was analyzed using two-tailed paired t-test to determine whether the stock percent quoted spread after being included was different. The tested results and summary statistics of the calculated percent quoted spreads were shown table 4.4 and 4.6, respectively.

Statistically significant differences between the measures before and after the index inclusion were observed with P-value of 0.0164. Interestingly, the spread after index inclusion increased slightly comparing to the period prior to the inclusion from 0.5125 percent to 0.5213. The elevated spread accounted for 1.71 percent increase in percent quoted spread.

This result provided different finding from short term intraday percent quoted spread analysis where a 5.69 decrease in spread was observed. Overall this may suggest that the transaction cost improvement following the index was not persistent. This may due to the nature of the included stock,

which were highly liquid with tight relatively spread even before the implementation of the index and trading link.

Table 4.5 Summary statistics of amihud's illiquidity measures

This table presented the summary statistics of the calculated Amihud's illiquidity ratio of the 235 trading days prior and after index inclusion and ASEAN Linkage implementation. The illiquidity ratio of each day was calculated as; illiquidity ratio = absolute stock return/ THB volume\*10<sup>7</sup>.

| Amihud's Illiquidity Ratio |        |       |        |        |        |        |        |        |        |       |
|----------------------------|--------|-------|--------|--------|--------|--------|--------|--------|--------|-------|
| Ticker                     | N      |       | Mean   |        | SD     |        | Max    |        | Min    |       |
|                            | Before | After | Before | After  | Before | After  | Before | After  | Before | After |
| <b>ADVANC</b>              | 235    | 235   | 0.0167 | 0.0116 | 0.0125 | 0.0086 | 0.0692 | 0.0571 | 0      | 0     |
| <b>AOT</b>                 | 235    | 235   | 0.0922 | 0.0460 | 0.1066 | 0.0376 | 1.2078 | 0.1938 | 0      | 0     |
| <b>BANPU</b>               | 235    | 235   | 0.0172 | 0.0369 | 0.0155 | 0.0850 | 0.0883 | 1.2592 | 0      | 0     |
| <b>BAY</b>                 | 235    | 235   | 0.0526 | 0.0206 | 0.0509 | 0.0223 | 0.3364 | 0.1542 | 0      | 0     |
| <b>BBL</b>                 | 235    | 235   | 0.0144 | 0.0129 | 0.0133 | 0.0104 | 0.0839 | 0.0460 | 0      | 0     |
| <b>BEC</b>                 | 235    | 235   | 0.2095 | 0.1218 | 0.2133 | 0.1073 | 1.4781 | 0.6209 | 0      | 0     |
| <b>BGH</b>                 | 235    | 235   | 0.0707 | 0.0346 | 0.0834 | 0.0244 | 0.6909 | 0.1256 | 0      | 0     |
| <b>BIGC</b>                | 235    | 235   | 0.1475 | 0.1680 | 0.1473 | 0.1936 | 1.0391 | 1.4453 | 0      | 0     |
| <b>CPALL</b>               | 235    | 235   | 0.0248 | 0.0143 | 0.0262 | 0.0120 | 0.2326 | 0.0632 | 0      | 0     |
| <b>CPF</b>                 | 235    | 235   | 0.0139 | 0.0279 | 0.0136 | 0.0320 | 0.0755 | 0.2230 | 0      | 0     |
| <b>CPN</b>                 | 235    | 235   | 0.1688 | 0.0743 | 0.1701 | 0.0902 | 1.2273 | 1.1349 | 0      | 0     |
| <b>DTAC</b>                | 235    | 235   | 0.0286 | 0.0382 | 0.0273 | 0.0361 | 0.2646 | 0.2046 | 0      | 0     |
| <b>EGCO</b>                | 235    | 235   | 0.1864 | 0.1491 | 0.1893 | 0.1427 | 1.1256 | 0.7950 | 0      | 0     |
| <b>GLOW</b>                | 235    | 235   | 0.2859 | 0.2501 | 0.4900 | 0.2205 | 6.5755 | 1.2052 | 0      | 0     |
| <b>INTUCH</b>              | 235    | 235   | 0.0262 | 0.0097 | 0.0403 | 0.0079 | 0.3418 | 0.0448 | 0      | 0     |

