SEC WORKING PAPERS FORUM 2018

REGULATING BY MARKET FORCES

Proceedings

The Securities and Exchange Commission, Thailand

28 November 2018

In Collaboration with

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SEC Working Papers Forum 2018: Regulating by Market Forces

วันพุธ ที่ 28 พฤศจิกายน 2561

สำนักงานคณะกรรมการกำกับหลักทรัพย์และตลาดหลักทรัพย์

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1. หลักการและเหตุผล

เพื่อเป็นการส่งเสริมให้เกิดการแลกเปลี่ยนองค์ความรู้และแนวคิดที่เกี่ยวข้องกับนโยบายตลาดทุนระหว่างภาควิชาการและภาคปฏิบัติจาก อาจารย์ นักศึกษา บุคลากรตลาดทุน และผู้สนใจโดยทั่วไป เพื่อนำไปสู่การส่งเสริมการกำกับและพัฒนาการในแง่ต่าง ๆ ในตลาดทุน สำนักงานคณะกรรมการกำกับหลักทรัพย์และตลาดหลักทรัพย์ (“สำนักงาน ก.ล.ต.”) จึงได้ริเริ่มงาน SEC Working Papers Forum ซึ่งเป็นความร่วมมือกับสถาบันการศึกษาและองค์กรชั้นนำ ได้แก่ จุฬาลงกรณ์มหาวิทยาลัย มหาวิทยาลัยเกษตรศาสตร์ สถาบันบัณฑิตพัฒนบริหารศาสตร์ มหาวิทยาลัยธรรมศาสตร์ เอเชีย แปซิฟิก รีเสิร์ช เอ็กซ์เชนจ์ (Asia-Pacific Research Exchange: ARX) โดยสถาบัน ซีเอฟเอ (CFA Institute) และ สมาคมซีเอฟเอ ไทยแลนด์ ซึ่งจัดต่อเนื่องมาตั้งแต่ปี 2557 จนปัจจุบัน

2.สาระสำคัญของการจัดการสัมมนา

ในปี 2561 ทางสำนักงานคณะกรรมการกำกับหลักทรัพย์และตลาดหลักทรัพย์ ได้ส่งเสริมตลาดทุนเกี่ยวกับการกำกับดูแลและพัฒนาตลาดทุนด้วยการใช้เครื่องมือและกลไกที่หลากหลาย ไม่ใช่อาศัยเพียงการออกกฎระเบียบ (Regulatory Discipline) แต่รวมไปถึงการมี Self-discipline และ Market Discipline ซึ่งจะเป็นส่วนสำคัญในการกำกับดูแลและพัฒนาตลาดทุนให้มีความยั่งยืนต่อไป

3.รูปแบบการสัมมนา

งานสัมมนา SEC Working Papers Forum เริ่มจัดขึ้นตั้งแต่ปี พ.ศ. 2557 ลักษณะของงานสัมมนาเป็นการนำเสนอผลงานวิจัยจากผู้ที่มีประสบการณ์ทางด้านตลาดทุนไม่ว่าจะเป็นบุคลากรทางตลาดทุนหรือนักวิชาการจากสถาบันต่าง ๆ ซึ่งในงานสัมมนาเปิดโอกาสให้มีการวิจารณ์และแลกเปลี่ยนความคิดเห็นจากการนำเสนอผลงานวิจัย

ตั้งแต่ปี 2560 เป็นต้นมา ทางสำนักงานคณะกรรมการกำกับหลักทรัพย์และตลาดหลักทรัพย์ได้ร่วมมือเพิ่มเติมกับเอเชีย แปซิฟิก รีเสิร์ช เอ็กซ์เชนจ์ (Asia-Pacific Research Exchange: ARX) โดยสถาบัน ซีเอฟเอ (CFA Institute โดยมีการเพิ่มเป็นรูปแบบการเสวนาจากนักวิชาการและบุคคลากรจากตลาดทุนมาและเปลี่ยนความคิดเห็น อีกทั้งรูปแบบของการเปิดสมัครแข่งขันผลงานวิจัย โดยแบ่งรางวัลออกเป็นสามสาขา คือ
1. Asset Management 2. Corporate Finance 3. Market Structure and Intermediation และทางคณะกรรมการจะคัดเลือกผลงานวิจัยจากสามสาขารางวัลขึ้นมาเพื่อได้รับรางวัล Paper of the Year

ในปี 2561 นี้ทางงานสัมมนายังคงมีการจัดรูปแบบการประกวดแข่งขันผลงานวิจัยและรูปแบบเสวนา คือมีการจัดและร่วมแลกเปลี่ยนความคิดเห็นและรับฟังข้อเสนอแนะเกี่ยวกับ หัวข้อที่มีความเกี่ยวข้องกับ Market Forces ในหลายแง่มุมจาก stakeholders ที่สำคัญในตลาดทุน เช่น ตลาดหลักทรัพย์ นักลงทุนสถาบัน กองทุนบำนาญและกองทุนต่าง ๆ บริษัทจดทะเบียนผู้ประกอบธุรกิจในตลาดทุน ผู้ประกอบวิชาชีพในตลาดทุน ผู้ลงทุนโดยทั่วไปโดยจากภาควิชาการทั้งในและต่างประเทศ

4.คณะกรรมการพิจารณาผลงาน

1. นางทิพยสุดา ถาวรามร	ประธานกรรมการร่วม
2. รศ. ดร. พรอนงค์ บุษราตระกูล	ประธานกรรมการร่วม
3. ศ.ดร. อาณัติ ลีมัคเดช	กรรมการ
4. ผศ. ดร. โทมัส คอนเนลลี่	กรรมการ
5. ดร. กฤษฎา นิมมานันทน์	กรรมการ
6. ดร. ศรายุทธ เรืองสุวรรณ	กรรมการ
7. นาย เอกพล แสวงศรี	กรรมการและเลขานุการ

SEC Working paper Forum 2017: Capital Market Review

Research Paper Awards

Paper of the Year

"Who Should Regulate Investment Advisers"

By Assistant Professor Ben Charoenwong National University of Singapore
Assistant Professor Alan Kwan Hong Kong University และ
Assistant Professor Tarik Umar Rice University

Asset Management Winning Paper

"Who Should Regulate Investment Advisers"

By Assistant Professor Dr. Ben Charoenwong National University of Singapore
Assistant Professor Dr. Alan Kwan Hong Kong University and
Assistant Professor Dr. Tarik Umar Rice University

Corporate Finance Winning Paper

"White Knights or Machiavellians? Understanding the motivation for reverse takeovers in Singapore and Thailand"

By Associate Professor Dr. Pantisa Pavabutr Thammasat University

Market Structure Winning Paper

"A study of intraday trading behavior around tick size changes"

By Dr.Roongkiat Ratanabanchuen Chulalongkorn University
Dr.Kanis Saengchote Chulalongkorn University

SEC Working paper Forum 2017: Capital Market Review

List of Finalists

1.Corporate Governance and Stock Returns: Evidence from Stock Exchange of Thailand

Author: Sakkakom Maneenop and Visarut Pugdeepunt

2.Do independent directors improve firm value? Evidence from the Great Recession

Author: Nattawut Jenwittayaroje and Pornsit Jiraporn

3.Do Investors Benefit from DCA? Evidence from the Stock Exchange of Thailand

Author: Kanin Anantanasuwong and Sirithida Chaivisuttankgun

4.Family Affair? - Insider Trading and Family Firms: Evidence from Thailand

Author: Rapeepat Ingkasit and Arnat Leemakdej

5.Heterogeneity Effects on the Management of Retirement Fund

Author: Thepdanai Danswasvong

6.Investigating Asset Pricing Anomalies with Econometrics

Author: Jordan French

7.Is Smart Beta Still Smart Outside Paper

Author: Kanin Anantanasuwong

8.Is Thailand's credit default swap market linked to bond and stock markets?

Author: Boonlert Jitmaneeroj

9.Rational Decision-Making in Portfolio Management for Thai Investors

Author: Karuna Rat-arpa

10.Reducing Economic Inequality through Public-Private Partnerships in Bond and Capital Markets

Author: Sadudee Vongkiattikachorn

11.The effect of corporate social responsibility on firm value: An application of latent variable analysis to emerging markets in Asia Pacific

Author: Kanin Anantanasuwong and Sirithida Chaivisuttankgun

12.The Effect of Index Inclusion on Corporate Risk-Taking: Evidence from Thailand

Author: Thanisorn Pasurapanya and Kanis Saengchote

13.Time-Varying Risk Aversion: A Dynamic Application in Index Hedging

Author: Aran Phringphred

List of finalists are sorted by alphabetical order of research titles.

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1.Analysts' Recommendation and Stock Performance in the Case of Thailand Stock Exchange

Author: Pongsutti Phuensane, Thanapon Juicharoen, Suthin Wianwiwat and Tanyamat Srungboonmee

2.Are Equity Markets Really Casinos? When the timing is right.

Author: Tanakorn Likitapiwat and William F.Johnson

3.Asymmetric information in Property Funds and REITs

Author Chittisa Charoenpanich

4.Equity offering types, financing objectives, and long-run stock performance

Author: Sakkakom Maneenop and Chaiyuth Padungsaksawasdi

5.ESG: Alpha or Duty?

Author Rajnish Kumar

6.Essays on Open-Ended on Equity Mutual Funds in Thailand

Author: Roongkiat Ratanabanchuen and Kanis Saengchote

7.Information flows and shock transmissions across CDS, bond and stock markets: Implications for regulatory policy in Thailand

Author: Boonlert Jitmaneeroj

8.Impact of Management on the Performance of Domestic Equity Mutual Funds: Evidence for Thailand

Author: Natta Panyabodegun

9.Performance Comparison of VaR and LVaR for Market-Risk Measurement in the Thai Financial Market

Author: Suebsak Rochanarat

10.Study of the Economic System of the Industrial Age: Financial Technology

Author: Theerasak Sakatatiyagul and Apirada Chinprateep

11.Synergistic effects of CSR practices on firm value: Evidence from Asia Pacific emerging markets

Author: Boonlert Jitmaneeroj

12.The Determinants of Mutual Fund Cash Holdings: Evidence of Thailand

Author: Ratawan Bangkarm

13.The stochastic trading system through the ex-ante expectation of the maximum. drawdown and the maximum drawup: Theory and empirical evidence in the Thailand stock market.

Author: Akara Kijkarncharoensin and Somporn Punpocha

14.Value-at-Risk (VaR) and Performance Predictability: Evidence on Skewed distribution mutual fund in Thailand

Author: Apichai Akechamanon

15.What are the critical drivers of corporate sustainability? Evidence from emerging and developed markets

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REGULATING BY MARKET FORCES

Analysts' Recommendation and Stock Performance in the Case of Thailand Stock Exchange

Pongsutti Phuensane
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Tanyamat Srungboonmee

ANALYSTS’ RECOMMENDATION AND STOCK PERFORMANCE IN THE CASE OF THAILAND STOCK EXCHANGE

Thanapon Juicharoen*, Suthin Wianwiwat*, Tanyamat Srungboonmee*,
Pongsutti Phuensane**

I. Background and rationale of the study

Over the past decade investing in securities has continuingly gaining popularity. One of the factors that made investing in securities has become so popular is because the investors can access news and information easier than the past. The investors use this information to determine their choices of investing in different securities such as Daily transaction reports, Companies yearly reports, Financial report and also investment news from medias such as televisions newspapers or from online medias. Therefore, there is one information that is very important and popular which is securities analyst’s recommendation that has been provided by brokers in order to give beneficial information about securities. This recommendation making investor have more information to support their investment. However, there is a question about this recommendation whether the investor is certain that the information is trustworthy and enhance their capabilities of investing. Thus this research studying the efficiency of the analyst recommendation or as we called brokers, we using the report that brokers recommend to investor to as an example. We focus on the price change behavior comparing between before and after the brokers released their daily research recommending stocks in the Thailand stock market.

The Capital market in Thailand can be considered to be one of the top five large market in Asia that has attract the eyes of foreign investor all over the world. On one hand the securities market is a source of long-term capital for entrepreneur for the business growth. On another hand he is one of the choices of savings and diversify risks of investment making investors able to directly invest in to business without any intermediary which is different from Money market which is a source of short-term capital and requires a financial institution as the center. Referring to the large elements that drives Thailand capital market by type of investors, it can be divided into 4 type of investor. First, institutional investors that invest in consolidated funds having a manager managing investment portfolio, have their own investment policy. Second, Foreign investors, there are non-Thai nationality investor mostly these investors also invest in consolidated funds but it is a consolidated fund from foreign countries. Third, retail investors, this is the most numerous of the 4 groups. They invest by using their own money, no fundraising like the consolidated fund. Lastly, securities companies, a group that uses their own funds no fund raising but registered as a corporation. All of this groups are gradually interested in investing into Thailand's securities market as the transaction and the value are still increasing.

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However, investing in the Capital market is a high risk investment compared to other investment. Thus, investors need to study and carefully consider investing in the stock exchange. There are some ways of initial data that support the investor's decision to buy and sell in any securities such as; quantitative data and qualitative data. For example, interest rate changes, rate of inflation, economic and political conditions, television news, newspaper, internet articles, data that shows the statement of financial position. Another type of information, that investor commonly used to support their investing decision is stock analyst recommendation from securities companies or brokers provided to investors. Brokers is not just an intermediary for buying/selling securities for investors, brokers also have responsibilities and services that beneficial to investor decisions. By giving counsel recommend investment data for investors to support their investment analyst recommendation should be an efficient tool. This because before it is published it is made by critics specialized in analyzing securities that has legal certificate from S.E.C. who can access data faster and deeper than minor investor. Therefore, the main issue is the investor that uses this recommendation to buy stocks can win the market or not? Can they be able to continually profit? Can they manage their portfolio to face uncertainty situations in the market or not? So, this is quite crucial to know that the recommendation is an effective tool for investor.

The study of the capability of investment portfolio has become a momentum in traditional financial research for a long time. Mostly, they study about capabilities of investing in mutual funds such as;Carhart, 1997; Fama and French, 1993; Pendaraki et al, 2005 or studies about portfolio management strategies that fund managers uses such as; Chan and Lakonishok, 2004. However, this research focus on the efficiency of investment by using stock recommendation to investigate the performance of investment if we buy the stock follow analyst's recommendation and see these recommendations can truly help investors to win the market, or not?

Objectives of the study

This research aims to study the performance of stock investment using stock analyst's recommendation from brokerages in the Thailand Stock Exchange.

The scope and limited of the study

1. This research uses price data and buy quantity of common stock in the securities market of Thailand from January 2017 to May 2018.
2. This research uses records of trading price at the market closure time from the database.
3. This research uses daily research of securities from 12 brokerages firm starting from August 2017 to January 2018 a total of 1384 articles.
4. This research uses analyst's recommendation for 233 securities.

Procedure of research

1. Price data is collected from the Stock exchange of Thailand

2. Collect review articles published from brokers
3. Study techniques and strategies of the related research
4. Analyze the example to create a set of data to be compare it's capabilities by finding factors from the examples
   4.1 Create a set of price before and after publishing the review of the recommendations 50 days before publish
   4.2 Create a set of price after the compared data which is the index of the securities market (SET) along whit the first set of data
   4.3 Input the data into the simulation to find it's factor
5. Create 1 random set of data and use the same method of finding the results of this set of data to compare with the previous data.
6. Summarize and Suggestion

II. LITERATURE REVIEWS

This study examines the performance of investment in stocks when using the analyst recommendation, which is related to several financial theories. This section will discuss the theories and related research used in this study.

Efficient market hypothesis (EMH)

Efficient market hypothesis (EMH) is invented and developed by Eugene fama, this theory explains that information is reflected in to price of the securities. Every investor can access and receive all information equally. Stock prices will rise or decline immediately when new information came into the market. Effective market theory can be divided into three levels of efficiency.

1. **Weak-form efficiency**

   The analysis of trend and price data in the past (Technical analysis) cannot be forecasted and predicted prices in the future. It is believed that prices are moving in a random way.

2. **Semi-strong form efficiency**

   A market that assumes the price of a stock reflects the information that is publicly available. The price will be adjusted to respond to new information immediately, such as dividend declaration, par split announcement.

3. **Strong-form efficiency**

   At this level stock price respond to all kinds of information including public information and private information. This means that no investor can make a profit beyond the normal range using inside information to trade.

Follow EMH, there are some studies have been conducted in the Asia-Pacific region. Hamid et al, 2017 study the efficiency of the capital market through the use of statistical methods, Autocorrelation, Unit Root Test, Variance Ratio Test. The result show that capital markets in 14 countries including Thailand are not classified as a low-performing market. This means that in these countries the information is already affects the stock prices.

Not only the EHM but also the efficiency of stock recommendation that we have to do the lit-reviews. There are various types of data, both quantitative and qualitative that investors use to adjust their strategy to manage their portfolio. One of the most used information for retail investors is the analyst's recommendation that published by brokers. WMR Liu et al, 2016, has also confirmed that brokers have a greater impact on liquidity or trading volume.

In addition, MD Maggio et al., 2017, also states that brokers' information networks are important and affect the price of securities. This makes institutional investors trading and making more profitable. The impact of the information has been researched since Conrad et al. (1994), find that information is only affecting the stock price within one week. Lee et al, (2003) argues that the yield data in the Australian market affect short-term investment. According to a study by Ali and Ahmad, (2011), it has been find that the Malaysian market has responded to news in only a few weeks. In Thailand, Udomponglukkana T. (2012), find that the stock market in Thailand is responding to news only a few days. Recent research, Pan and Liu (2018), also finds that the leverage of short-term investment returns is more significant and better than long-term investment.