|                |     |     |        |        |        |        |        |        |   |   |
|----------------|-----|-----|--------|--------|--------|--------|--------|--------|---|---|
| <b>IRPC</b>    | 235 | 235 | 0.0685 | 0.1106 | 0.0635 | 0.1152 | 0.2939 | 0.6501 | 0 | 0 |
| <b>IVL</b>     | 235 | 235 | 0.0301 | 0.0906 | 0.0275 | 0.0888 | 0.1621 | 0.4230 | 0 | 0 |
| <b>KBANK</b>   | 235 | 235 | 0.0139 | 0.0104 | 0.0105 | 0.0085 | 0.0549 | 0.0678 | 0 | 0 |
| <b>KTB</b>     | 235 | 235 | 0.0233 | 0.0156 | 0.0193 | 0.0121 | 0.1160 | 0.0656 | 0 | 0 |
| <b>LH</b>      | 235 | 235 | 0.1406 | 0.0717 | 0.1355 | 0.0633 | 1.0046 | 0.3343 | 0 | 0 |
| <b>PTT</b>     | 235 | 235 | 0.0092 | 0.0076 | 0.0068 | 0.0055 | 0.0322 | 0.0305 | 0 | 0 |
| <b>PTTEP</b>   | 235 | 235 | 0.0204 | 0.0146 | 0.0188 | 0.0120 | 0.1414 | 0.0837 | 0 | 0 |
| <b>PTTGC</b>   | 235 | 235 | 0.0149 | 0.0171 | 0.0123 | 0.0129 | 0.0784 | 0.0658 | 0 | 0 |
| <b>RATCH</b>   | 235 | 235 | 0.1891 | 0.2028 | 0.2182 | 0.1812 | 1.3458 | 0.9877 | 0 | 0 |
| <b>SCB</b>     | 235 | 235 | 0.0157 | 0.0116 | 0.0119 | 0.0085 | 0.0637 | 0.0372 | 0 | 0 |
| <b>SCC</b>     | 235 | 235 | 0.0148 | 0.0246 | 0.0112 | 0.0177 | 0.0639 | 0.0938 | 0 | 0 |
| <b>SCCC</b>    | 235 | 235 | 0.4200 | 0.3115 | 0.4568 | 0.2869 | 3.3785 | 1.6021 | 0 | 0 |
| <b>TMB</b>     | 235 | 235 | 0.0869 | 0.0441 | 0.0971 | 0.0473 | 0.5182 | 0.2703 | 0 | 0 |
| <b>TOP</b>     | 235 | 235 | 0.0255 | 0.0368 | 0.0214 | 0.0290 | 0.1047 | 0.1745 | 0 | 0 |
| <b>TUF</b>     | 235 | 235 | 0.0829 | 0.0884 | 0.1010 | 0.0868 | 0.8641 | 0.4536 | 0 | 0 |
| <b>Average</b> |     |     | 0.0837 | 0.0691 |        |        |        |        |   |   |

Table 4.6 Summary statistics of daily percent quoted spread

This table presented the summary statistics of the calculated daily percent quoted spread of 235 trading days prior and after index inclusion and ASEAN Linkage implementation. The daily percent quoted spread of each day was calculated as; daily percent quoted spread =  $100 \times \text{mid price} / \text{quoted spread}$ .

| Percent Quoted Spread (%) |        |       |        |        |        |        |        |        |        |        |
|---------------------------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| Ticker                    | N      |       | Mean   |        | SD     |        | Max    |        | Min    |        |
|                           | Before | After | Before | After  | Before | After  | Before | After  | Before | After  |
| <b>ADVANC</b>             | 235    | 235   | 0.3899 | 0.4377 | 0.1517 | 0.1437 | 1.4085 | 1.2072 | 0.2541 | 0.2503 |

|               |     |     |        |        |        |        |        |        |        |        |
|---------------|-----|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>AOT</b>    | 235 | 235 | 0.5702 | 0.4241 | 0.2991 | 0.2172 | 2.1739 | 1.3605 | 0.2869 | 0.2554 |
| <b>BANPU</b>  | 235 | 235 | 0.3894 | 0.3636 | 0.0865 | 0.1606 | 0.9217 | 1.5625 | 0.2503 | 0.2503 |
| <b>BAY</b>    | 235 | 235 | 0.7194 | 0.7434 | 0.2143 | 0.0758 | 1.7544 | 1.4388 | 0.4008 | 0.6557 |
| <b>BBL</b>    | 235 | 235 | 0.3295 | 0.4309 | 0.1359 | 0.1834 | 1.3870 | 1.4815 | 0.2503 | 0.2503 |
| <b>BEC</b>    | 235 | 235 | 0.7269 | 0.5921 | 0.4237 | 0.3977 | 2.5974 | 2.7833 | 0.4073 | 0.3252 |
| <b>BGH</b>    | 235 | 235 | 0.4022 | 0.4521 | 0.1955 | 0.2036 | 1.7789 | 1.3514 | 0.2503 | 0.2861 |
| <b>BIGC</b>   | 235 | 235 | 0.4524 | 0.6122 | 0.2032 | 0.3716 | 1.6393 | 2.0888 | 0.2503 | 0.2503 |
| <b>CPALL</b>  | 235 | 235 | 0.6020 | 0.6198 | 0.1803 | 0.1643 | 1.4815 | 2.8169 | 0.3263 | 0.4819 |
| <b>CPF</b>    | 235 | 235 | 0.7176 | 0.7533 | 0.0579 | 0.1649 | 0.8439 | 1.8182 | 0.5970 | 0.4008 |
| <b>CPN</b>    | 235 | 235 | 0.6353 | 0.5372 | 0.2264 | 0.3362 | 1.6713 | 3.4682 | 0.3795 | 0.2503 |
| <b>DTAC</b>   | 235 | 235 | 0.3347 | 0.4103 | 0.0675 | 0.1876 | 0.7246 | 1.3730 | 0.2721 | 0.2516 |
| <b>EGCO</b>   | 235 | 235 | 0.5052 | 0.5124 | 0.3166 | 0.3021 | 2.1277 | 2.2989 | 0.2509 | 0.3044 |
| <b>GLOW</b>   | 235 | 235 | 0.6300 | 0.6700 | 0.3736 | 0.4768 | 2.3753 | 3.3557 | 0.3552 | 0.2999 |
| <b>INTUCH</b> | 235 | 235 | 0.4708 | 0.3393 | 0.0875 | 0.0632 | 0.7435 | 0.8097 | 0.3540 | 0.2574 |
| <b>IRPC</b>   | 235 | 235 | 0.4911 | 0.5585 | 0.0648 | 0.1437 | 1.0363 | 1.2739 | 0.4141 | 0.4376 |
| <b>IVL</b>    | 235 | 235 | 0.7958 | 0.6385 | 0.0864 | 0.2431 | 0.9569 | 1.2270 | 0.6006 | 0.4008 |
| <b>KBANK</b>  | 235 | 235 | 0.3844 | 0.3729 | 0.1337 | 0.1465 | 1.2320 | 0.9852 | 0.2685 | 0.2503 |
| <b>KTB</b>    | 235 | 235 | 0.6164 | 0.5652 | 0.0475 | 0.1713 | 0.7117 | 0.9950 | 0.5333 | 0.4008 |
| <b>LH</b>     | 235 | 235 | 0.7667 | 0.8123 | 0.2270 | 0.2180 | 1.9048 | 1.8692 | 0.5510 | 0.5038 |
| <b>PTT</b>    | 235 | 235 | 0.3087 | 0.3219 | 0.0436 | 0.0812 | 0.6849 | 0.9050 | 0.2736 | 0.2729 |
| <b>PTTEP</b>  | 235 | 235 | 0.3409 | 0.3595 | 0.1247 | 0.1226 | 1.1834 | 0.9820 | 0.2692 | 0.2920 |
| <b>PTTGC</b>  | 235 | 235 | 0.4039 | 0.4007 | 0.0896 | 0.1514 | 1.3730 | 1.4184 | 0.3317 | 0.3101 |
| <b>RATCH</b>  | 235 | 235 | 0.6271 | 0.5471 | 0.2941 | 0.2247 | 4.4693 | 1.4670 | 0.4640 | 0.3883 |
| <b>SCB</b>    | 235 | 235 | 0.3978 | 0.3452 | 0.1201 | 0.1187 | 1.1050 | 0.9539 | 0.2928 | 0.2548 |
| <b>SCC</b>    | 235 | 235 | 0.3145 | 0.4842 | 0.0873 | 0.2021 | 1.2085 | 1.8100 | 0.2759 | 0.2503 |