Performance Measurement

From the above information, it is understandable that analyst's recommendation from securities companies is correlated with stock prices. Therefore, the performance of analyst's recommendation should be identified. Can the information that comes out of the brokers make it profitable for investors? The theory used in this research is based on the Jensen model (Jensen, 1968) developed from the CAPM model (The capital asset pricing model), presented by Sharpe in 1964. The idea is that the yield of any securities is equal to the risk-free return plus the expected return to compensate the market risk. Jensen has developed a portfolio performance indicator called Jensen's Alpha to evaluate the predictive efficiency that affects the return of a portfolio of securities based on this model

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t}$$

Where $r_{i,t} = (R_{i,t} - R_{f,t})$

$R_{i,t}$ = the expected return of the portfolio i in period t.
$R_{f,t}$ = risk-free rate of return.
$r_{m,t} = (R_{m,t} - R_{f,t})$ the expected excess return on the market.

If the broker has the ability to choose a good stock. This means that stocks can be picked and returns are greater than market returns. The α_i value in the model will be positive. If brokers are unable to effectively analyze stock selections, it means that the return of the selected stocks to the portfolio does not outperform the market returns. The value of α_i will be negative. Another instrument to measure portfolio performance is Sharpe's ratio, created by William F. Sharp, which is a very popular indicator for measuring stock performance.

$$S_i = \frac{r_i - r_f}{\sigma_i}$$

Where r_i = the return of securities i.
R_f = risk-free rate of return.
σ_i = the standard deviation of the return of the fund.

The result will be the ratio of excess return from investment in risk-free portfolio. If this ratio is low It shows that the portfolios are high risk or low efficiency, because the yield is spreading out of the expected yield, the opportunity to deviate too much. If the standard deviation is low, it indicates that the portfolios are low risk or high performance. And the last indicator used in this study is Treynor's ratio, invented by Jack Treynor to measure the return of securities over or above the yield of risk-free securities.

$$T_i = \frac{r_i - r_f}{\beta}$$

Where $\beta = \frac{Cov(r_i, r_m)}{Var(r_m)}$ = systemic risk.
r_i = the return of securities i.
r_f = risk-free rate of return.

The result will be the ratio of excess return from investment in risk-free portfolio to market risk. The higher the value, the more effective the portfolios are.

For research related to performance measurement using the model mentioned above. Sharp (1964) and Lintner (1965) develop indicators to evaluate the performance of mutual funds in the United States between 1945 and 1964. The result show that the total funds are operating at an average level. This means that the fund manager cannot predict the price of securities well enough to make a better return than investing in a long-term securities holding. Treynor (1966) study the ability of fund managers 57 open-ended funds in 1963 and the results showed that fund managers could not forecast the market price.

There are many researches that use the indicators developed by Sharp, Treynor and Jensen as the basis for the efficiency of the fund. (McDonald, 1974) find out about the performance of 123 funds in the United States. Using the above indicators, the result is that the fund is inefficient compared to the market return. (Malkiel, 1995) studied the return of the equity fund in the United States between 1971-1991 using Jensen's Alpha. The results were worse than the comparable securities. (Malkiel, 1995) studied the return of the equity fund in the United States between 1971-1991 using Jensen's Alpha. The results were worse than the comparable securities. (Shamsher et al., 2000) used the above indicators to find the fund performance in Malaysia, with 41 funds. The results, whether active or passive, are less effective than the market. (Pendaraki et al, 2005) Measuring Fund Performance in Greece. Using the expected return of investment in mutual funds compared to the benchmark. (Wuthivigaigan S., 2006) measured fund performance in Thailand through the Morningstar rating using the Cross Product Ratio (CPR) and Chi-squre. (Mohamad, 2007) uses the Sharp and alpha values by adding the Modigliani index to the fund's performance. 65 Funds that invest in the capital market, whether it's a bull market or bear market. The results showed that the fund chose to invest in the worst of both situations. (Ratanasimanon, 2011) Researched the performance of mutual funds in Thailand from 2001 to 2010. The net return of the fund was at the average level. It is not over the performance of long-term investment.

On the other hand, some research has found that fund management is quite effective. (Dhanda et al., 2012) finding the performance of an open-ended fund in India, the result was that the performance of the fund in India was quite effective compared to the benchmark. Or (Karim et al, 2014) find out the performance of the Islamic Exchange (DJIM) in Malaysia from 2000 to 2011 using the improved Sharp ratio. The results show that the Islamic Stock Exchange returns is more profitable than common market.

There are also many researches on the performance of fund measurement. Such as (Gaba and Kumar, 2018) compare the performance of mutual funds between the Exchange Trade funds and the Index funds. The results show that both funds have better return than market returns. The above indicators are also used to compare and study the efficiency of the events. Such as (Sandblom and Jansson, 2017) use 127 fund information in Sweden from 2006 to 2016 to find out whether different investment patterns will make a difference. The results show that funds that invest in different ways are equally effective. (Svanberg and Karlsson, 2018) uses 38 funds in Sweden that are active and passive funds to analyze performance during the economic crisis and after the crisis.

The data above shows that most of the research in the past is usually the same as Jensen's. The portfolio management of the fund is rather ineffective. Investors can not expect returns from fund managers or choose to invest in a fund based on the ability of the fund manager.

In reviewing literature related to performance measurement, it is found that most research focuses on the effectiveness of fund performance. In terms of investment, direct investment in the stock market is no less important than investment in mutual funds as well. Also, when brokers issue an analyst recommendation to buy the stocks, it is the same as the fund manager decides to invest in a securities. Then, the researchers are interested to study that, use of analyst recommendation from brokers to assist in investment. How effective is it?

III. RESEARCH METHODOLOGY

This research focuses on finding the performance of analyst recommendation. The advice issued by analysts from broker company in Thailand. Find out by performing an analysis of the portfolios generated by collecting Broker's review that recommended to buy shares. Use Jensen, Sharp, Treynor models to find the overall performance and Apply the ARIMA (Auto Regressive Integrated Moving Average) model to generate predictive equation to analyze the price response when information is suddenly affected. When all results are obtained. The Randomness test was used to compare the results between the actual dataset and the randomized data. Make sure that the results of the performance is based on the actual analyst recommendation. This will benefit investors who use these information to make a decision to invest in the Stock Exchange of Thailand.

Data used in research

1. Closing price of shares in the Stock Exchange of Thailand, from January 2560 to June 2018, data was collected from the Thomson Reuter eikon.

2. Analyst recommendation of securities companies, 12 companies issued by licensed securities analysts. The analysis is based on both quantitative and qualitative information, during August 2017 to January 2018, data from the efin Stock Pick Up.

Research tools

1. Sharpe Ratio, Treynor Ratio, Jensen's Alpha
2. Standard Regression
3. ARIMA (Auto Regressive Integrated Moving Average)
4. Impulse Response Function
5. Randomness Test

Data collection

1. Make a database of the date, month, year of all stocks that recommended to buy.
2. Create a price database before and after 50 days of stocks that have been recommended.
3. Find the variables in the performance measurement model.
4. Create a new set of randomly generated data (date, month, year).

Research Process

Create a data set of stocks that daily research reccommended to buy. The date of issue of the report is t = 0. Then create 50-day closing price data before and after release date.

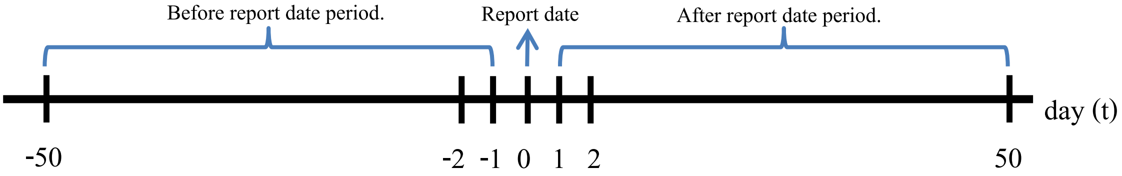

Figure 1 Displays data collection methods when an analysis is made to buy one stock.

If the stock is unable to trade at that date, then the stock price will be kept from that day to the next one day. If a securities company issues an analyst recommendation to buy the same stock more than once, the average price of the stock is determined before making a data set. All data is done in conjunction with the SET Index.

Since the price of a stock has a different price range (Space). The price has to be adjusted to the new value. The average price index is used to measure the trend of prices in different periods. The average price index is derived from the equation.

$$\text{Price index}_{\text{i}} = \frac{\text{Price}_{\text{i}}}{\text{Price}_0}$$

Calculate the return value and the cumulative return. From the equation.

$$\text{PR}_{\text{t}} = \frac{(\text{P}_{\text{t}} - \text{P}_{\text{t}-1})}{\text{P}_{\text{t}-1}} \times 100$$

Where PR_t is the return rate at t.

P_t is the closing price of any shares at t.

$$CPR_t = CPR_{t-1} + PR_t$$

Where CPR_t is the cumulative return at t.

Use the previous data to calculate the mean value from day t = -50 to day t = 50, which is assumed to be the return of investment in this portfolios.

$$AVE_t = \frac{\sum_1^n PR_t}{n}$$

Where AVE_t is the average of the return at t.

n is the total number of shares that recommended by analyst

Use the average return and cumulative return data to find α from Jensen's model using the regression equation tools.

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t}$$

Where $r_{i,t}$ = average return on all stock purchases followed by the advice of brokers.

$r_{m,t}$= return of SET in the same period

Use the average return and cumulative return data to calculate the ratio from Sharp and Treynor equations.

$$\mathbf{S_i} = \frac{\mathbf{r_i} - \mathbf{r_f}}{\boldsymbol{\sigma}_\mathbf{i}}$$

Where r_i = the average return on all stock purchases, as recommended by the broker.

r_f = risk-free rate of return.

σ_i = the standard deviation of the average return that occurs when every share is purchased, according to the analyst recommendation.

$$T_i = \frac{r_i - r_f}{\beta}$$

Where r_i = the average return on all stock purchases, as recommended by the broker.

r_f = risk-free rate of return.
β = systemic risk

$$\beta = \frac{\mathrm{cov}(r_i, r_m)}{\sigma^2(r_m)}$$

Use the average return result to calculate the VAR (Vecter Autoregression Model) equation to generate the predictive equation.

$$y_t = c + \sum_{i=1}^{n} A_i y_{t-i} + e_t$$

Where y_t = the vector of internal variables
A_i = Lagged parameters
e_t = Disturbing term or Impulses

Use the equation for analyzing the Impulse Response Function

IV. RESULTS

This chapter presents the results of the study following the methodology in section 3. The section starting with the results of the average price, as shown in Figure 1.

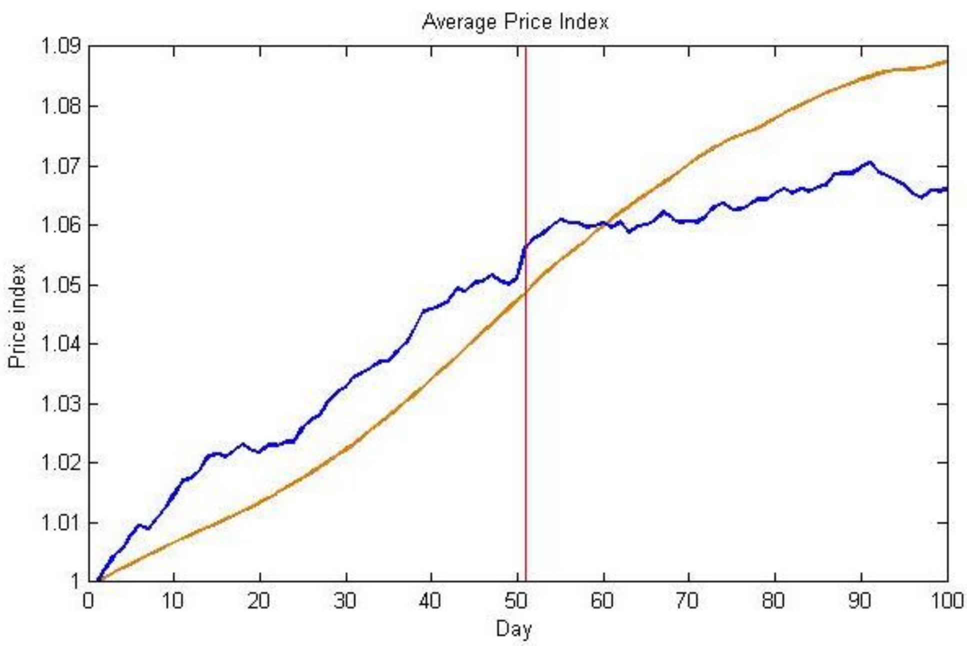

Figure 2 Shows the average price index of securities that the analyst recommended to buy.

The figure 2 shows that the average price of all securities on buy recommended is increasing on the period before the analyst's recommendation was announced and after the report was published the price will rise constantly for a short time (4-5 days).

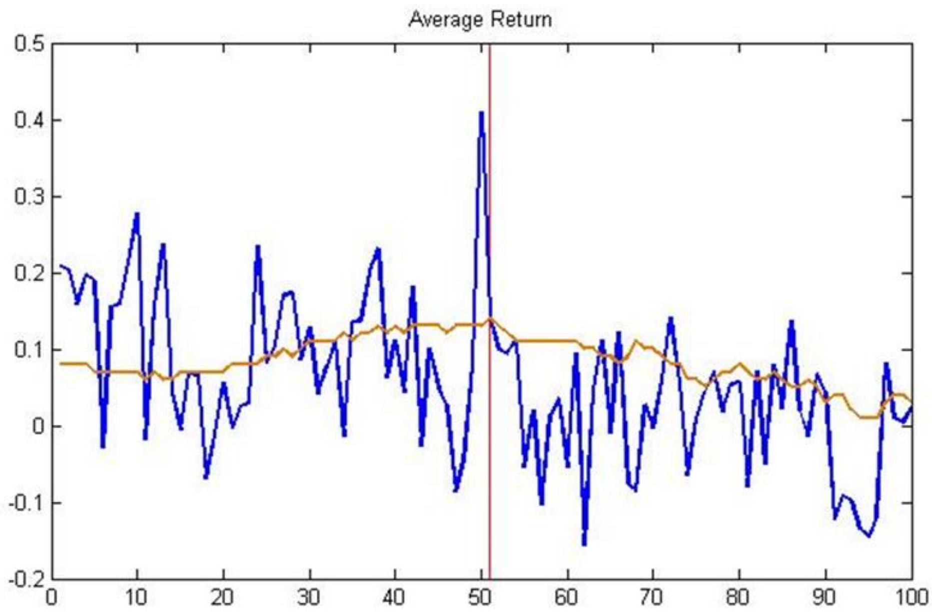

Figure 3 Show the average return of securities that the analyst recommended to buy and the average return of the SET at the same time.

From figure 3, it can be seen that the blue line, which is the average return of all securities for buy side recommended is fluctuate for the hold period. However, the rate of return is significantly increased over the next 4- 5 days before the buy recommendation is published. However, after the analysts recommends to buy that stock, the level of return immediately decreased.

From the previous result, it is evident that the change in the information of analyst recommendation has a significant impact on the short-term price. So, the price response to information test is required. We use the impulse response function to investigate how is the price react to the information using the equation below.

$$y_d = 0.022 + 0.241y_{d-1} + 0.123y_{d-2} + 0.101y_{d-3} + 0.017y_{d-4} + 0.036y_{d-5}$$

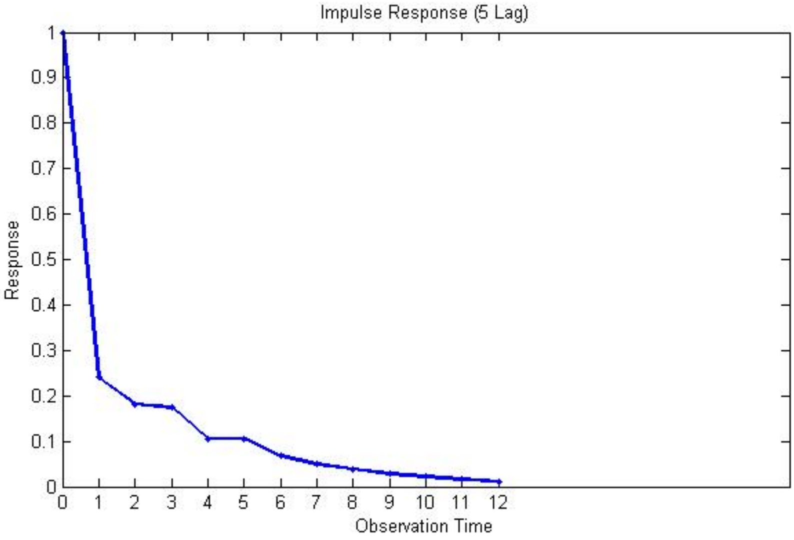

Figure 4 Display the result of impulse response function

The impulse response function shows the impact of analyst recommendation on average return change only for a short period.

Performance from Jensen's model

Jensen alpha Performance from Return					
Day	10	20	30	40	50
Beta	8.37	3.33	0.98	0.54	1.15
alpha	-0.57	-0.10	-0.06	-0.09	-0.03
p-value	0.03	0.01	0.17	0.11	0.60
Standard Error	0.22	0.04	0.04	0.06	0.06
R squar	0.45	0.16	0.05	0.02	0.16

Table 1: Performance calculations using the Jensen model.

Table 1 shows that whether for a short period of time or longer period the value of Jensen alpha is relatively low. Also, in some period the Jensen alpha are negative, which mean that investor who buy stock using analyst's recommendation have return that worse than the market returns.

Performance model using Sharp and Treynor

Performance Ratio from Return					
Day	10	20	30	40	50
Sharp ratio Port	0.13	-0.47	**-0.98**	**-1.59**	**-2.18**
Sharp ratio SET	**6.41**	**1.00**	-1.97	-3.78	-4.67
Treynor ratio Port	0.00	-0.02	-0.10	-0.27	-0.19
Treynor ratio SET	0.01	0.00	**-0.05**	**-0.18**	-0.14

Table 2: Performance calculations using the returns as a measure in Sharpe and Treynor equations.