|                |     |     |        |        |        |        |        |        |        |        |
|----------------|-----|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>SCCC</b>    | 235 | 235 | 0.5787 | 0.6852 | 0.3414 | 0.3780 | 1.7762 | 1.9802 | 0.2554 | 0.2509 |
| <b>TMB</b>     | 235 | 235 | 0.6340 | 0.7531 | 0.1003 | 0.1318 | 1.4815 | 0.9950 | 0.5305 | 0.5038 |
| <b>TOP</b>     | 235 | 235 | 0.3986 | 0.4245 | 0.0592 | 0.1467 | 0.8511 | 1.1928 | 0.3284 | 0.3295 |
| <b>TUF</b>     | 235 | 235 | 0.4420 | 0.4717 | 0.1838 | 0.2183 | 1.3652 | 2.2676 | 0.3231 | 0.3306 |
| <b>Average</b> |     |     | 0.5125 | 0.5213 |        |        |        |        |        |        |

### 4.3.3 Volume

Since ASEAN STARS inclusion along with ASEAN Linkage implementation allows more convenient trans-border trading of the selected stocks, the change in stock trading volume was also investigated. If the index inclusion attracted more foreign investors, elevated trading volume should be observed. The monthly average volume of each stock was computed and used for the analysis. Similarly, the sample size was 360 samples (30 stock monthly average trading volumes x 12 months (before/after)). Related statistical summary of stock volume was presented in table 4.4.

The result with the P-value of 0.0098, which is less than  $\alpha = 0.05$ , indicated that the volume after index inclusion was statistically different from the prior level. Most of the included stocks (20 out of 30 stocks) have increased average trading volume comparing to period before inclusion. The overall average volume of these stocks after the index inclusion was also greater, with the increase accounted for 29.89 percent higher than the before inclusion.

Similarly to the index effect on volume detected in SET50 index rebalancing, inclusion into ASEAN STARS index accompanied by the implementation of ASEAN Linkage promoted trading volume of the targeted stocks. Previous studies have investigated using both volume adjusted by the market volume as well as trading volume (Teerapongpraty (2010); Triempanichgul (2010)). The study observed significant increase in volume ratio within the three days prior to the index effective date. Elevated volume was also increased at one day before the inclusion without further improvement after the event date.

Instead, this study focused on overall change of trading volume within the study period of one year after index inclusion, and the observed results suggested an overall increase in trading volume during the study period. Although the aim of this research was to investigate overall changes in liquidity within

the whole study period, for comparison purpose, the trading volume during each of the three day period prior to the index inclusion was tested against the level of the one year period before those dates, and no significant increase in trading was observed (data not shown). These results revealed the overall long term improvement in trading volume of the targeted stocks, whereas no significant improvement in volume around the event date was observed.

Table 4.7 Summary statistics of daily trading volume

This table presented the summary statistics of the calculated trading volume of 235 trading days prior and after index inclusion and ASEAN Linkage implementation. The automatic order matching (AOM) volume was used for the test.