Table 12 shows that mostly the Sharpe ratio is negative. That means that if you want to set the investment strategy according to the analyst recommendation you will have the return that lower than investing in risk-free asset. Also, the result of the Treynor ratio shows that if the investor investing according to the recommendations investor is not able get the return higher than the return of the market.

V. DISCUSSION AND CONCLUSION

This research aimed to study the efficiency of stock investment that recommended by the analyst of securities company. Price data and review from analyst have been used to simulate the efficiency from Jensen, Sharpe and Treynor models.

The results are different by the different form of return. The results from the average return data are not effective no matter which model is used to measure the performance. However, the results from the accumulated average return data found that the ratio can indicates the efficiency of investment.

The result is indicative that the investors should have the stock beforehand to make the profit. If the investors wait the review from analyst to buy the stock, from the study this situation is likely tend to loss. It can be concluded that long-term investment can reduce the risk of price volatility due to influence of the information.

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SEC WORKING PAPERS

FORUM 2018

REGULATING BY MARKET FORCES

Asymmetric information in Property Funds and REITs

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Asymmetric Information in Property Funds and REITs

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Special Project Submitted in Partial Fulfillment of

The Requirements for The Degree of Master of Science in Finance

Faculty of Commerce and Accountancy

Chulalongkorn University

Academic Year 2017

ABSTACT

In this paper, I investigate the underpricing determinants of Thailand property funds and real estate investment trusts initial public offerings under asymmetry information framework by using OLS regression. Under rational approach, this paper reports a statistically significant average return 2.40% on the first trading day for a sample of 66 initial public offerings of property funds and real estate investment trusts during 2005-2018.

The characteristics of PFPO and REIT IPOs structure (both from asset and fund organization) are used as proxies of uncertainty, heterogeneous informed investors and conflict of interest to test degree of underpricing (measured by initial-day return). The report finds that guarantee is most explanatory factor to initial-day return of Thailand PFPO& REIT IPOs.

1. Introduction

Overview and Background of the study

The well-known financial anomaly associated with the firm's going public is IPO underpricing. There are several studies on initial public offerings ("IPOs") of firms showing on average experience positive return on their first day of trading, or on average firms' IPOs have been facing with underpricing. For example, Ibbtson (1975) and Ritter (1984) report average initial return 11.4 % and 48.4 %, respectively. The underpricing of IPOs phenomenon is costly to equity issuers. A number of explanations have existed for the phenomenon of this positive large opportunity cost and one popular explanation of multi model rooted from asymmetry information. The popular model is so-called 'winner curse' adverse selection (Rock, 1986).

In this paper, I examine this particular explanation in the context of Property Fund for Public Offering ("PFPO") and Real Estate Investment Trust ("REIT") IPOs in Thailand, with hypothesis that some characteristics of PFPO and REITs IPOs affect degree of adverse selection.

In contrast to empirical studies on firms' equity, Wang, Chann and Gau (1992) find that REIT IPOs are statically significantly overpriced (a 2.82% price decline on the first day of trading) using a sample of 87 REIT IPOs in the 1971-1988. Wang, Chan, and Gau argue that their results appear to be inconsistent with winner's curse explanations of IPO returns and suggest that the winner's curse model might not apply to these IPOs. However, Ling and Ryngaert (1997) find document that post-1990 REIT IPOs have features that make them more difficult to value than pre-1990 REIT IPOs. Using a sample of the 1991-1994 period, they find average initial-day returns of 3.60% of REIT IPOs and the underpricing is associated with the change of REIT regime. (i.e., increase of complexity in asset valuation and more intuitional investment in more recent REIT IPOs)

Significance of the problem and objectives of the study

REITs have become an increasingly popular vehicle for real estate ownership. Global market capitalization now stands at approximately US$1.7trillion, up from US$734billion in 2010. Since 2010, the US REIT market has grown by almost 150 percent from 2010-2016, while the market capitalization of non-US REITs has more than doubled in United States dollars (USD) terms. (Ernst & Young, 2016). Like public offering of equity securities, REIT issuer raise funds from offering trust units. After SEC's approval is granted, the issuer uses proceeds to invest in properties and establish a trust. After REIT establishment, REIT issuer will register REIT units in the stock of exchange and make the units tradable like stocks.

In Thailand, the similar vehicle named the Property Fund for Public Offering Type I or the so–called Property Fund was introduced in 2003 before first establishment of REIT in 2014 and continuously grown up by 290 percent from 2010-2016 with net asset value of approximately 337.1 billion Baht, up from 86.1 billion in 2010. (SEC, 2016). Funds mobilized from the public through REITs have been nearly one-third of total capital raised in the primary market between 2014-2016. In 2016, REIT IPOs amounted to 20.2 million Baht, accounted for 38% of total capital raised. (The Securities and Exchange Commission, 2016)

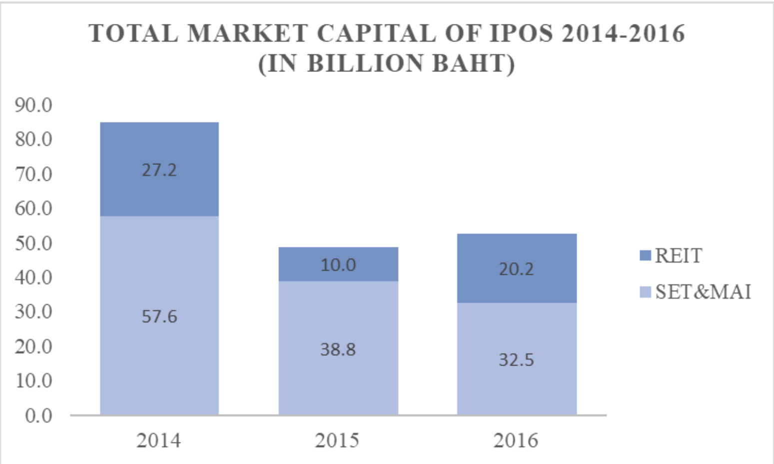

Figure1. Total market capital of initial public offering in Thailand. This diagram plots the total market capital of REIT and firm IPOs registered in Stock Exchange of Thailand (SET) and Market for Alternative Investment (MAI) over the period of 2014 to 2016.

In investors' aspect, REIT is an alternative investment product that generates recurring income from real properties passing-through dividend form. Investors require small capital to invest in REIT units, comparing to direct investment in real properties. However, to property owners, so-called sponsors, REIT is an alternative fundraising vehicle by monetizing assets through REIT. The cost of capital from fund raising via REIT generally higher than debt but lower than equity. The higher the underpricing, the more money is "left on the table" for the issuer.

This objective of this study is to test the empirical evidence of asymmetric information, using a sample of Thailand PFPO & REIT IPOs during January 2005- January 2018. In order to determine the factors that affect to the underpricing, the characteristics of PFPO& REIT IPOs structure (both from asset and fund organization) are used as proxies of uncertainty, heterogeneous informed investors and conflict of interest) to test the magnitude of first day return.

In addition to other existing researches, there is a gap of IPO underpricing in captive REITs among previous studies. Unlike most general firms and US REITs, Most Thailand REITs are structured as captive REITs, or so-called sponsor REITs. An independent asset management company, wholly owned by the sponsor, is generally set up to manage the REIT as an external manager. As such, sponsors have considerable influence over REIT's financing and investment policies. The captive management structure also tends to invite agency problems. Those conflicts can arise when property fund/ REIT manager's interest is not aligned with unitholders. In this paper, I also test the effect of conflict of interest (i.e., conflicts of interest between property fund/ REIT manager and unitholders and sponsor reputation) to the degree of IPO underpricing.

Research Hypothesis

<u>Hypothesis 1:</u> Adverse selection causes the underpricing of new issued IPOs. The explanation of adverse selection requires both uncertainty about the true value of the IPOs and heterogeneous information about the value. (Rock 1982 and Ritter 1984)

Hypothesis 1.1 With more certainly about the value of fund's underlying asset (e.g., revenue/EBITDA steam), property fund and REIT IPOs should experience less degree of adverse selection. Fund structure that provide more certain of fund cashflow steam are guarantee offer and long lease length between REIT and tenants. Therefore, I hypothesize that the IPO underpricing is negatively associated with provision of guarantee and lease length.

Hypothesis 1.2 Privileged information given to more informed investors put less informed investors at a disadvantage. If investors know a priori that they do not have to compete with informed investors, IPOs are not underpriced. Since a sponsor is assumed to have better information about true value and future cash flows of the assets than outside investors. Therefore, I hypothesize that the IPO underpricing is negatively associated with free float (i.e. the fraction of shares that is not retained by the sponsor or related parties).

Hypothesis 2: Under ''rational discounting,'' all market participants fully anticipate the conflict. Investors require greater underpricing to compensate for the adverse effects of any conflicts of interest (Gompers and Lerner, 1997)

Hypothesis 2.1 Investment banker or so-called underwriter is hired to issue securities in an initial public offering. Many investment banks underwrite initial public offerings (IPOs) and also manage mutual funds. When an investment bank is both the seller and a possible buyer of a security, a potential conflict of interest could arise. In the case of REIT, underwriters have incentives to maximize the offer price both because their compensations are practically subjected to the total offering value, and also their affiliated mutual funds that take equity position in sponsor's firm stock can get benefit from high offering value (e.g. special dividends are normally declared after the sponsor's firm divest its assets to PFPO/REIT). In addition to the potential conflicts of underwriter, Thailand REITs are mostly structured as captive REITs. An independent asset management company (specialized property management companies), wholly owned by the sponsor, is set up to manage as a REIT manager. As such, sponsors have considerable influence over REIT's financing and investment policies. The structure tends to invite agency problems in REIT.

With the structure of both property funds and REITs, conflict of interest could occur (i.e. collusion between REIT manager and sponsor and/or hidden incentive of underwriter) and lead to adverse selection from moral hazard risk perceived by investors.

I hypothesize that the IPO underpricing is positively associated with REIT manger and/or underwriter relationship with sponsor.

Hypothesis 2.2

Capital markets recognize high quality monitors by requiring a lower underpricing for issues with large sponsor ownership at IPO. When a potential conflict of interest exists, the reputation of the sponsor should mitigate some of the negative impact.

I hypothesize that the IPO underpricing is negatively associated with sponsors' reputation

Conceptual Framework

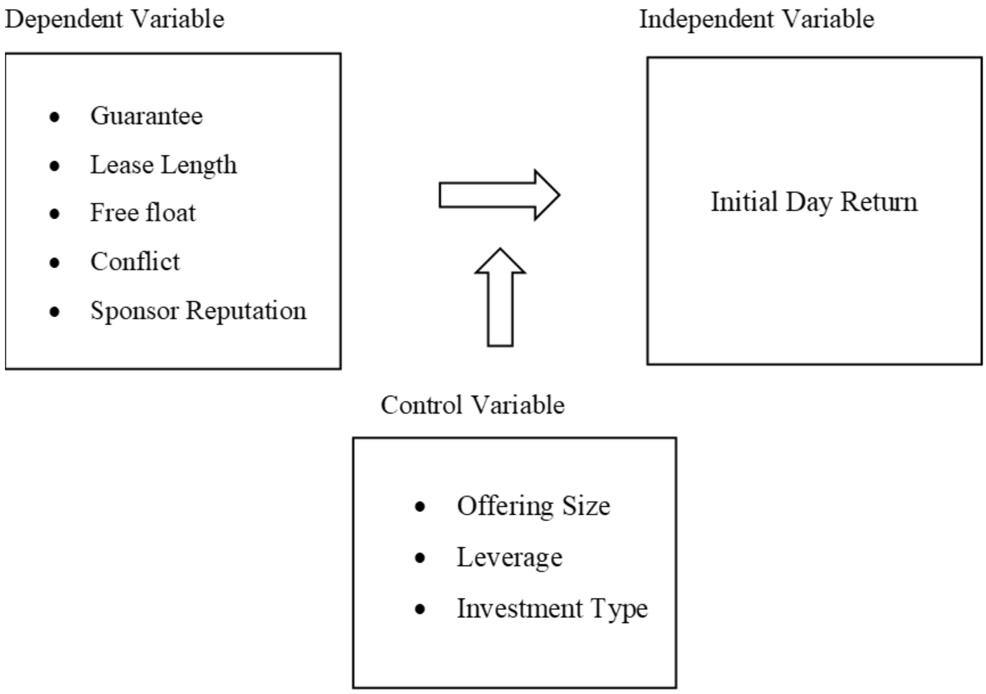

Figure2. Conceptual research framework. This diagram illustrates the selected variable under asymmetry information framework to determine the characteristics of PFPO and REIT IPOs structure that affect to the underpricing (Initial day return as a proxy).

The key variables are proxies of uncertainty cashflow (Guarantee and Lease length), heterogeneous informed investors (Free float) and moral hazard risk (Conflict of interest and Sponsor's reputation).

2. Literature review

Firms' IPO underpricing and asymmetric information

Akerlof's (1970) introduces the concept of adverse selection, or the so called 'lemons problem'. This phenomenon exists when an asymmetry information characterizes a market and can stop the gains from honest trade being realized. The paper is a groundbreaking of asymmetric information problem and explains the theory of markets in many contexts such as automobile, insurance and welfare.

Asymmetric information is also the key dominant on how firm makes decision in financing and investing. Myers and Majluf (1984) argue that firms prioritize their sources of financing, first preferring internal financing, and then debt, lastly raising equity as a last resort. This model is so called the pecking order. The model is explainable with involvement of asymmetric information. Since managers (who know better about true value of the firm than investors) issue new equity, investors believe that managers think that the firm is overvalued and managers are taking advantage of this over-valuation. As a result, investors will place a lower value to the new equity issuance. Consequently, equity issuance is the last order in source of fund.

Rock (1982) develop the model to explain the well-established phenomenon of the IPO underpricing. His model relies on information asymmetry between informed and uninformed investors and assumes that no agency conflict between issuer and underwriter. The informed investors possess better knowledge about the future prospects of the firm than uninformed investors. Consequently, informed investors will participate in good issues and uninformed investors face 'winner curse" since they will get the allocation of only bad issues which are not subscribed by informed investors. In addition, the bias against uninformed investors can be even larger if the underwriters favor informed investors, who are primarily institutional investors. Therefore, uninformed investors require a higher average return to compensate for the allocation disadvantage – hence the underpricing in the IPO market.

Ritter (1984) develop an implication of the Rock's model and applied it to the 'hot issue' market of 1980. In general, the greater the uncertainty about the true price of the new shares, the greater the advantage of the informed investors and the deeper the discount the firm must offer to entice uninformed investors into the market. Ritter tested to see whether the predictable occurrence of market cycles in which initial offerings are deeply discounted could be explained as a change in the composition of the firms going public. The hypothesis is that during one phase, the initial uncertainty about firm values is low while during the other the uncertainty is high. While Ritter finds a significant statistical relation between the price variability of an issue in the aftermarket (which serves as a proxy for initial uncertainty) and the size of the discount.

Grinblatt and Hwang (1989) develops a signaling model to explain new issue underpricing. In their analysis, an issuer is assumed to have better information about his firm's future cash flows than outside investors. To overcome the asymmetric information problem, the issuer signals the true value of the firm by offering shares at a discount and by retaining some of the shares of the new issue in his personal portfolio. Both the fraction of the new issue retained by the issuer and its offering price convey to investors the unobservable "intrinsic" value of the firm and the variance of its cash flows

A number of independent variables are used to explain the variation around underpricing effect among issued IPOs in the previous literatures. Downers and Heinkel (1982) and How and Low (1993) find evidence that a firm's abnormal return rises as the proportion of equity retained by the existing shareholders rises, and Ritter (1991) and Levis (1993) show that abnormal returns are more prevalent in firms which seeks lower gross proceeds from the IPOs. Thus, as explained in the signaling hypothesis, the retention rate by existing shareholders can be counted as a credible signal of firm value to outside investors. In addition to the retention rate, a negative correlation between offering price and underpricing is anticipated. This is because the variance of the firms' cash flow is expected to positively associated with underpricing, and the offering price signals the uncertainties in the firm's cash flows (Brennan & Hughes, 1991; Tinic, 1998). As some of prior studies by Ibbotson, Sindelar and Ritter (1994), Booth and Chua (1996) and Cheng et al.(2005) have documented, the offering price of an IPO is expected to impact the underpricing level in negative manner with a higher IPO price leading to lower underpricing level. When the objective of IPO is to promote the participation of the retail investors, the issuing firms set a relatively low offering price to encourage small investors.

Apart from that, many empirical studies have shown a negative relation between the firm size can be taken into account as it is negatively associated to its risk and, therefore, has a negative impact on the level of IPOs underpricing. Larger firms usually have more diversified product lines, better access to investment capital as well as resources important for the firms' profitability and survival, and are well monitored (Frinkle,1998). These factors help reducing the uncertainty around IPO of large firms (Kiymaz,2000: Bhabra & Pettway, 2003). The negative link between firm size and risk is supported in a number of studies (Titman & Wessels,1998: Schultz, 1993).

The underpricing is also viewed as evidence of agency costs. Since many of venture capital firms are subsidiaries of securities firms in U.S and Japan, Gompers and Lerner (1997) examine the effects of the conflict of interest between underwriters and outside investors in IPOs where the venture capital firm backing the offering is a captive subsidiary of, or otherwise affiliated with, the underwriting investment bank. In such cases, the underwriter is likely to have access to private information about the issuing company and an incentive to exploit this information at the expense of IPO investors. Specifically, underwriters may set offer prices too high and time share offerings so as to coincide with the market's overvaluation of the issuing firm's equity. Gomper finds that as a conflict of interest becomes more likely (i.e., from no underwriting being a venture investor to any underwriter being a venture investor to all underwriters being venture investors), the average underpricing increases. However the difference are statistically insignificant, there does appear to be a monotonic relationship between venture capital/underwriter affiliation and under affiliation and underpricing. A closer relationship is associated with greater underpricing. In contrary, Hamao et al. (1988) find that IPOs in which the lead venture capitalist is also the lead underwriter have significantly higher initial returns than other venture capital-backed IPOs. This result suggest that conflict of interest influence the initial pricing.