| Volume (‘000) |        |       |        |       |        |       |        |        |        |       |
|---------------|--------|-------|--------|-------|--------|-------|--------|--------|--------|-------|
| Ticker        | N      |       | Mean   |       | SD     |       | Max    |        | Min    |       |
|               | Before | After | Before | After | Before | After | Before | After  | Before | After |
| ADVANC        | 235    | 235   | 4658   | 7060  | 1959   | 3505  | 10993  | 29638  | 772    | 1410  |
| AOT           | 235    | 235   | 3103   | 3896  | 1990   | 3579  | 10418  | 46565  | 362    | 484   |
| BANPU         | 235    | 235   | 1739   | 1950  | 1390   | 4567  | 16542  | 60204  | 248    | 190   |
| BAY           | 235    | 235   | 13692  | 20171 | 10609  | 18269 | 97026  | 132854 | 2282   | 3268  |
| BBL           | 235    | 235   | 5049   | 5486  | 2450   | 2987  | 14570  | 22670  | 810    | 1091  |
| BEC           | 235    | 235   | 2113   | 2917  | 1506   | 1970  | 15250  | 20651  | 264    | 309   |
| BGH           | 235    | 235   | 2412   | 3533  | 1812   | 3027  | 15876  | 36919  | 109    | 856   |
| BIGC          | 235    | 235   | 925    | 632   | 758    | 471   | 5294   | 4825   | 101    | 65    |
| CPALL         | 235    | 235   | 15050  | 34777 | 15634  | 43748 | 172685 | 488147 | 1157   | 5510  |
| CPF           | 235    | 235   | 26358  | 24333 | 19925  | 14758 | 184980 | 155142 | 4102   | 2897  |
| CPN           | 235    | 235   | 2275   | 5723  | 1389   | 5948  | 7885   | 62086  | 403    | 894   |
| DTAC          | 235    | 235   | 7001   | 5136  | 5133   | 3430  | 35991  | 28760  | 1277   | 1029  |

|                |     |     |            |            |            |            |             |             |               |      |
|----------------|-----|-----|------------|------------|------------|------------|-------------|-------------|---------------|------|
| <b>EGCO</b>    | 235 | 235 | 628        | 712        | 494        | 634        | 3981        | 6896        | 45            | 92   |
| <b>GLOW</b>    | 235 | 235 | 1168       | 1039       | 931        | 575        | 8848        | 3545        | 37            | 156  |
| <b>INTUCH</b>  | 235 | 235 | 12409      | 22453      | 7877       | 14735      | 62183       | 99138       | 1127          | 2799 |
| <b>IRPC</b>    | 235 | 235 | 74705      | 47293      | 69154      | 49413      | 498535      | 445868      | 11419         | 9238 |
| <b>IVL</b>     | 235 | 235 | 25948      | 13607      | 18337      | 11089      | 107334      | 79686       | 5147          | 2304 |
| <b>KBANK</b>   | 235 | 235 | 6865       | 7776       | 3133       | 5327       | 18636       | 36294       | 770           | 1809 |
| <b>KTB</b>     | 235 | 235 | 39415      | 57154      | 23050      | 33570      | 134826      | 175154      | 7751          | 7942 |
| <b>LH</b>      | 235 | 235 | 18313      | 29971      | 12081      | 20854      | 86884       | 129250      | 2749          | 4193 |
| <b>PTT</b>     | 235 | 235 | 3944       | 4421       | 1923       | 2134       | 15559       | 15911       | 631           | 1059 |
| <b>PTTEP</b>   | 235 | 235 | 3949       | 5990       | 2190       | 3270       | 13485       | 19101       | 612           | 1138 |
| <b>PTTGC</b>   | 235 | 235 | 18511      | 13788      | 12223      | 6470       | 62287       | 48041       | 2890          | 3524 |
| <b>RATCH</b>   | 235 | 235 | 1189       | 1166       | 832        | 815        | 5198        | 7119        | 91            | 253  |
| <b>SCB</b>     | 235 | 235 | 6365       | 7837       | 3014       | 4362       | 20280       | 26414       | 747           | 1088 |
| <b>SCC</b>     | 235 | 235 | 2037       | 1458       | 1259       | 734        | 11940       | 5342        | 213           | 333  |
| <b>SCCC</b>    | 235 | 235 | 120        | 155        | 107        | 137        | 914         | 1541        | 17            | 19   |
| <b>TMB</b>     | 235 | 235 | 15246<br>4 | 26388<br>6 | 17362<br>1 | 22794<br>7 | 144628<br>6 | 115796<br>5 | 1558<br>16736 | 1    |
| <b>TOP</b>     | 235 | 235 | 10114      | 6842       | 5912       | 3921       | 36210       | 26878       | 1510          | 1433 |
| <b>TUF</b>     | 235 | 235 | 2723       | 3162       | 2035       | 2056       | 14067       | 15640       | 191           | 420  |
| <b>Average</b> |     |     | 15508      | 20144      |            |            |             |             |               |      |

This may be due to the difference in the cases of SET50 and ASEAN STARS index where the former was followed by index funds but the latter one was firstly established. Hence, no adjustment of index funds occurred when the 30 stocks were initially included. Nonetheless, in the long run, being included in the ASEAN STARS index as well as the ASEAN Linkage may attract more investor activities. This may also suggest the possibility that the improvement in illiquidity, as measured by Amihud's method, may result from the increase in investor attention and trading.