REIT in Thailand Capital Market

REIT is a globally– recognized investment asset which was initiated in US in 1972. In Thailand, the similar vehicle named the Property Fund for Public Offering Type I or the so–called Property Fund was introduced in 2003 as a recovery vehicle for distressed property assets as a result of 1997 financial crisis. Property Fund is governed by mutual funds regulation. Given inflexible structure of PFPO (e.g., expansion and debt utilization), SEC has introduced REIT in 2012 with objective to develop the structure of funds mobilization and investment in real property in order to be in line with international practice and provide greater flexibility in establishing and managing real estate investment. REIT is established and managed under the Trust Act. Beginning 2014 REIT is introduced to replace property funds in Thailand. There will be no new PFPO in the capital market. The existing PFPOs are not allowed to raise additional capital however they are still tradable in the secondary market.

REIT allow additional investment regulations as followed; REIT can lend from financial institution up to 35% of total asset value, or 60% if the REIT itself has investment grade (comparing to 10% of net asset value for Property fund). Debt financing will allow REIT to achieve higher ROE. On the other hand, REIT can also engage in investment in green field or partially developed asset up to 10% of total asset. REIT can invest in the asset outside Thailand. Investing abroad not only helps diversify geographical related risks, but more importantly, it also adds to the attractiveness of the REIT itself. Other positive characteristic of REIT is that it can also invest in various types of asset not restricted by Securities Exchange Committee (SEC). Under PFPO, the fund can only invest in 9 different types of asset; namely, office, shopping center, factory, warehouse, service apartment and residential, hotel, convention center, large distribution center. Under the REIT scheme, REIT's opportunity is broaden to any businesses that yield rental income, e.g. vacant land for car park rental. Moreover, REIT can also invest directly or indirectly through subsidiaries of 99% share. Investment by acquiring company that holds many assets will benefit investors by saving associated property taxes and fees paid by investors. These investment methods provide for continuous portfolio growth not existed in the PFPO's.

In term of organization structure, REIT manager is another important role being added to the REIT structure. REIT manager will be the party that manage REIT's assets and create economics value for all investors. Eligible REIT manager must own proper system and suitable personnel(s) who has at least 3 out of 5 years of asset management and investment experience according to SEC. REIT manager will, most of the time, be the sponsor's subsidiaries (instead of asset management company only for property fund scheme) due to familiarity with existing tenants and experiences in real estate investment, development, and operation. REIT regulation allows sponsor or related party to hold trust unit up to 50%, instead of 1/3 in the PFPO. The higher share held allowed to original asset owners is to incentivize owners with quality assets to sell their assets to REIT, per se to the public, and uphold good performance as REIT manager and or property manager (REIT manager, focusing on investment side of the REIT, may hire property manager to take care of the day-to-day operation of the asset). Conflict of interest could arise when major unitholders is the sponsor and sponsor's subsidiaries take roles as REIT manager and property manager on management fee paid to REIT manager and property manager. Trustee will be the entity to manage these issues.

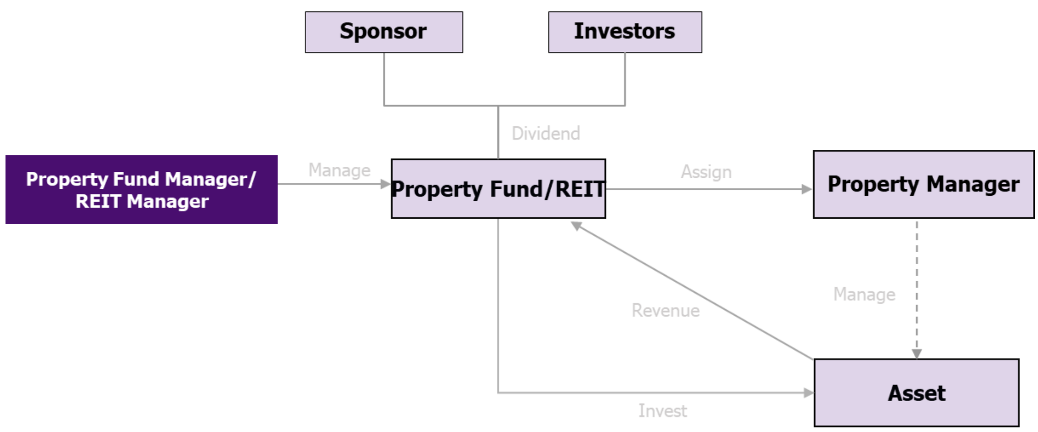

Figure3. Typical Property Fund /REIT Structure

REIT IPOs underpricing

As many previous empirical studies of IPO underpricing generally do not include REITs and closed end funds in their samples. Weiss (1990) and Peavy (1991) document that the mean initial-day returns of closed-end fund IPOs are not significantly different from zero, but substantially underperform the market during the next 100 or 120 trading days. Ibbotson et al. (1988) argue that the insignificant initial-day return is supportive of the information asymmetry hypothesis because there is little uncertainty about the underlying value of the funds' assets

REIT is similar to a closed end mutual fund in that its shares are publicly traded. As a result of this, the return is observable in daily basis. In contrast to closed-end funds, REITs invest in infrequently-traded real estate assets (properties and mortgages) and there is much uncertainty regarding their values, especially when compared to a fund investing in stocks with observable market values. Howe and Shilling (1988) state that, REIT operating cash flows are difficult to forecast (e.g. expected rents, vacancies, or selling prices). In order to value a REIT, it requires knowledge of the market value of the properties in the REIT portfolio, and the value of growth options from REIT expansion. Under Rock (1986) models of underpricing, this increased uncertainty could result in higher initial-day return for REIT IPOs.

In early document of REIT IPOs study, Wang, Chan, and Gau (1992) report a significantly average return of negative 2.82% on the first day of trading for a sample of 87 REIT IPOs issued during the period 1971-1988. The important factors influencing the initial - day price performance are distribution method and asset type (i.e. equity REITs), whereas the overpricing results is invariant to offer price, issue size, distribution method, offer period and underwriter reputation. This finding appears to be inconsistent with winner's curse explanations of IPO returns. They argue that under realistic conditions, there is no incentive for issuers (or underwriters) to systematically underprice REIT IPOs. In equilibrium, the cost of information for informed investors equals the expected gain from the purchase of underpricing IPOs. This implies that if the expected gain in the aftermarket for the purchase of underpriced IPOs is small, then the investors will be reluctant to incur information search costs to identify underpriced IPOs. Under this scenario, there will be informed investors and IPOs will not be underpriced.

However, the more recently issued REIT IPOs (post-1990) have features that make them more difficult to value than the predecessors. The recent REITs manage their portfolios more actively than the past and are infinite-life REITs which create more growth potential than many pre-1990 REITs which are finite-horizon that are pre-committed to liquidate at some terminal date. The more recently issued REITs also have attracted significantly more institutional investment than pre-1990 REIT IPOs. The combination of new regimes which increased valuation uncertainty and a larger class of better-informed (or potentially favored) institutional investors has made the REIT IPO market more susceptible to the winner's curse and should imply larger initial-day returns for these issues. In consistent with Ling and Ryngaert's (1997) finding, they report average initial-day returns of 3.60% of the REIT IPOs for sample of 85 equity REITs issued in the period 1991-1994. They find that the level of new issue underpricing is negatively associated with underwriter reputation, the degree of financial leverage and property type and is positively associated with level of institutional involvement.

Chen and Lu (2006) looking at confirm this trend and found significantly positive 4.3 % return from the samples during the period 1990-1999. Following by Ghosh et al. (2000), and Bairagi and Dimovski (2011) continue to report small, positive and significant first day returns (average 3-4 %) with REIT IPO data from 1990 to 2006. Wong WC, Ong SE, Ooi JTL (2013) reports that Asian REIT IPOs from 2001 to 2008 are significantly underpriced by 3.1%. They examine the impact of sponsors on IPO underpricing and find the positive relation between underpricing and sponsor ownership (measured as number of shares held by the sponsor and sponsor reputation (measured as the size and age of the sponsor).

Underpricing Determinants

3. Data

I examine the sample of all 66 property funds and REITs that went initial public between January 2005 - January 2018. The data was obtained from Bloomberg, Stock Exchange of Thailand website, IPO prospectus and annual reports.

4. Methodology

I use the ordinary least square (OLS) method consisted of relevant variables to test effect of underpricing in which are: guarantee scheme, lease length (as proxies of uncertainty), free float (as a proxy of heterogeneous informed investors) and conflict of interest by observing relationship between sponsor and REIT (or Property Fund) manager by examining whether REIT (or asset) management company is a subsidiary of sponsor company and/or relationship between sponsor and underwriter by examining whether its mutual fund holds sponsor's firm stock, also sponsor's reputation measured by corporate governance scores (as proxies conflict of interest). Moreover, I include control variables which there exist in prior evidence but are not in this research objective. In all models, I include year fixed effect to control for any unobservable differences across each year. The regression models are formulated as follows;

Model 1:

$$RETURN_i = \delta_t + \beta_1 GUA_i + \beta_2 INV_i + \beta_3 SIZE_i + \beta_4 LEV_i + \varepsilon_i$$

Model 2:

$$RETURN_i = \delta_t + \beta_1 LENGTH_i + \beta_2 INV_i + \beta_3 SIZE_i + \beta_4 LEV_i + \varepsilon_i$$

Model 3:

$$RETURN_i = \delta_t + \beta_1 FREE_i + \beta_2 INV_i + \beta_3 SIZE_i + \beta_4 LEV_i + \varepsilon_i$$

Model 4:

$$RETURN_i = \delta_t + \beta_1 CONF_i + \beta_2 INV_i + \beta_3 SIZE_i + \beta_4 LEV_i + \varepsilon_i$$

Model 5:

$$RETURN_i = \delta_t + \beta_1 SPON_i + \beta_2 INV_i + \beta_3 SIZE_i + \beta_4 LEV_i + \varepsilon_i$$

Model 6:

$$\begin{aligned} RETURN_i = {} & \delta_t + \beta_1 GUA_i + \beta_2 LENGTH_i + \beta_3 FREE_i + \beta_4 CONF_i + \beta_5 SPON_i \\ & + \beta_6 INV_i + \beta_7 SIZE_i + \beta_8 LEV_i + \varepsilon_i \end{aligned}$$

4.1 Independent Variable

Initial day return [RETURN] is the key variable in this paper. Most of prior studies measure the costs associated with adverse selection using first-day return. RETUN refers to the initial day return of IPO at the first day listed in SET calculated by first day closing price minus the offering price divided by the offering price.

$$IR_{i,1} = \frac{P_{i,1-} P_{i,0}}{P_{i,0}}$$

Where $IR_{i,1}$= Initial return of fund i on the first trading day

$P_{i,1}$ = The closing price of fund i on the first trading day

$P_{i,0}$ = the subscription price of fund i

4.2 Dependent Variable

Guarantee [GUA] is dummy variable which code one (1) if the IPO offers guarantee, otherwise code zero (0). Before going public, issuers deal with sponsors to acquire properties under guarantee terms and conditions e.g., minimum revenue/EBITDA guarantee, minimum rent and/ or occupancy guarantee, minimum income guarantee, sale-and- leaseback with guarantee income and fixed rental over a specific period. The guarantee clauses help mitigate risk from unstable income for PFPO and REIT. The guarantee scheme is often offered for asset with high revenue/EBITDA uncertainty, asset with unproven track record and asset with riskier exposure from the shorter lease period. The guarantee makes less volatile to REIT cashflow steam. It is hypothesized that the IPO underpricing is negatively associated with guarantee provision

Lease length [Length] is lease duration between PFPO/ REIT and tenants. Since PFPO & REIT earn income by leasing the space in the properties it owns, the lease maturity structure is critical importance to the future income and operating strategy of PFPO & REIT. Funds that can enter long-term leases for its properties has, in theory, "locked in" future cash flows from its tenants. It is hypothesized that the IPO underpricing is negatively associated with length of lease.

Free float [FREE] is the percentage of shareholders at IPO who are not the strategic shareholders playing roles in managing PFPO/REIT (i.e. sponsors and their related parties). With more free float (less informed investors), the less degree underpricing is expected.

Conflict of Interest [CONF] is dummy variable which code one (1) if the REIT manager is a subsidiary company of the sponsor or mutual fund is an affiliated to lead underwriter and holds the sponsor's firm stocks, otherwise code zero (0).

Sponsor's governance [SPON] is dummy variable which code one (1) if the sponsor company obtains cooperate governance score equivalent to 4 or higher, otherwise code zero (0).

4.3 Control Variables

Investment type [INV] is a dummy variable which code (1) if fund invest in freehold asset for at least 70% of asset value, otherwise code zero (0). Investment in freehold right can create more growth potential than leasehold right that are pre-committed to liquidate at some terminal date. The degree of information asymmetry is expected more for freehold REITs. This implies a positive relation between freehold right and information asymmetry.

Offering size [Size] is value of equity issue at IPO. It is calculated by the offer price multiply with the number of shares offered at the IPO. Larger REITs tend to invest in more number of assets and make more difficult to value than smaller REITs. The degree of information asymmetry is expected more for larger REITs. This implies a positive relation between Size and information asymmetry.

Leverage [LEV] is percentage of debt to total asset value at IPO. The higher leverage firms have fewer growth opportunities and therefore are more easily valued. The degree of information asymmetry is expected less for higher degree of leverage. This implies a negative relation between LEV and information asymmetry.

Table 1

Variables and expected sign

This table displays selected variables for the regression model and the expected sign. The initial return is calculated using the offer price and the closing price on the first trading day retrieved from The Stock Exchange of Thailand (SET) website. Guarantee is taken from IPO prospectus. Free float is the percentage of shareholders who are not the strategic shareholders playing roles in managing PFPO/REIT taken from annual report on the year which the IPO is issued. Conflict of interest is measured by relationship between REIT manager and sponsor disclosed in IPO prospectus or between lead underwriter and sponsor by examining mutual funds' stock holding from Bloomberg. Sponsor's governance is based on corporate governance score reported in The Stock Exchange of Thailand (SET) website. Investment type is based on funds' investment structure in the assets disclosed in IPO prospectus. The offering size (Size) is the product of the offer price and the number of shares offered at the IPO. Leverage is percentage of total debt as a percentage of total asset value..

Symbol	Variables	Explanation	Expected Sign
Gua	Guarantee	Dummy variable (with guarantee =1; otherwise = 0)	-
Length	Length of lease	The length of tenancy agreement	-
Free	Free float	The percentage of issued shares deducted by sponsor and its related party	-
Conf	Conflict of Interest	Dummy variable (with conflict =1; otherwise = 0)	+
Spon	Sponsor's governance	Dummy variable (sponsor's corporate governance score equivalent to 4 or higher =1; otherwise = 0)	-
Inv	Investment type	Dummy variable (Freehold asset at least 70% =1; otherwise =0)	+
Size	Offering size	The dollar value of equity raised at IPOs	+
Lev	Leverage	The percentage of debt to total asset value	-

5. Empirical results

In this study, total of 66 PFPO and REIT IPOs is examined during the whole observation period. Panel A of Table 2 reveals that the IPO performances are cyclical and vary by sample periods. The average initial-day returns of PFPO and REIT IPOs are positive in the early period (2005-2006), negative during global economic downturn period (2007-2009) and clearly positive again after 2014. It reports the highest number of IPOs and total offering in 2014; the last year that the regulation allows new issue under property fund scheme.

The big change in IPO performance after 2014 is likely due to a change of PFPO regime to REIT regime and is confirmed in Panel B with significant positive return of REIT at 7.67% after the property fund regime is discontinued. Panel C shows that all property types, on average, underpriced. The most common types of issues are hotel and serviced apartment (19), industrial (17) and office (15). Interestingly, office experience high initial-day returns at 7.19%. In term of total offering size, commercial is the largest issues (64,111.22 million, in total) and the smallest issues are residential (3,540.00 million, in total).

Table 2

Average initial-day return, number of IPOs and total offering

This table provides the number of offerings, average initial-day return, and total size of offerings of 66 PFFO and REIT IPOs over the period of January 2005 to January 2018. The data is partitioned by issued year, regime and asset type. The mean initial-day return is measured as the difference between the offer price and the closing price at the end of the first day of trading. The offering size is the product of the offer price and the number of shares offered at the IPO. The number of offering and total offering size each year are taken from Stock Exchange of Thailand (SET) website. PFPO is property fund (Fund I) established under Securities and Exchange Act B.E. 1992. REIT is Real Estate Investment Trust established under the Trust for Transactions in Capital Market Act B.E. 2007.

Year	No. of Offering	Average Initial Day Return (%)	Total Offering Size (Million Baht)
Panel A: PFPO and REIT IPOs partitioned by year			
2005	5	2.80	15,780.00
2006	3	1.17	22,203.16
2007	3	-0.33	5,080.00
2008	4	-1.13	6,760.00
2009	3	-8.00	3,811.00
2010	4	8.25	5,871.00
2011	6	0.58	13,509.00
2012	7	6.55	19,474.38
2013	7	-2.40	25,647.32
2014	9	-0.38	60,515.76
2015	6	0.75	31,543.55
2016	3	24.00	19,316.60
2017	3	2.83	10,281.06
2018	3	7.67	10,391.10

Year	No. of Offering	Average Initial Day Return (%)	Total Offering Size (Million Baht)
Panel B: PFPO and REIT IPOs partitioned by regime			
PFPO	49	1.08	173,258.96
REIT	17	6.18	76,924.7
Panel C: PFPO and REIT IPOs partitioned by asset type			
Airport	1	2.00	9,500.00
Residential	5	0.40	3,540.00
Commercial	9	1.75	65,472.92
Hotel and Serviced Apartment	19	0.24	68,590.29
Industrial	17	1.53	38,969.50
Office	15	7.19	64,111.22

Table 3 provides descriptive statistic for the variables used in this study. The average return for the first trading day is 2.40 %. The range, however, is dramatic, with a minimum first-day return of -30.00 % and a maximum of 45.00 %. Fifty-one percent (34 of 66 IPO issues) experience positive returns, twenty-six percent (17 of 66 IPO issues) incur negative returns and twenty-three percent (15 of 66 IPO issues) experience no price movement. Sixty-four percent of the PFPO & REIT IPOs offers guarantee scheme. The average length of lease period is 7.62 years with a wide range from 1 to 30 years. The free float at IPO is 77.67 % on average with a range from 50 to 100 %. About one-third (33 %) of funds has conflict of interest incurred in the structure and 88 % of sponsor companies obtain cooperate governance score equivalent to 4 or higher. The size of IPO varies greatly across the sample. The average of the offering size is 3,790.67 million THB with a range from 505,000 to 26,200 million THB. Two-third (67 %) invest with more than 70% of assets value in freehold right. Average debt to total asset is 6.11 % with a range from zero leverage to 35 % leverage.

Table 3

Summary statistics of key variables

This table provides descriptive statistics of selected variables for 66 PFPO and REIT IPOs issued during January 2005-January 2018.The initial return is calculated using the offer price and the closing price on the first trading day retrieved from The Stock Exchange of Thailand (SET) website. Guarantee is taken from IPO prospectus. Free float is the percentage of shareholders who are not the strategic shareholders playing roles in managing PFPO/REIT taken from annual report on the year which the IPO is issued. Conflict of interest is measured by relationship between REIT manager and sponsor disclosed in IPO prospectus or between lead underwriter and sponsor by examining mutual funds' stock holding from Bloomberg. Sponsor's governance is based on corporate governance score reported in The Stock Exchange of Thailand (SET) website. Investment type is based on funds' investment structure in the assets disclosed in IPO prospectus. The offering size (Size) is the product of the offer price and the number of shares offered at the IPO. Leverage is percentage of total debt as a percentage of total asset value.

	Mean	S.D.	Minimum	Maximum
Initial return (%)	2.40	9.47	-30.00	45.00
Guarantee (Yes=1; No=0)	0.64	0.48	0	1
Length (Years)	7.62	7.98	1.00	30.00
Free float (%)	77.67	12.40	50.00	100.00
Conflict (Yes=1; No=0)	0.33	0.47	0	1
Sponsor's governance (Yes=1; No=0)	0.88	0.32	0	1
Offering size (THB million)	3,790.67	4,371.44	505.00	26,200
Investment type (Freehold=1; Leasehold=0)	0.67	0.89	0	1
Leverage (%)	6.11	10.48	0.00	35.00

Table 4 partitions the initial-day returns by variables that theory suggests might affect the underpricing of new issues. Most of the subclassification (e.g. either larger or smaller issues, either higher or lower leverage) reveals all positive initial-day returns. This suggest that the underpricing result is robust. The sample partitioned by guarantee provision shows that the mean initial-day returns of funds without guarantee is statistically significant positive 7.53 % whereas the mean initial-day returns of funds with guarantee is insignificant negative 0.54 %. The sample partitioned by lease length also shows that the mean initial-day returns of funds with shorter lease length (not exceeding 3 years) is statistically significant positive 3.15 %, comparing to positive 1.23 % initial-day returns of funds with longer lease length (greater than 3 years). These results consistent with the more certainty about the value of fund's underlying asset, the less degree of adverse selection.

The sample partitioned by free float shows that the mean initial-day returns of funds with lower free float (less than 75%) is statistically significant positive 3.08 %, comparing to positive 1.86% initial-day returns of funds with higher free float (equivalent to or greater than 75%). These results consistent with the more fraction of shares retained by more informed investors, the more degree of adverse selection. The sample partitioned by conflict of interest shows that the mean initial-day returns of funds without conflict is insignificant positive 1.47 % whereas the mean initial-day returns of funds with conflict is insignificant positive 4.24%.

The sample partitioned by sponsors' governance shows that the mean initial-day returns of funds without sponsors' governance is insignificant positive 8.88 % whereas the mean initial-day returns of funds with conflict is insignificant positive 1.50%. These results consistent with investors require greater underpricing to compensate for the adverse effects of potential conflicts of interest.

Table 4

Sample statistics of the initial-day returns

This table provides summary statistics of the initial-day returns of 66 PFPO and REIT IPOs issued during 2003 – 2018. The initial return is calculated using the offer price and the closing price on the first trading day retrieved from The Stock Exchange of Thailand (SET) website. Guarantee is taken from IPO prospectus. Free float is the percentage of shareholders who are not the strategic shareholders playing roles in managing PFPO/REIT taken from annual report on the year which the IPO is issued. Conflict of interest is measured by relationship between REIT manager and sponsor disclosed in IPO prospectus or between lead underwriter and sponsor by examining mutual funds' stock holding from Bloomberg. Sponsor's governance is based on corporate governance score reported in The Stock Exchange of Thailand (SET) website. Investment type is based on funds' investment structure in the assets disclosed in IPO prospectus. Size is the offering size calculated from total common shares sold at IPO multiplied by offering price. Leverage is percentage of total debt as a percentage of total asset value. ***, **, and * represent the significant at 1%, 5% and 10% confidential level, respectively.

	Sample size	Mean return (%)	Std dev. (%)	t-stat	Minimum return (%)	Maximum return (%)
All IPOs	66	2.40	9.47	2.06**	-30.00	45.00
Partitioned by guarantee						
Without guarantee	24	7.53	12.03	3.07***	-8.37	45.00
With guarantee	42	-0.54	6.07	-0.57	-30.00	12.00
Partitioned by length of lease						
<= 3 Years	40	3.15	11.30	1.76*	-30.00	45.00
>3 Years	26	1.23	5.61	1.12	-7.00	20.00
Partitioned by free float						
<75%	29	3.08	9.79	1.70*	-10.50	45.00
>=75%	37	1.86	9.31	1.21	-30.00	27.00
Partitioned by conflict						
Without conflict	44	1.47	7.77	1.26	-30.00	27.00
With conflict	22	4.24	2.19	1.63	-10.50	45.00
Partitioned by Sponsor						
Without governance	8	8.88	15.36	1.64	-0.94	45.00
With governance	58	1.50	8.16	1.40	-30.00	27.00
Partitioned by investment type						
Leasehold	22	4.52	-12.25	1.73*	-10.50	45.00
Freehold	44	1.33	7.67	1.15	-30.00	27.00
Partitioned by offering size						
THB <3,000 M	36	0.88	6.90	-0.56	-30.00	20.00
THB 3,000-6,000 M	22	2.91	9.74	0.61	-10.50	27.00
THB >6,000 M	8	7.84	16.23	1.78	-8.37	45.00
Partitioned by Leverage						
<10%	50	1.08	7.59	1.01	-30.00	26.21
>=10%	16	6.50	13.29	1.96*	-6.50	45.00

Pearson correlation matrix for the variables used in the models is presented in Table 5. Although some of the independent variables are correlated, none of the coefficients are greater than 0.5 and none of the variance inflation factors (VIF) for the variables are greater than three, which indicates that multicollinearity is not a cause for concern in the IPO underpricing model.

Table 5

Correlation between key variables

The sample is 66 PFPO and REIT IPOs during January 2005 – January 2018. The initial return is calculated using the offer price and the closing price on the first trading day retrieved from The Stock Exchange of Thailand (SET) website. Guarantee is taken from IPO prospectus. Free float is the percentage of shareholders who are not the strategic shareholders playing roles in managing PFPO/REIT taken from annual report on the year which the IPO is issued. Conflict of interest is measured by relationship between REIT manager and sponsor disclosed in IPO prospectus or between lead underwriter and sponsor by examining mutual funds' stock holding from Bloomberg. Sponsor's governance is based on corporate governance score reported in The Stock Exchange of Thailand (SET) website. Investment type is based on funds' investment structure in the assets disclosed in IPO prospectus. The offering size (Size) is the product of the offer price and the number of shares offered at the IPO. Leverage is percentage of total debt as a percentage of total asset value. * represent the significant at 5% confidential level.

	Return	Gua	Lnlength	Free	Conf	Spon	Inv	Lnsize	Lev
Return	1.00								
Gua	-0.41*	1.00							
Lnlength	-0.04	0.36*	1.00						
Free	-0.00	0.21	-0.05	1.00					
Conf	0.14	-0.14	-0.34*	0.08	1.00				
Spon	-0.26*	0.20	0.14	-0.10	-0.03	1.00			
Inv	-0.16	0.41*	0.17	0.15	-0.32*	0.03	1.00		
Lnsize	0.20	-0.35*	-0.06	-0.43*	0.45*	0.03	-0.42*	1.00	
Lev	0.20	-0.03	-0.11	-0.16	0.37*	-0.06	-0.12	0.24*	1.00

Notes: Return = Initial-day return; Gua = Guarantee; Lnlegth = Natural log of Lease length; Free = Free float; Conf = Conflict of Interest; Spon = Sponsor's governance; Inv = Investment type; Lnsize = Natural log of offering size; Lev = Leverage

The results give a first impression that initial day return is significantly negatively correlated with guarantee and sponsor's governance. This supports the hypothesis that funds with more certain cashflow tend to experience less underpricing and sponsor's reputation tends to mitigate the degree of underpricing arising from compensation for potential conflict of interest.

Table 6 reports the regression results. The first two models regress initial-day return on each proxy of cash flow certainty (guarantee and lease length). The result from model 1 shows the coefficient of guarantee is negative as expected and significant at the 1% level. This result supports Hypothesis 1.1 that fund structure providing more certain of fund cashflow steam like guarantee scheme should experience less degree of adverse selection. However, the coefficient of (natural log of) lease length shows insignificantly unexpected sign in model 2. It is plausible to explain that under practical condition of leasing properties in Thailand. Rental of properties exceeding 3 years must be registered with the Land Department and cannot exceed a period of 30 years. To avoid incurred registration fee and taxes, commercial properties often make a typical lease term for 3 years with renewal option, for example, the lease agreement will be made a 3 years rental with an option for another two years, instead of making 5 years lease term. In such a case, this renewal option could still leave some uncertainty to REIT's cashflow.

Table 6

OLS regression of initial-day return

This table provides OLS regression of initial-day return on selected independent variables with time fixed effect for sample of 66 PFPO and REIT IPOs issued during January 2005-January 2018.The initial return is calculated using the offer price and the closing price on the first trading day retrieved from The Stock Exchange of Thailand (SET) website. Guarantee is taken from IPO prospectus. Free float is the percentage of shareholders who are not the strategic shareholders playing roles in managing PFPO/REIT taken from annual report on the year which the IPO is issued. Conflict of interest is measured by relationship lead underwriter and sponsor by examining mutual funds' stock h9olding from Bloomberg. Sponsor's governance is based on corporate governance score reported in The Stock Exchange of Thailand (SET) website. Investment type is based on funds' investment structure in the assets disclosed in IPO prospectus. The offering size (Size) is the product of the offer price and the number of shares offered at the IPO. Leverage is percentage of total debt as a percentage of total asset value. Standard errors are corrected for heteroskedasticity using White's (1980) method and t-statistics are reported in square parentheses. ***, **, and * represent the significant at 1%, 5% and 10% confidential level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Guarantee (Yes=1; No=0)	-7.035 *** [-2.69]					-8.652*** [-2.93]
Lnlength		0.85 [0.87]				3.405*** [2.67]
Free float			0.0115 [0.15]			-0.0486 [-0.55]
Conflict (Yes=1; No=0)					1.304 [0.65]	3.889 [1.54]
Sponsor (Yes=1; No=0)				-6.815** [-2.06]		-4.449 [-1.32]
Investment (FH=1, LH=0)	1.011 [0.38]	-1.658 [-0.52]	-0.978 [-0.32]	-0.569 [-0.21]	-0.892 [-0.31]	0.277 [0.11]
Lnsize	-0.342 [-0.21]	0.578 [0.5]	0.785 [0.59]	0.542 [0.4]	1.137 [085]	-1.612 [-0.85]
Leverage	-0.093 [-0.73]	-0.101 [-0.81]	-0.106 [-0.83]	-0.132 [-1.04]	-0.137 [-1.08]	-0.151 [-1.06]
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	66	66	66	66	66	66
Adjusted R^2	0.332	0.227	0.222	0.225	0.286	0.379

Model 3 uses a regressor representing proxy of heterogeneous informed investors to test Hypothesis 1.2. the percentage of free float has either insignificant or marginally significant explanatory power in any models. It is plausible to argue that the Thai PFPO and REIT regulation limits sponsor and its related party to hold trust unit not more than 1/2 of total trust certificates issued in the case of REIT and 1/3 in the case of PFPO. The data in table 3 shows that sponsor and related party only hold, 22.33% on average of the equity of the PFPO & REIT IPOs in the sample, it is possible that this limitation eases the degree of underpricing.

Model 4 and Model 5 regress initial-day return on conflict of interest and sponsor's governance respectively as proxies of moral hazard risk. The positive sign of the coefficient of conflict of interest is expected in model4 but the result is insignificant. In model 5, the coefficient of sponsor's governance is negative as expected and significant at the 5% level. This result supports Hypothesis 2.2 that the reputation of the sponsor should mitigate some of the negative impact (i.e. underpricing of IPO) from potential conflict of interest

Three control variables (investment type, size and percentage of leverage) enter in all model. The coefficient of freehold investment type is mostly negative in models, consistent with Wang, Chan. and Gau (1991) finding that finite-life REIT are more overpriced than infinite-life REITs. However, the result is insignificant. It is plausible to explain that the market is familiar with both investment type and the required yields are reflected in offering price for different type of investment. The coefficient of (natural log of) size is mostly positive, consistent with previous empirical results but insignificant. It is plausible to explain that the larger IPOs are often issued by well-established firms, the risk is expected to be lower and therefore, less underpriced. The coefficient of leverage is negative, consistent with the argument that there is more uncertainty on value of firms with growth opportunities and firm with greater growth opportunities will tend to rely less on debt financing. Therefore, REITs that rely on more debt financing should have less underpricing. However, the result is insignificant. It is plausible to argue that the regulation limits debt by not more than 10% and 35% of total asset value for PFPO and REIT respectively. it is possible that this limitation eases the degree of underpricing.

6. Conclusion

This paper documents significant initial day return in PFPO and REIT IPOs during January 2005 – January 2018. Under asymmetric information, it is hypothesized that some characteristic of PFPO and REIT IPOs are the factors that affect to the underpricing. The regression models regress the initial -day return on the guarantee provision, natural log of lease length, free float, conflict of interest, sponsor reputation and three control variables.

The results suggest that the guarantee provision is the most explanatory variable that supports the asymmetric information hypothesis in respect to the underpricing of PFPO and REIT IPOs whereas other factors report insignificant results, in consistent with firm IPOs and

U.S. REIT IPOs findings. It is possible to explain these contrary results under practical conditions and regulation limitation of Thailand PFPO and REIT IPOs.

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APPENDIX

Appendix 1. Differences between REIT and Property Fund

Topic	Property Fund	REIT
General		
Legal Structure	Mutual fund	Trust
Minimum Size	Not less than 500 million Baht	Same
Number of Unit holder	Upon establishment: ≥ 250 After establishment: ≥ 35	Same
Listing of Unit	Investment units must be listed	REIT units must be listed
Management	Asset management company	REIT Manager, namely an asset management company or a company with expertise in managing real estate and is qualified according to the criteria set by the SEC
Registrar	Not required to be TSD	Requires consent of the SET
Investment		
Type of property in which investment can be made	Only ones listed on the SEC's positive list	Not specified; however, the real estate shall not be used by the lessee to operate immoral or illegal business
Investment in real estate abroad	Not permitted	Permitted
Development of real estate (Green-field project)	Not permitted	Not exceeding 35% of the total assets and not

Topic	Property Fund	REIT
		exceeding 60% in the case REIT has received an investment grade.
Leverage limit	Not exceeding 10% of the net asset value (NAV)	Not exceeding 35% of the total assets and not exceeding 60% in the case REIT has received an investment grade.
Distribution and allocation of units		
Distribution	At least 25% must be offered to the public, and units must be allocated to all free float subscribers equally, one board lot at a time, until all subscribed units are allocated (Small Lot First	Not specified; allocated to free float REIT unit holders in accordance with the criteria for listing (no less than 20% of the total trust units and of each tranche (if any)
Holding Restriction for Any Person or Group of Persons	No more than 1/3 of the total number of investment units	No more than 50% of the total number of REIT units and of each tranche (if any)
Disclosure	Similar to mutual funds	Similar to listed companies
Annual meeting of unit holders	Not specified	Annually, within four months from the end of the fiscal year
Codes concerning the acquisition and disposal of assets / related parties transactions	Resolution of unit holders not required	Resolution of unit holders required for transactions of a significant size, as prescribed

Topic	Property Fund	REIT
Maintaining listing status (free float)	Not specified	Having free float unit holders holding an aggregate of not less than 15% of the total REIT units and of each tranche (if any)
Tax	• Fund is exempt from CIT. • In some cases, unit holders are not subject to tax levied on dividends such as a company holding units for three months prior and three months after the date of dividend payment.	• Trust is exempt from CIT. • REIT unit holders of all types are subject to tax.