#### 4.3.4 Turnover

In order to confirm the test conducted on volume, analysis on turnover was also implemented. The turnover was computed as the ratio of stock trading volume to the tradable shares of that stock (eq. (9)). This tradable share number was calculated as the number of free floating shares (percent free float x total outstanding shares). The totals of 7050 samples (30 stocks x 235 trading days) from before and after the inclusion were tested. The t-test results and summary statistics of the adjusted turnover were illustrated in table 4.4 and 4.8, respectively.

The paired t-test was applied for the analysis of the daily turnover. Statistically significant result was observed as indicated by the P-value of less than 0.0001. This indicated significant difference in the turnover levels prior and after index inclusion, which increased from 0.529 percent turnover to 0.5651 percent. The change following index inclusion accounted for 6.82 percent comparing to the average turnover level prior to the ASEAN Linkage implementation.

Similarly to the volume measurement, recent study has investigated the turnover ratio during index readjustment (Triempanichgul (2010)). Comparable to the volume effect observed in the same study, the turnover ratio increased significantly during the one day period before the new list of stocks was included. Although the turnover in previous study used outstanding shares without adjusting by free float like what was employed in this study, the results should also provide some comparable information. As discussed previously, turnover analysis in this research detected long term improvement of turnover after the event date.

Table 4.8 Summary statistics of daily turnover

This table presented the summary statistics of the calculated turnover of 235 trading days prior and after index inclusion and ASEAN Linkage implementation. The turnover ratio was adjusted by the free float level which was defined by the SET as the number of shares less strategic partner ownership. The turnover of each day was calculated as;  $\text{turnover} = 100 \times \text{trading volume} / \text{free float} \times \text{outstanding shares}$ .

| Daily Turnover (%) |   |      |    |     |     |
|--------------------|---|------|----|-----|-----|
| Ticker             | N | Mean | SD | Max | Min |

|               | Before | After | Before | After  | Before | After  | Before | After   | Before | After  |
|---------------|--------|-------|--------|--------|--------|--------|--------|---------|--------|--------|
| <b>ADVANC</b> | 235    | 235   | 0.4325 | 0.6556 | 0.1819 | 0.3255 | 1.0209 | 2.7523  | 0.0717 | 0.1309 |
| <b>AOT</b>    | 235    | 235   | 0.7243 | 0.9094 | 0.4644 | 0.8353 | 2.4316 | 10.8687 | 0.0846 | 0.1130 |
| <b>BANPU</b>  | 235    | 235   | 0.7607 | 0.6725 | 0.6029 | 0.6077 | 7.1605 | 3.9979  | 0.1074 | 0.0823 |
| <b>BAY</b>    | 235    | 235   | 0.3082 | 1.0625 | 0.2377 | 1.0923 | 2.1398 | 7.8142  | 0.0503 | 0.0812 |
| <b>BBL</b>    | 235    | 235   | 0.2708 | 0.2945 | 0.1314 | 0.1603 | 0.7814 | 1.2158  | 0.0434 | 0.0585 |
| <b>BEC</b>    | 235    | 235   | 0.2229 | 0.2896 | 0.1589 | 0.1929 | 1.6083 | 2.0290  | 0.0278 | 0.0304 |
| <b>BGH</b>    | 235    | 235   | 0.3181 | 0.5296 | 0.2363 | 0.4309 | 2.0762 | 4.8280  | 0.0154 | 0.1250 |
| <b>BIGC</b>   | 235    | 235   | 0.2788 | 0.1847 | 0.2250 | 0.1378 | 1.5485 | 1.4112  | 0.0343 | 0.0191 |
| <b>CPALL</b>  | 235    | 235   | 0.4329 | 0.6668 | 0.5632 | 0.8308 | 6.9587 | 9.2763  | 0.0498 | 0.1111 |
| <b>CPF</b>    | 235    | 235   | 0.7392 | 0.6038 | 0.5540 | 0.3861 | 5.1244 | 4.2978  | 0.1172 | 0.0692 |
| <b>CPN</b>    | 235    | 235   | 0.3235 | 0.4434 | 0.1961 | 0.5973 | 1.1114 | 8.7516  | 0.0575 | 0.1032 |
| <b>DTAC</b>   | 235    | 235   | 1.0085 | 0.7382 | 0.7397 | 0.4931 | 5.2505 | 4.1342  | 0.1862 | 0.1478 |
| <b>EGCO</b>   | 235    | 235   | 0.2973 | 0.3336 | 0.2372 | 0.2962 | 1.9127 | 3.2087  | 0.0192 | 0.0441 |
| <b>GLOW</b>   | 235    | 235   | 0.2584 | 0.2299 | 0.2060 | 0.1272 | 1.9580 | 0.7845  | 0.0082 | 0.0345 |
| <b>INTUCH</b> | 235    | 235   | 0.9678 | 1.2445 | 0.6007 | 0.7760 | 4.3115 | 5.2988  | 0.1727 | 0.1941 |
| <b>IRPC</b>   | 235    | 235   | 0.7934 | 0.5023 | 0.7345 | 0.5249 | 5.2922 | 4.7362  | 0.1212 | 0.0981 |
| <b>IVL</b>    | 235    | 235   | 1.6060 | 0.8426 | 1.1349 | 0.6867 | 6.6433 | 4.9351  | 0.3186 | 0.1427 |
| <b>KBANK</b>  | 235    | 235   | 0.3695 | 0.4090 | 0.1687 | 0.2788 | 0.9996 | 1.9025  | 0.0421 | 0.0948 |
| <b>KTB</b>    | 235    | 235   | 0.7847 | 0.9140 | 0.4589 | 0.5333 | 2.6841 | 2.7893  | 0.1543 | 0.1265 |
| <b>LH</b>     | 235    | 235   | 0.3503 | 0.5733 | 0.2311 | 0.3989 | 1.6620 | 2.4725  | 0.0526 | 0.0802 |
| <b>PTT</b>    | 235    | 235   | 0.2828 | 0.3169 | 0.1378 | 0.1530 | 1.1156 | 1.1403  | 0.0452 | 0.0759 |
| <b>PTTEP</b>  | 235    | 235   | 0.3430 | 0.4486 | 0.1902 | 0.2490 | 1.1712 | 1.4121  | 0.0532 | 0.0988 |
| <b>PTTGC</b>  | 235    | 235   | 0.8045 | 0.5988 | 0.5314 | 0.2810 | 2.7087 | 2.0863  | 0.1257 | 0.1531 |
| <b>RATCH</b>  | 235    | 235   | 0.2102 | 0.2112 | 0.1471 | 0.1468 | 0.9339 | 1.2547  | 0.0164 | 0.0461 |

|                |     |     |        |        |        |        |        |        |        |        |
|----------------|-----|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>SCB</b>     | 235 | 235 | 0.2637 | 0.3066 | 0.1249 | 0.1687 | 0.8403 | 1.0209 | 0.0309 | 0.0451 |
| <b>SCC</b>     | 235 | 235 | 0.2508 | 0.1794 | 0.1550 | 0.0903 | 1.4699 | 0.6576 | 0.0262 | 0.0409 |
| <b>SCCC</b>    | 235 | 235 | 0.2130 | 0.2774 | 0.1903 | 0.2456 | 1.6367 | 2.7580 | 0.0306 | 0.0331 |
| <b>TMB</b>     | 235 | 235 | 0.8001 | 1.3827 | 0.9112 | 1.1944 | 7.5910 | 6.0628 | 0.0878 | 0.0817 |
| <b>TOP</b>     | 235 | 235 | 0.9920 | 0.6711 | 0.5799 | 0.3846 | 3.5514 | 2.6362 | 0.1481 | 0.1406 |
| <b>TUF</b>     | 235 | 235 | 0.4616 | 0.4597 | 0.3523 | 0.2976 | 2.5290 | 2.2589 | 0.0373 | 0.0629 |
| <b>Average</b> |     |     | 0.5290 | 0.5651 |        |        |        |        |        |        |