Note. Adapted from “Listing, Disclosure of Information, and Delisting of Real Estate Investment Trusts Units B.E. 2556 (2013)” by Regulation of the Stock Exchange of Thailand, 2013. (Stock Exchange of Thailand, 2013)

WORKING PAPERS
FORUM 2018

REGULATING BY MARKET FORCES

Equity offering types, financing objectives, and long-run stock performance

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Equity offering types, financing objectives, and long-run stock performance

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This version: August 29, 2018

[1] Corresponding author. This study is supported by Business Research Center, Thammasat Business School. We thank Visarut Pugdeepunt for his valuable research assistance. We remain responsible for all errors and omissions.

Equity offering types, financing objectives, and long-run stock performance

ABSTRACT

We investigate whether issuance type, including seasoned equity offering and private placement, or financing objectives, including investment, recapitalization, and working capital management, have higher impacts on long-run stock performance. We find that issuance type affects long-run stock returns whereas financing objectives do not. Further, private placement (PP) issuers which report a working capital financing objective underperform in the subsequent year compared to seasoned equity offering (SEO) issuers which report an investment financing objective. The Fama-French-Carhart 6-factor regressions of long-short strategy for these two groups provide 0.72% of abnormal returns per month. SEO issuers with investment objective are reliably signaling profitable opportunities whereas other financing issuers are more likely to be opportunistic market timers. The Fama-MacBeth regression that controls for several firm characteristics shows that PP firms with recapitalization and working capital management financing objectives underperform non-issuers by 1.19% and 1.10% per month, respectively. Also, we learn that issuers from the property and construction industry do not suffer from long-run underperformance.

Keywords: seasoned equity offering, private placement, financing objectives, long-run stock performance, asset pricing

1. Introduction

Previous literature on post-issuance long-run stock performance study *either* the differences in equity offerings between seasoned equity offering (SEO) and private placement (PP) *or* financing objectives among investment, debt refinancing, working capital management, and other purposes.[2] The separation between these two stock issuing dimensions leads to difficulty when interpreting from which aspect abnormal returns arise. For example, PP issuers with specific financing purpose may reap better long-run stock performance compared to PP issuers with other financing purposes. Thus, this paper combines both aspects and provides answers as to which has more influence on long-run stock performances and which particular combination of offering types and financing objectives provides the most adverse returns to long-term investors. We respond to these questions using Thai firms' equity issuance information from 2000 to 2017.

A firm may choose to raise equity via public or non-public offerings. Public offerings, often called seasoned equity offerings (SEOs), are offered to the majority of investors from an already traded company. SEOs can be comprised of shares sold by existing shareholders (RO, right offering), new shares (PO, public offering), or a combination of the two. In general, investment bankers, in the role of underwriters, perform multiple origination services including prospectus preparation and other filing documents. On the other hand, non-public equity offerings or private placement (PP) are offered to a small number of selected investors (Hertzel, Lemmon, Linck, and Rees, 2002). Normally, experienced investors, especially institutional investors who have the ability to investigate securities by themselves, are the target of the issuance. These investors include insurance companies, mutual funds, pension funds or even

[2] See Chen, Dai, and Schatzberg (2010), Dahiya, Klapper, Parthasarathy, and Singer (2017), and Krishnamurthy, Spindt, Subramaniam, and Woidtke (2005) for difference type of offerings; and Autore, Bray, and Peterson (2009), Amor and Kooli (2017), Leone, Rock, and Willenborg (2007), Walker and Yost (2008), and Wyatt (2014) for intended use of proceeds.

entities related to the firm, etc. However, the majority of shareholders will be punished if they interpret this offering type as a negative signal compared to SEO issuance.

Existing literature shows short-run returns to be negative for SEO issuers, but positive for PP issuers (Hertzel and Smith, 1993; Wruck, 1989). SEO stocks are viewed as overvalued or problematic firms that need capital injection. On the other hand, private placement is viewed as undervalued stocks that PP investors can access at a lower cost. Long-run return study results, however, are more controversial. Bessembinder and Zhang (2013) find no abnormal returns whereas Chen, Dai, and Schatzberg (2010); Eckbo, Masulis, and Norli (2007); Hertzel et al. (2002); and Krishnamurthy, Spindt, Subramaniam, and Woidtke (2005) show negative abnormal returns. Due to these conflicting results, we seek to answer the question as to which perform better in the long-run.

Another dimension of interest includes intended use of proceeds, which can be categorized as investment, recapitalization, working capital, and general purposes (see Autore, Bray, and Peterson, 2009 and Wyatt, 2014, among others). It is shown in current studies that investment intention offers abnormal returns which are different from zero, whereas recapitalization and general purposes result in negative abnormal returns (Autore et al., 2009). Investment objective can be viewed as a good sign to investors because it may lead to an increase in value of a firm. The other purposes, contrarily, do not offer such a signal.

This paper contributes to existing literature at least in twofold. First, to the best of our knowledge, this study is the first to investigate both offering type and financing objective dimensions simultaneously while previous literature considers either offering type or financing objective. The combination of both aspects fills the gap in stock issuance literature. It helps clarify which has a greater effect on long-run stock returns. Also, PP firms can alleviate long-run negative stock returns if they state investment objective as intended use of proceeds.

Second, with the unique dataset from Thailand, we reduce data bias between SEO and PP proportion both in number of events and total value of proceeds, which is distinguished in prior literature. Also, as there are many firms from the property industry that issue stocks through primary market, we provide sector analysis separating the dataset into property and non-property firms. To the best of our knowledge, this is the first work to investigate differences between them.

We use complete data in Thailand from 2000 to 2017, covering wide-ranging stock cycles, because the Thai stock market has the unique characteristic of high PP issuance in proportion to SEO issuance both in number of events and total value of stock issuance. We apply the calendar-time portfolio approach to test long-run stock performance. The Fama-French-Carhart 6-factor model, including market, size, value, investment, profitability, and momentum factors, provides the following results. Private placement issuers have long-run negative abnormal stock returns of 0.55% per month whereas SEOs do not have significant positive abnormal returns. Thus, PP issuers stand as a negative indicator to investors. Investment purpose provides a positive signal to investors whereas recapitalization and working capital management both provide negative abnormal returns of 0.55% and 0.47% per month, respectively. Moreover, calendar-time long-short portfolio approach find SEO issuers outperform PP issuers for 0.56% per month or 6.77% per year while issuers with investment objective do not outperform issuers with recapitalization or working capital management objectives. However, when considering both dimensions, we find that SEO stocks with investment purpose outperform PP stocks with working capital management purpose for 0.72% per month or 8.59% per year. The effect of raising type is slightly stronger than financing objective. In addition, firms that issue PP with working capital management objective are small, distressed, unprofitable, and contrarian firms. We confirm these results using Fama-MacBeth (1973) regressions. Regardless of issuing types, financing stocks with recapitalization and working management purposes underperform non-issuers by 0.79% and 0.86%, respectively. The worst performers are PP firms with recapitalization or working capital management objectives.

Through deeper analysis, we provide sector analysis separating the dataset into property and non-property firms. To the best of our knowledge, this is the first work to investigate differences between them. Property firms, which have frequent equity issuance relative to firms from other sectors, return insignificant abnormal returns whereas other firms return significant negative abnormal returns even when controlled for the Fama-French-Carhart 6-factor model. As firms in this industry have a higher proportion on SEO and investment purpose issuance compared to firms in other industries.

The organization of this paper is as follows. Section 2 provides supportive reasons and evidence for choosing Thailand as the area of focus. Section 3 describes the data used and methodology of the study. Sections 4 and 5 show empirical results of long-run stock performance and Section 6 concludes the paper.

2. Why Thailand?

Thailand offers an appropriate setting for a number of reasons. First, the Thai stock market has much more private placement issuance relative to the number of companies, number of transactions, total issuance values, and average issuance values.[3] In fact, more than 40% of equity issuance transactions and values in the Stock Exchange of Thailand comes from private placement. The ratio of PP issuance to overall stock offerings in Asian developed markets is 13% by number of issues and 12% by amount. Second, it is interesting to consider whether market behavior in an emerging market, with a higher proportion of uninformed traders to

[3] See Dahiya et al. (2017) for more details on other Asian market issuance.

informed traders, is similar to that in developed markets. Differences in behavior may result from the relatively lax nature of existing rules in Thailand as compared with those in the United States or other developed markets. Third, Thai equity market has a relatively high concentration of property and construction companies that issue stocks compared to companies in other industries. Their behavior and financing objectives can be different from non-construction firms.

3. Data and methodology

3.1 Data, financing types, and financing objectives

The initial sample of SEO and PP issuance is manually obtained from news corporate news reported in SETSMART and consists of capital raising data from 2000 to 2017. Our sample begins in 2000 as the companies' pre-2000 filing statements are not available. In contrast to Dahiya et al. (2017) whose dataset on Thailand provides incomprehensive data, we retrieve data from the original source to ensure that all available data are selected. Unlike Autore et al. (2009) and Leone et al. (2007), whose datasets on intended use of proceeds are clustered within a short timeframe, our dataset spans the period from 2000 to 2017. The period covers complete stock cycles from the recovery period after the 1997 Asian financial crisis, which started in Thailand, to the peak in 2007, the subsequent trough in 2008 due to the global financial crisis and the continual rise from that point to the present. We include public offering (PO) and right offering proportionate to their shareholding (RO) as parts of SEO. Shareholders will be able to maintain their shareholding proportions in the company if a rights offering is used to increase capital. Stock price and financial statement data are collected from Datastream. As suggested by Huang and Ritter (2018), we select a stock issuer whose equity issuance value is greater than 5% of the book value of equity and greater than 3% of market value of equity.[4]

We classify intended use of proceeds as investment, recapitalization, and working capital management which is done in the same manner as Amor and Kooli (2017), Autore et al. (2009), Leone et al. (2007), Walker and Yost (2008), and Wyatt (2014).[5] Investment includes financial asset investment, purchase of real assets, business expansion, capacity expansion, M&A transactions, etc. Recapitalization mainly concerns long-term debt repayment and restructuring of shareholder structures. Working capital includes short-term debt repayment, cash management, payments to accounts payable, liquidity management, etc. Others are those for which we cannot identify a specific purpose of proceed use. Our classification differs from previous literature that often combines recapitalization and working capital purposes together in one group. The separation of these two financing purposes helps clarify different effects. IN addition, some companies state more than one financing objectives so that a firm may end up with multi-purpose use of proceeds clarifications. Therefore, some transactions can be categorized as being in several groups.

Our sample starts with 1,222 issuing events from Stock Exchange of Thailand between 2000 and 2017. After adjusting for some firms that announce multiple issuances on the same date, we are left with 945 events. We further select only significant issuance as mentioned above and have a final number of 551 events in our dataset. Further, we classify stock issuance into two categories – offering types and financing objectives, with two offering types (SEO and PP) and three financing objectives (investment, recapitalization, and working capital management). Thus, we can group issuing stocks into six combinations; SEO & investment,

[4] The key reason of doing so is to ensure that such equity offerings have a meaningful effect.

[5] We do not include other financing objectives due to relatively small data sample.

SEO & recapitalization, SEO & working capital management, PP & investment, PP & recapitalization, and PP & working capital management.

3.2 Descriptive statistics

Table 1 provides issuance summary data from 2000 to 2017. The total number of significant SEO and private placement events are 301 and 250 events, respectively. The number of SEO firms is slightly higher than PP firms, which differs from many markets in which SEO firms greatly outnumber PP firms. In most years, the number of SEO companies is almost the same as the number of total SEO events, whereas PP companies are relatively less numerous than PP events. In other words, PP firms offer stock issuance more frequently than SEO firms. Total values (average values) of SEO offerings equal 627.7 (2.1) whereas PP offerings stand at 425.4 (1.7) billion Baht. These events correspond to 294 and 199 companies, respectively. The number of events, total value, and average value for both SEO and PP firms drop significantly between 2007 and 2009 due to global financial crisis.

Table 2 shows issuance summary with a combination of issuing types and financing objectives. Many issuing firms state multiple purposes as their needs of proceeds. This nature differs from other markets where most firms state only one financing objective. Table 3 shows issuance summary by industry and offering type. Industry type is categorized in the same manner as Stock Exchange of Thailand (SET).[6] Resource, service, and financial industries predominantly offer equities through SEO while property & construction industry offers the

[6] Stock Exchange of Thailand (SET) classifies listed companies into eight industry groups. They consist of agribusiness & food industry (AGRO), consumer products (CONSUMP), financials (FINCIAL), industrials (INDUS), property & construction (PROPCON), resources (RESOURC), services (SERVICE), and technology (TECH).

majority through the PP channel. Of all 250 PP events, 112 events are from the property & construction industry alone.

*** Table 1 is here. ***

*** Table 2 is here. ***

*** Table 3 is here. ***

4. Calendar-time abnormal returns

4.1 Baseline results

Long-run event studies can also be tested by the calendar-time portfolio approach, encouraged by Fama (1998).[7] We form portfolio returns based on equal-weighted portfolios for each pair of dimensions because value-weighted portfolios are dominated by large stocks. We introduce a firm that issues stocks into our portfolio and keep it for 36 months.[8] In the next month, if there is another firm that issues stock, we include this new issuing firm in our portfolio. For example, if firm A announces its capital raising in December 2010, we will include this stock in the portfolio from January 2011 to December 2013.

We use the traditional Fama-French 3-factor and 5-factor models (Fama and French, 1993, 2015). In addition, we propose Fama-French-Carhart 6-factor model which is the 5-factor model with the additional factor of momentum. We use three different models because there is no general consensus on the best asset pricing model for identifying abnormal returns. Moreover, by increasing the number of factors from three to six, significance of abnormal

[7] This methodology is applied widely in focus of corporate events such as security offerings (Eckbo et al., 2007; Lowry et al., 2017), mergers and acquisitions (Betton et al., 2008), IPO underpricing, etc.
[8] We also keep stocks in the portfolio for 48 and 60 months but report only 36-month results. Results are available upon request.

returns or alphas can be identified more easily if they still persist after more controls. These three models can test whether there is an independent issuer effect after controlling for size, value, momentum, profitability, and investment momentum effects. Further, the models can examine how financing firm types are associated with each premium factor. The 6-factor model is in the following form.

$$R_{pt} = \alpha_p + \beta_{RMRF} RMRF_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{UMD} UMD_t + \beta_{RMW} RMW_t + \beta_{CMA} CMA_t + e_t \quad (1)$$

In this regression, R_{pt} is the excess return of a certain portfolio at time *t*, $RMRF_t$ is the excess returns over the risk-free rate at time *t*, SMB_t is the difference of return from diversified portfolio of small and big stocks (size factor), HML_t is the difference of return from diversified portfolio of high and low B/M stocks (value factor), UMD_t is the difference of return from diversified portfolio of winner and loser stocks in the previous one year (momentum factor), RMW_t is the difference of return from diversified portfolio of profitable (robust) and nonprofitable (weak) stocks (profitability factor), and CMA_t is the difference of return from diversified portfolio of higher investment (conservative) and lower investment (aggressive) stocks (investment factor). The financial statement data of companies and all relevant market prices are collected from Datastream whereas the risk-free rate data are from Thai Bond Market Association (ThaiBMA). Details of forming the above loading factors and their components can be found in Fama and French (1993), Carhart (1997), and Kenneth French's website.

Table 4 shows baseline results based on Fama-French regression for portfolios formed on the basis of all financing objectives, financing firms classified by issuing type, and financing firms classified by purpose of capital use. We use monthly equal-weighted returns from January 2000 to December 2017. We report the coefficients from the 3-factor, 4-factor, and 6-factor models.

*** Table 4 is here. ***

The first column of Table 4 reports coefficients for portfolios sorted by all equity issuing firms in the past three years. Using the three-factor model, the portfolio of equity issuers has a statistically significant intercept of -0.51% per month or -6.12% per year. Financing firms are riskier than the market as market factor beta is equal to 1.18. Further, they are small and value firms as SMB and HML loadings are equal to 0.82 and 0.19, respectively. The strongly positive SMB loading corresponds with Autore et al. (2009) whereas the positive HML loading stands in contrast with much existing literature that reports negative HML slope coefficients. When the 4-factor model is used, alpha is lower from -0.51% to -0.41% per month. The significant UMD loading of -0.26 suggests that financing stocks are contrarian, which is consistent with Autore et al. (2009).

The 6-factor model, adding profitability and investment factors, reduces the alpha from -0.51% in the 3-factor model to a level statistically not different from zero. The 4-factor and 6-factor models slowly improve the description of the portfolio returns as intercepts get closer to zero, which is consistent with Fama and French (2015 and 2016). The additional profitability factor has a coefficient of -0.28, implying that issuing stocks are unprofitable firms. Adjusted R-squared also gradually increases as we move from the 3-factor model to the 6-factor model.

Columns 2 and 3 of Table 4 show results from separate SEO and PP firms. SEO stocks do not generate alphas different from zero for all asset pricing models. In contrast, PP firms have strongly negative abnormal returns of -0.94% per month in the 3-factor model and less marked negative abnormal returns of -0.55% per month in the 6-factor model. Results are in the same manner as in Krishnamurthy et al. (2005) even when we control for more factors. Momentum, investment, and profitability factors subsume part of abnormal returns and finally lead to lower abnormal returns.

Columns 4 to 6 of Table 4 show results categorized by different intended use of proceeds. Overall, issuing stocks with investment objective do not suffer from negative abnormal returns whereas stocks with recapitalization and working capital objectives have negative abnormal returns. The magnitude and significance of recapitalization (working capital management) portfolio's alphas, however, decline from -0.86% (-0.89%) to -0.55% (-0.47%) per month as we move from the 3-factor model to the 6-factor model.

In conclusion, PP firms show higher market beta, size, momentum, and profitability coefficients relative to SEO firms. In addition, issuing stocks with working capital management objective are small, contrarian, and unprofitable firms.