Additional test was conducted to measure the change in turnover ratio during the period of three days preceding the event date comparing to its average level in one year trading prior to the inclusion. As a result, no significant increase in turnover was detected (data not shown). In fact, the turnover level was slightly decreased just before the effective date. The results were consistent with finding observed in the volume study. As oppose to the immediate increase in trading volume and turnover due to portfolio readjustment of index funds observed in SET50 (Triempanichgul (2010 )), the ASEAN STARS index was established for the first time, and there was no index fund following it. This may lead to no significant improvement in trading turnover of the targeted stocks after event date. More importantly, during the one year period after the index was establish as well as the implementation of ASEAN Linkage, long term improvement of both turnover and volume was detected.

## 5. CONCLUSIONS AND IMPLICATIONS

This research study has investigated the liquidity effect of ASEAN STARS index inclusion and the adaptation of ASEAN trading linkage on the 30 stocks initially covered by the index. The ASEAN Linkage has provided a unique opportunity to study index effect in the sense that the included stocks were not conveniently traded prior to the establishment, especially for the retail investors who have limited resources to invest across countries. The aim of the study was to determine whether the implementation of these index and infrastructure would influent the liquidity of the targeted stocks.

The result observed from the intraday percent quoted spread analysis indicated a significant improvement during the two months period following index inclusion. This was different from the

previous study where the decrease in trading cost as measure by quoted spread occurred only on the index adjustment date. The tests of other long term liquidity changes found significant improvement in price impact (illiquidity decreased by 17.43 percent), volume (increased by 29.89 percent), and free float adjusted turnover (increased by 6.82 percent) during one year period after index inclusion and ASEAN Linkage implementation.

Interestingly, the investigation of percent quoted spread within one year using daily data where trading cost was increased slightly contradicted with the short term intraday results. This suggested that the improvement in trading cost may exist only in the short term since the included stocks were considered as highly liquid with tight spread.

The observed improvement in liquidity was different from the previous studies on SET50 index rebalancing where the changes of volume and turnover were observed within the a few days prior to index adjustment. This may due to the fact that the ASEAN STARS index was just established and there was no index funds following it. More importantly, the overall improvements in price impact, volume, and turnover suggested a long term improvement of liquidity after adopting the ASEAN STARS index and ASEAN Linkage.

As for the future study, the long term effect on trading cost should be confirmed using intraday data when they become available since it may contain more information comparing to the daily data. Moreover, it is interesting to further investigate changes in other dimension of liquidity as well as in market microstructure such as market dept, order size, frequency of trade and so on. After the ASEAN markets are fully integrated, it may be interesting to extend the data to other less liquid stock where the change in liquidity may be more profound.

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## ภาคผนวก

### การดำเนินงานวิจัยไปใช้ประโยชน์

## **Output** จากโครงการ ผลกระทบของประชาคมเศรษฐกิจอาเซียนต่อตลาดทุนไทย

### 1. การนำเสนอผลงาน

1.1 การประชุมสัมมนา Capital Market Research Forum ตลาดหลักทรัพย์แห่งประเทศไทย 1.2 การประชุมกลุ่มนโยบาย สกว.

### 2. การนำผลงานวิจัยไปใช้ประโยชน์

เชิงนโยบาย:

It is possible to assess policy implications before events happen when possible. This is beneficiary for comparison with after event and understanding and adjustment of policy. Financial large-scale events are rare. To sustain economic stability and each-country's self-interest, possible events need to be analyzed as soon as they can be and learned from.

เชิงสาธารณะ: Paper presented at Capital Market Research Forum and Stock Exchange of Thailand and presentations at schools' meetings.

### 3. การสร้างเครือข่ายความร่วมมือทางวิชาการ

Proceedings of Asian Financial Association meeting 2016 (26-28 June). The papers have also been sent to be considered for publications in peer-review journals.