4.2 Combination of offering types and financing objectives

The previous subsection illustrates separate results from each issuing aspect. The current section combines two dimensions and investigates which dimension plays a more marked role in long-run stock underperformance. Table 5 reports results from SEO portfolio regressions. Column 1 of Table 5 reproduces results from Column 2 of Table 4 for ease of comparison. Columns 2 to 4 of Table 5 provide results of SEO stocks with different financing purposes: investment, recapitalization, and working capital management. In general, intercepts from all models are not different from zero, suggesting that SEO firms offer no abnormal returns across all capital raising purposes.

*** Table 5 is here. ***

Table 6 reports results from PP portfolio regressions. Column 1 of Table 6 reproduces results from Column 3 of Table 3 to enable easy comparison. Columns 2 to 4 of Table 6 illustrate results of PP stocks with different financing purposes in the same manner as Table 5. Intercepts from all models are significantly negative except for the intercept from the 6-factor model of PP stocks with investment objective portfolio. Overall, the impact of abnormal returns decreases as we expand from the 3-factor model to the 6-factor model. This result is the same as in Table 4. In the 6-factor model, recapitalization and working capital portfolios still have economic and significant negative abnormal returns of 0.86% and 0.88% per month, respectively. Thus, we can summarize that negative abnormal returns from different financing purposes shown in Table 4 derive mainly from PP firms.

*** Table 6 is here. ***

Table 7 shows long-short portfolio regressions. Column 1 of Table 7 shows SEO/PP long-short regressions, investors long SEO portfolio and short PP portfolio. Investors can earn positive abnormal returns of 0.56% per month or 6.72% annually. Column 2 of Table 7 reports long-short regression based on financing objective strategy. Investors earn no abnormal returns from long stocks with investment objectives and short stocks with working capital needs. Finally, Column 3 of Table 7 displays long-short regression based on mixed dimensions, investors long SEO stocks with investment objectives and short PP stocks with working capital management objective. They generate positive abnormal returns of 0.72% per month or 8.64% per year.

*** Table 7 is here. ***

4.3 Combination of offering type and issuing industry

We classify portfolios into two categories: property & construction firms (PROPCON) and non-property firms as PROPCON companies dominate approximately one-third (one-half) of SEO (PP) stocks. Moreover, their financing objectives are mostly for investments. Table 8 shows regression results from two different industrial portfolios. Columns 1 and 2 of Table 8 report PROPCON portfolio and portfolio of issuing stocks from other industries. In the 3-factor model, market beta of PROPCON companies is 1.63 whereas that of the remaining companies equals 1.02.

*** Table 8 is here. ***

Considering all issuing types, both PROPCON and the other portfolio have alphas of no different from zero. CMA loading of PROPCON financing stocks has economic and significant value of -0.34, suggesting that these firms are aggressive in investment plans.

Columns 3 and 4 of Table 8 report SEO stocks. Market betas of all regression models still confirm that PROPCON are riskier than markets whereas other companies have market betas of close to one. Momentum loadings from the 4-factor and 6-factor models show that PROPCON issuing stocks are more momentum-losing compared to other financing stocks. Alphas from all regressions are not statistically different from zero.

Columns 5 and 6 of Table 8 show regressions for PP stocks. In the 6-factor model, PROPCON stocks deliver close to zero alpha whereas another portfolio shows significant and economic alpha of -0.74% per month. Whereas other portfolios generate alpha of -0.74% per month in the 6-factor model, PROPCON stocks have alpha of statistically not different from zero.

In sum, PROPCON financing companies offer multiple points of interest. Their factor loadings are more extreme that other financing firms in general. First, they have higher market beta. Second, they are smaller firms compared to other financing stocks. Third, they are more distressed. Fourth, they are more momentum-losing. Fifth, they are more aggressive in investing. Finally, they have low profitability compared to others. However, their alphas are not different from zero.

5. Fama-MacBeth results

Fama-French regressions from the previous section are designed to test performance of issuing stocks in portfolio level with recognized factors. In contrast, Fama-MacBeth (1973) style regression controlling firm characteristics can show performance in the firm level. We apply this regression in the same manner as Huang and Ritter (2018) using monthly returns. Using the return on a stock as the dependent variable, we find cross-sectional regressions of a variety of model specifications for each of the 216 months from January 2000 to December 2017. We then calculate time-series averages of each cross-sectional coefficient. We control the estimation model using Tobin's Q, size, returns, profitability, and investment variables.

Table 9 reports the times-series averages of coefficients from monthly regressions with t-statistics in parentheses. The dependent variable is the firm's monthly stock return in each month. Model 1 does not include financing type or objective dummy variables. The coefficients on the independent variables are generally consistent with the literature. Tobin's Q, sales, and investment are negatively related to future stock returns, while profitability is positively related to future stock returns. The stock return in year *t* is used to capture potential momentum effects. Its coefficient is not statistically significant.

*** Table 9 is here. ***

Model 2 of Table 9 adds one dummy variable for stock issuance regardless of issuing type or objective. Consistent with the 3-factor regression in the previous section, issuing stocks are followed by lower stock returns. These stocks underperform non-issuers by 0.72% per month. Model 3 of Table 9 adds two dummy variables for SEO stocks and PP stocks. Their coefficients are both economic and significant at -0.90% and -0.72% per month, respectively. The impact of SEO stocks is slightly more than that of PP stocks, contradicting the results from Fama-French regressions. Model 4 of Table 9 includes three dummy variables for the issuing objectives including investment, recapitalization, and working capital management. The results suggest that investment objective does not generate significantly negative returns whereas recapitalization and working capital management objectives result in lower returns of -0.79% and -0.86%, respectively.

Model 5 of Table 9 presents six dummy variables with a combination of issuing types and objectives. Three dummy variables equal one for the combination of SEO with investment, recapitalization, and working capital management, respectively; and three dummy variables equal one for the combination of PP with three financing objectives. The results show that three combinations, including SEO and working capital management; PP and recapitalization; and PP and working capital management, provide economic and significant lower stock returns in the subsequent year of -1.05%, -1.19%, and -1.10% per month, respectively.

Model 6 of Table 9 includes two dummy variables presenting stock issuance from the PROPCON industry and other industries. Financing stocks from PROPCON industry do not have lower returns in the subsequent year whereas financing stocks from other industries have lower returns of -1.14% per month. Model 7 of Table 9 adds four dummy variables with a combination of issuing types and industries. Two dummy variables equal one for SEO stocks from PROPCON industry and SEO stocks from other industries, respectively. Another two dummy variables equal one for PP stocks from PROPCON industry and PP stocks from other industries. Financing stocks from PROPCON industry, regardless of issuing type, do not have lower returns in the subsequent year. On the other hand, financing stocks from non-property industries underperform non-issuing stocks by 1.01% and 1.18% per month, respectively. These underperformance results are consistent with results from Table 8.

6. Concluding remarks

We document the impact of stock issuing types and objectives on long-run stock returns. Of all possible combinations, private placement stocks with recapitalization and working capital management objectives perform the most poorly. In addition, they have higher beta, are smaller stocks, and are more momentum-losing compared to SEO stocks with investment objectives. We also find that regardless of issuing type, stocks from property & construction industry do not suffer from long-run stock returns whereas issuing stocks from other industries have significantly lower returns in following years.

This paper has two prominent implications. First, it suggests that investors penalize stocks for both issuing type and objective dimension, with private placement being penalized slightly more than issuing objectives. Companies may reduce the impact of lower returns in the long run by mentioning investment objective as they announce interim stock issuance. Second, property and construction companies can benefit from being in the right industry in which investors do not punish these stocks even when they issue private placement offerings. Investors tend to believe that companies from this industry use their proceeds wisely or invest in opportunistic projects as compared to firms issuing stocks in other industries.

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Table 1 Issuance summary by year

This table reports seasoned equity offering (SEO) and private placement (PP) issuance summary by year.

Year	Seasoned Equity Offering				Private Placement			
	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)
2000	16	16	19,894	1,243	13	14	12,002	857
2001	15	15	5,045	336	4	5	10,681	2,136
2002	14	15	10,950	730	8	8	2,020	252
2003	10	12	56,984	4,749	12	16	51,220	3,201
2004	11	12	7,721	643	10	12	12,957	1,080
2005	21	21	46,152	2,198	12	16	34,506	2,157
2006	17	17	14,183	834	15	18	48,843	2,714
2007	14	14	11,251	841	5	5	11,339	2,268
2008	11	11	9,248	832	9	9	5,649	628
2009	8	8	3,968	496	8	12	4,923	410
2010	17	17	41,710	2,454	7	7	29,432	4,205
2011	13	13	20,632	1,587	7	8	15,971	1,996
2012	21	21	152,733	7,273	15	24	51,858	2,161
2013	37	39	46,450	1,191	20	26	19,762	760
2014	18	18	16,138	897	19	29	38,060	1,312
2015	23	23	34,885	1,517	16	21	23,055	1,098
2016	13	13	98,234	7,556	7	7	25,821	3,689
2017	15	16	36,201	2,263	12	13	27,362	2,105
Total	294	301	632,378	37,281	199	250	425,461	33,022

Table 2 Issuance summary: Combination of issuing types and financing objectives

This table reports issuing types (including SEO and PP) and financing objective (including investment, working capital management, recapitalization, multiple purpose, and other financing objectives) combination.

Purpose	Seasoned equity offering					Private placement				
	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)	% Total	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)	% Total
Investment	52	61	94,623	1,551	11.64%	40	55	137,703	2,504	27.20%
Working capital	44	58	95,810	1,652	12.40%	26	30	26,727	891	9.68%
Recapitalization	14	15	40,442	2,696	20.24%	22	33	91,104	2,761	29.99%
Others	16	20	108,593	5,430	40.76%	25	25	47,684	1,907	20.72%
Multiple purpose	113	147	292,910	1,993	14.96%	60	107	122,242	1,142	12.41%
TOTAL	**239**	**301**	**632,378**	**13,321**	**100.00%**	**173**	**250**	**425,461**	**9,205**	**100.00%**

Table 3 Issuance summary by industry

This table reports SEO and PP issuance summary by industry.

Industry	Seasoned Equity Offering					Private Placement				
	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)	% Total	No. of companies	No. of issuance	Total value (Mil. Baht)	Average value (Mil. Baht)	% Total
AGRO	14	22	48,852	2,221	12	6	9	23,473	2,608	18
CONSUMP	8	11	3,926	357	2	6	6	1,467	245	2
FINCIAL	27	45	150,894	3,353	18	18	29	125,429	4,325	30
INDUS	19	33	19,425	589	3	17	22	27,916	1,269	9
PROPCON	51	92	84,852	922	5	42	112	131,638	1,175	8
RESOURC	13	20	130,149	6,507	36	10	21	45,943	2,188	15
SERVICE	39	56	162,668	2,905	16	22	37	53,354	1,442	10
TECH	17	22	31,612	1,437	8	9	14	16,241	1,160	8
Total	188	301	632,378	18,291	12	130	250	425,461	14,412	100

Table 4 Fama-French regression: All financing stocks

This table reports the results of calendar-time regressions: $R_{pt} = \alpha + \beta_{RMRF}RMRF_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{UMD}UMD_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + e_t$. The dependent variable, R_{pt} , is monthly excess returns of issuing stocks. $RMRF_t$ represents the excess returns over the risk-free rate at time t, SMB_t is the size factor, HML_t is the value factor, UMD_t is the momentum factor, RMW_t is the profitability factor, and CMA_t is the investment factor. The *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

	All issuing stocks	Issuing types		Financing objectives		
		SEO	PP	Investment	Recapital-ization	Working Capital
3-factor						
Alpha	-0.508**	-0.320	-0.937***	-0.352	-0.861***	-0.887***
	(-2.11)	(-1.15)	(-3.03)	(-1.22)	(-2.63)	(-2.90)
RMRF	1.179***	1.164***	1.284***	1.109***	1.297***	1.321***
	(29.90)	(25.52)	(25.27)	(23.42)	(24.13)	(25.84)
SMB	0.824***	0.764***	0.922***	0.787***	0.813***	0.909***
	(14.98)	(12.01)	(13.01)	(11.91)	(10.84)	(13.02)
HML	0.190***	0.153*	0.179**	0.0997	0.330***	0.193**
	(2.78)	(2.78)	(2.03)	(1.22)	(3.54)	(2.22)
Adj R-squared	0.811	0.756	0.754	0.725	0.736	0.763
4-factor						
Alpha	-0.410*	-0.226	-0.810***	-0.272	-0.753**	-0.732**
	(-1.84)	(-0.85)	(-2.83)	(-0.97)	(-2.41)	(-2.59)
RMRF	1.145***	1.131***	1.239***	1.081***	1.259***	1.267***
	(31.07)	(25.85)	(26.15)	(23.34)	(24.33)	(26.50)
SMB	0.897***	0.834***	1.017***	0.846***	0.893***	1.005***
	(17.18)	(13.46)	(15.15)	(12.90)	(12.19)	(15.23)
HML	0.210***	0.173**	0.205**	0.116	0.352***	0.213***
	(3.32)	(2.30)	(2.52)	(1.46)	(3.97)	(2.67)
UMD	-0.257***	-0.248***	-0.335***	-0.209***	-0.284***	-0.338***
	(-6.11)	(-4.96)	(-6.18)	(-3.95)	(-4.80)	(-6.27)
Adj. R-squared	0.839	0.782	0.792	0.744	0.762	0.801
6-factor						
Alpha	-0.199	0.0175	-0.547*	-0.053	-0.545*	-0.471*
	(-0.89)	(0.07)	(-1.88)	(-0.18)	(-1.70)	(-1.71)
RMRF	1.044***	1.014***	1.121***	0.979***	1.166***	1.140***
	(24.73)	(20.54)	(20.45)	(18.17)	(19.28)	(21.99)
SMB	0.811***	0.742***	0.915***	0.753***	0.810***	0.894***
	(15.13)	(11.83)	(13.14)	(11.02)	(10.55)	(13.61)
HML	-0.0170	-0.0500	-0.0558	-0.101	0.135	-0.0380
	(-0.28)	(-0.71)	(-0.72)	(-1.31)	(1.57)	(-0.52)
UMD	-0.208***	-0.192***	-0.278***	-0.158***	-0.241***	-0.257***
	(-4.90)	(-3.88)	(-5.04)	(-2.92)	(-3.97)	(-4.87)
RMW	-0.278***	-0.332***	-0.333***	-0.280***	-0.261***	-0.433***
	(-4.00)	(-4.08)	(-3.69)	(-3.16)	(-2.62)	(-4.96)
CMA	-0.125	-0.111	-0.0750	-0.0968	-0.0767	-0.0637
	(-1.56)	(-1.19)	(-0.72)	(-0.95)	(-0.67)	(-0.65)
Adj. R-squared	0.846	0.797	0.797	0.747	0.763	0.822

Table 5 Fama-French regressions: SEO stocks

This table reports the results of calendar-time regressions: $R_{pt} = \alpha + \beta_{RMRF}RMRF_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{UMD}UMD_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + e_t$. The dependent variable, R_{pt}, is monthly excess returns of issuing stocks. $RMRF_t$ represents the excess returns over the risk-free rate at time *t*, SMB_t is the size factor, HML_t is the value factor, UMD_t is the momentum factor, RMW_t is the profitability factor, and CMA_t is the investment factor. The *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

	SEO	Objectives for financing		
	stocks	Investment	Recapitalization	Working Capital
3-factor				
Alpha	-0.320	-0.098	-0.664*	-0.644*
	(-1.15)	(-0.29)	(-1.66)	(-1.85)
RMRF	1.164***	1.082***	1.204***	1.281***
	(25.52)	(19.62)	(18.32)	(22.06)
SMB	0.764***	0.799***	0.624***	0.809***
	(12.01)	(10.38)	(6.80)	(10.20)
HML	0.153*	0.0814	0.329***	0.182*
	(2.78)	(1.22)	(3.54)	(2.22)
Adj R-squared	0.756	0.650	0.619	0.700
4-factor				
Alpha	-0.226	-0.046	-0.588	-0.475
	(-0.85)	(-0.14)	(-1.49)	(-1.47)
RMRF	1.131***	1.064***	1.177***	1.222***
	(25.85)	(19.23)	(17.97)	(22.33)
SMB	0.834***	0.839***	0.681***	0.914***
	(13.46)	(10.71)	(7.34)	(12.10)
HML	0.173**	0.0922	0.345***	0.204**
	(2.30)	(0.97)	(3.07)	(2.23)
UMD	-0.248***	-0.140**	-0.202***	-0.368***
	(-4.96)	(-2.21)	(-2.70)	(-5.97)
Adj. R-squared	0.782	0.658	0.631	0.743
6-factor				
Alpha	0.0175	0.170	-0.273	-0.186
	(0.07)	(0.50)	(-0.68)	(-0.60)
RMRF	1.014***	0.965***	1.041***	1.077***
	(20.54)	(15.03)	(13.76)	(18.44)
SMB	0.742***	0.756***	0.561***	0.798***
	(11.83)	(9.27)	(5.84)	(10.78)
HML	-0.0500	-0.119	0.153	-0.0429
	(-0.71)	(-1.30)	(1.42)	(-0.52)
UMD	-0.192***	-0.0900	-0.144*	-0.279***
	(-3.88)	(-1.40)	(-1.89)	(-4.70)
RMW	-0.332***	-0.279***	-0.402***	-0.494***
	(-4.08)	(-2.64)	(-3.23)	(-5.02)
CMA	-0.111	-0.0696	0.0305	-0.0806
	(-1.19)	(-0.57)	(0.21)	(-0.73)
Adj. R-squared	0.797	0.664	0.642	0.777

Table 6 Fama-French regression results: Private placement stocks

This table reports the results of calendar-time regressions: $R_{pt} = \alpha + \beta_{RMRF} RMRF_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{UMD} UMD_t + \beta_{RMW} RMW_t + \beta_{CMA} CMA_t + e_t$. The dependent variable, R_{pt} , is monthly excess returns of issuing stocks. $RMRF_t$ represents the excess returns over the risk-free rate at time *t*, SMB_t is the size factor, HML_t is the value factor, UMD_t is the momentum factor, RMW_t is the profitability factor, and CMA_t is the investment factor. The *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

	PP	Objectives for financing		
	stocks	Investment	Recapitalization	Working Capital
3-factor				
Alpha	-0.937***	-0.968**	-1.240***	-1.470***
	(-3.03)	(-2.28)	(-2.71)	(-3.51)
RMRF	1.284***	1.275***	1.423***	1.456***
	(25.27)	(18.32)	(18.64)	(20.76)
SMB	0.922***	0.988***	0.966***	1.150***
	(13.01)	(10.18)	(9.27)	(12.02)
HML	0.179**	0.102	0.393***	0.149
	(2.03)	(0.85)	(3.03)	(1.25)
Adj R-squared	0.754	0.620	0.628	0.681
4-factor				
Alpha	-0.810***	-0.843**	-1.070**	-1.270***
	(-2.83)	(-2.06)	(-2.43)	(-3.25)
RMRF	1.239***	1.231***	1.363***	1.384***
	(26.15)	(18.18)	(18.32)	(20.97)
SMB	1.017***	1.081***	1.073***	1.278***
	(15.15)	(11.27)	(10.45)	(14.03)
HML	0.205**	0.128	0.415***	0.176
	(2.52)	(1.10)	(3.33)	(1.59)
UMD	-0.335***	-0.329***	-0.373***	-0.446***
	(-6.18)	(-4.25)	(-4.45)	(-6.00)
Adj. R-squared	0.792	0.650	0.660	0.728
6-factor				
Alpha	-0.547*	-0.577	-0.855*	-0.875**
	(-1.88)	(-1.37)	(-1.90)	(-2.23)
RMRF	1.121***	1.108***	1.269***	1.212***
	(20.45)	(13.97)	(14.96)	(16.37)
SMB	0.915***	0.964***	0.980***	1.103***
	(13.14)	(9.57)	(9.12)	(11.76)
HML	-0.0558	-0.152	0.165	-0.148
	(-0.72)	(-1.34)	(1.37)	(-1.41)
UMD	-0.278***	-0.265***	-0.312***	-0.336***
	(-5.04)	(-3.33)	(-3.61)	(-4.46)
RMW	-0.333***	-0.329**	-0.329**	-0.582***
	(-3.69)	(-2.52)	(-2.31)	(-4.67)
CMA	-0.0750	-0.130	-0.0238	0.0718
	(-0.72)	(-0.86)	(-0.15)	(0.51)
Adj. R-squared	0.797	0.650	0.663	0.740

Table 7 Fama-French regression results: Long-short portfolio results

This table reports the results of calendar-time regressions: $R_{pt} = \alpha + \beta_{RMRF}RMRF_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{UMD}UMD_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + e_t$. The dependent variable, R_{pt} , is monthly excess returns of long-short issuing stocks. $RMRF_t$ represents the excess returns over the risk-free rate at time *t*, SMB_t is the size factor, HML_t is the value factor, UMD_t is the momentum factor, RMW_t is the profitability factor, and CMA_t is the investment factor. The *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

	SEO-PP	Investment-Working capital	SEO & Investment – PP & working capital
3-factor			
Alpha	0.618**	0.389*	0.839***
	(2.42)	(1.96)	(2.83)
RMRF	-0.120***	-0.160***	-0.202***
	(-2.86)	(-4.91)	(-4.15)
SMB	-0.158***	-0.128***	-0.123*
	(-2.71)	(-2.80)	(-1.81)
HML	-0.0253	-0.0596	-0.0974
	(-0.35)	(-1.05)	(-1.16)
Adj R-squared	0.036	0.095	0.066
4-factor			
Alpha	0.585**	0.327*	0.765***
	(2.30)	(1.71)	(2.65)
RMRF	-0.108**	-0.139***	-0.176***
	(-2.57)	(-4.38)	(-3.67)
SMB	-0.182***	-0.174***	-0.178***
	(-3.06)	(-3.89)	(-2.63)
HML	-0.0320	-0.0724	-0.113
	(-0.44)	(-1.34)	(-1.37)
UMD	0.0868*	0.164***	0.196***
	(1.80)	(4.54)	(3.58)
Adj. R-squared	0.047	0.172	0.116
6-factor			
Alpha	0.564**	0.310	0.716**
	(2.15)	(1.58)	(2.40)
RMRF	-0.107**	-0.129***	-0.157***
	(-2.17)	(-3.50)	(-2.79)
SMB	-0.173***	-0.172***	-0.159**
	(-2.76)	(-3.66)	(-2.23)
HML	0.00579	-0.0338	-0.0632
	(0.08)	(-0.64)	(-0.79)
UMD	0.0851*	0.160***	0.188***
	(1.72)	(4.32)	(3.33)
RMW	0.00133	0.0291	0.0539
	(0.02)	(0.48)	(0.58)
CMA	-0.0362	0.0328	0.00537
	(-0.39)	(0.47)	(0.05)
Adj. R-squared	0.034	0.169	0.106

Table 8 Fama-French regressions: Property & construction financing stocks and other financing stocks

This table reports the results of calendar-time regressions: $R_{pt} = \alpha + \beta_{RMRF}RMRF_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{UMD}UMD_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + e_t$. The dependent variable, R_{pt} , is monthly excess returns of issuing stocks from PROPCON industry or other industries. $RMRF_t$ represents the excess returns over the risk-free rate at time *t*, SMB_t is the size factor, HML_t is the value factor, UMD_t is the momentum factor, RMW_t is the profitability factor, and CMA_t is the investment factor. The *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

	All issuing stocks		SEO		PP	
	PROPCON	Others	PROPCON	Others	PROPCON	Others
3-factor						
Alpha	-0.720*	-0.528**	-0.598	-0.338	-1.090**	-1.120***
	(-1.82)	(-2.20)	(-1.34)	(-1.17)	(-2.24)	(-3.59)
RMRF	1.625***	1.022***	1.593***	0.995***	1.633***	1.112***
	(24.58)	(25.94)	(21.35)	(21.04)	(20.11)	(21.76)
SMB	1.152***	0.684***	1.071***	0.606***	1.072***	0.817***
	(12.77)	(12.45)	(10.51)	(9.19)	(9.67)	(11.47)
HML	0.318***	0.144**	0.284**	0.102	0.413***	0.112
	(2.83)	(2.11)	(2.24)	(1.24)	(2.99)	(1.27)
Adj. R-squared	0.746	0.763	0.687	0.677	0.661	0.695
4-factor						
Alpha	-0.554	-0.450*	-0.440	-0.266	-0.877*	-1.020***
	(-1.47)	(-1.96)	(-1.02)	(-0.95)	(-1.91)	(-3.42)
RMRF	1.566***	0.995***	1.538***	0.970***	1.558***	1.078***
	(24.63)	(26.18)	(21.05)	(20.82)	(20.06)	(21.80)
SMB	1.256***	0.742***	1.169***	0.660***	1.206***	0.890***
	(14.30)	(13.79)	(11.59)	(10.01)	(11.24)	(12.70)
HML	0.340***	0.160**	0.304**	0.117	0.440***	0.132
	(3.19)	(2.46)	(2.49)	(1.46)	(3.39)	(1.56)
UMD	-0.363***	-0.205***	-0.344***	-0.190***	-0.467***	-0.256***
	(-5.06)	(-4.71)	(-4.18)	(-3.57)	(-5.34)	(-4.53)
Adj. R-squared	0.773	0.785	0.711	0.696	0.702	0.723
6-factor						
Alpha	-0.310	-0.231	-0.152	-0.017	-0.600	-0.741**
	(-0.85)	(-1.00)	(-0.36)	(-0.06)	(-1.31)	(-2.42)
RMRF	1.423***	0.899***	1.378***	0.861***	1.419***	0.960***
	(20.78)	(20.60)	(17.27)	(16.28)	(16.44)	(16.68)
SMB	1.132***	0.663***	1.030***	0.579***	1.087***	0.785***
	(13.04)	(11.97)	(10.18)	(8.62)	(9.94)	(10.73)
HML	0.0113	-0.0274	-0.00902	-0.0640	0.112	-0.0849
	(0.12)	(-0.44)	(-0.08)	(-0.85)	(0.91)	(-1.04)
UMD	-0.268***	-0.160***	-0.243***	-0.141***	-0.379***	-0.201***
	(-3.85)	(-3.65)	(-2.99)	(-2.65)	(-4.32)	(-3.47)
RMW	-0.451***	-0.280***	-0.509***	-0.332***	-0.465***	-0.344***
	(-3.91)	(-3.90)	(-3.79)	(-3.81)	(-3.20)	(-3.63)
CMA	-0.344***	-0.00897	-0.509***	0.0162	-0.196	0.0504
	(-2.65)	(-0.11)	(-3.79)	(0.16)	(-1.20)	(0.46)
Adj. R-squared	0.800	0.793	0.738	0.714	0.720	0.726

Table 9 Fama-MacBeth regressions of stock returns

This table reports Fama-MacBeth (1973) cross-sectional regressions estimated each month. The coefficients and their corresponding t-statistics are the time-series averages of the monthly coefficients. The dependent variable is the monthly return (in percent) on a firm's stocks. The control variables have values of previous year before the monthly regression and include Tobin's Q, size, stock returns, profitability, and investment variables (see more details in the text).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	2.935**	3.044***	3.074**	3.188**	3.186**	2.830**	2.833**
	(2.11)	(2.19)	(2.21)	(2.26)	(2.26)	(2.06)	(2.06)
SEO or PP		-0.719**					
		(-2.52)					
SEO			-0.904***				
			(-2.63)				
PP			-0.72**				
			(-1.98)				
Investment				-0.284			
				(-0.79)			
Recapitalization				-0.786*			
				(-1.84)			
Working capital				-0.863**			
				(-2.28)			
SEO & Investment					-0.088		
					(-0.18)		
SEO & Recapitalization					-0.446		
					(-0.78)		
SEO & Working Capital					-1.05*		
					(-1.88)		
PP &Investment					-0.417		
					(-0.72)		
PP & Recapitalization					-1.194**		
					(-2.51)		
PP & Working capital					-1.098*		
					(-1.96)		
Issuance from property industry						-0.376	
						(-0.81)	
Issuance from other industries						-1.147***	
						(-4.11)	
SEO from property industry							0.058
							(0.10)
SEO from other industries							-1.013***
							(-2.75)
PP from property industry							-1.015*
							(-1.66)
PP from other industries							-1.185***
							(-2.99)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.044	0.048	0.051	0.057	0.067	0.053	0.060

SEC WORKING PAPERS
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REGULATING BY MARKET FORCES

Essays on Open-Ended on Equity Mutual Funds in Thailand

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Essays on Open-Ended on Equity Mutual Funds in Thailand

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ABSTRACT

Mutual funds provide a convenient and well-diversified option for households make intertemporal fund transfers for their future needs. In this collection of three short essays, we investigate open-ended equity mutual funds in Thailand that invest in domestic equity during 2005 to 2016. While these funds collectively account for only 13.4% of assets under management of the whole industry in 2016, they comprise tax-privileged long-term equity funds (LTF) and retirement mutual funds (RMF) that had proven very popular since their inception in 2004. In the first essay, we document several stylized facts about open-ended equity mutual funds in Thailand, including facts about the types of stocks they hold and the positive relationship between past returns and the ability to attract new investment capital, which we build on in the second and third essays. The second essay investigates the influence that mutual fund capital has on the returns of the stocks they invest in, and the third essay explores how competition for investment capital can affect mutual fund investment strategy and thus their returns.

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Chapter 1:

Stylized Facts about Open-Ended Equity Mutual Funds in Thailand

ABSTRACT

Open-ended equity mutual funds in Thailand, while small relative to all mutual funds outstanding (13.4% of total net assets in December 2016), contains the tax-privileged investments (long-term equity funds and retirement mutual funds) that have proven very popular since their inception in 2004. In this article, we highlight four stylized facts regarding their returns, investment strategies and fund flows that we hope would be useful for both the investment community and academic researchers. A Power BI visualization of our results can be accessed at http://bit.ly/2PjAo2L.

Keywords: equity mutual funds, risk-adjusted return, flow-performance relationship

JEL Classification Code: G11

1. Introduction

Mutual funds have becoming an increasingly popular investment vehicle in Thailand, with total net assets (TNA) growing almost five-fold from just under 1 trillion Baht in 2005 to more than 4.6 trillion Baht by 2016, which is spread across more than 1,500 funds in several asset classes.[1] While most of Thai mutual fund capital is invested in domestic fixed income securities and foreign assets, a growing proportion is invested in domestic equity, representing around 13.4% of AUM in December 2016. In this article, we focus on this subset of open-ended equity mutual funds and highlight several stylized facts that, we hope, would give investors a better understanding about them. In examining 294 funds that together represent more than 620 billion Baht of AUM, the majority of which are tax-privileged, we document several interesting facts.[2] First, most open-ended equity mutual funds in Thailand do not beat the market, whether it is raw or risk-adjusted returns. Second, while 94% of funds in our sample are classified as actively-managed funds, the majority of the funds effectively act as *de facto* indexers. Third, the majority of capital is allocated to stocks with large market capitalization, and fund managers tend to prefer stocks classified as growth (versus value), and experience strong past performance (momentum). Fourth, funds that experienced higher returns and funds operated by bank-owned asset management companies tend to experience greater inflows in subsequent period. Moreover, tax-privileged investments tend to occur in the last quarter (in particular, December) of each year.

The rest of this article is structured as follow: Section 2 outlines our sources of data and empirical methodology. Section 3 presents the results and stylized facts grouped by themes as discussed above, and Section 4 concludes.

2. Data and Empirical Methodology

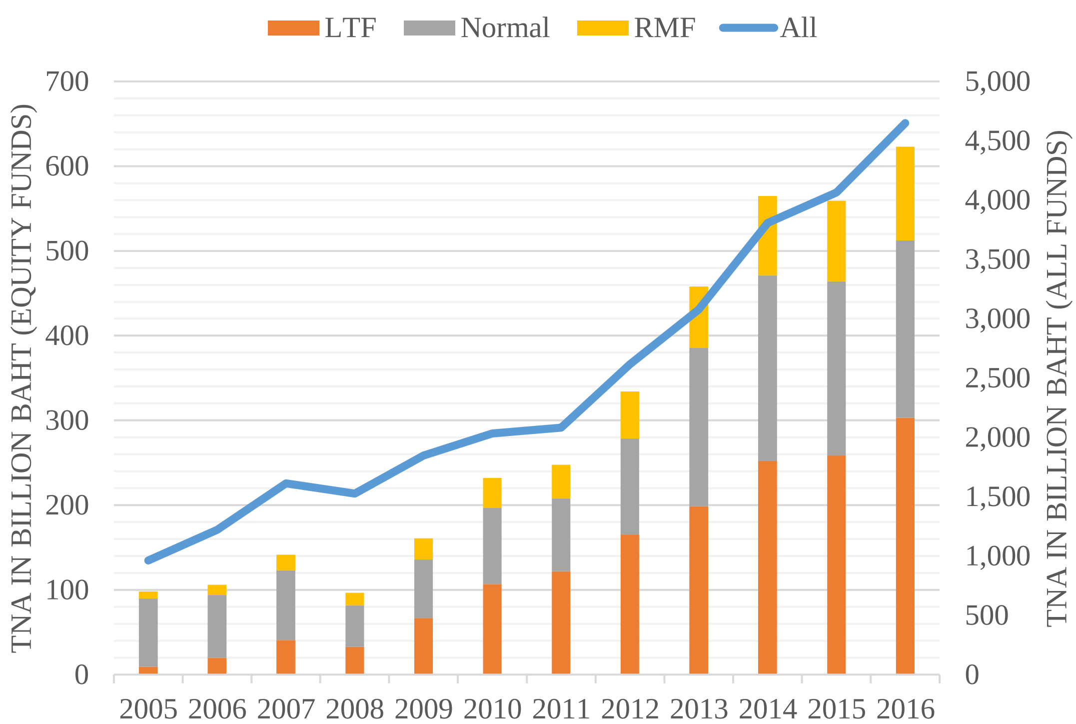
Our article relies on several data source. Fund total returns, investment objectives (referred to as Morningstar Category), fees, total net assets, fund holdings, and other fund characteristics are obtained from the Morningstar database. Stock characteristics and returns are obtained from Thomson Reuters Datastream, supplemented by stock market total returns from the Stock

[1] Another name for total net assets (TNA) is assets under management (AUM), which is a measure that represents size in the mutual fund industry.

[2] There are two main classes of tax-privileged investments: the Long Term Equity Fund (LTF), which are subjected to a 5-year lockup period (amended to 7 years for investments beginning 2016), and Retirement Mutual Fund (RMF), which are subjected to a minimum 5-year lockup period and cannot be redeemed until the investor's age reaches 55. If investments are sold prior to the respective lockup periods, investors must return the tax deductions claimed. While the tax deduction limits are separate for LTFs and RMFs, LTFs are more popular in Thailand, as more than 86% of tax-privileged assets in the sample are held through LTFs, which have much shorter effective lockup period.

Exchange of Thailand. During our sample period of 2005 to 2016, there are 294 unique open-ended equity mutual funds, whose TNA over time is presented in Figure 1.

Figure 1: Total net assets of open-ended equity mutual fund (LHS) versus all mutual funds (RHS)



Using data retrieved from providers, we compute additional variables that will be used in our analyses, which are relative return, tracking error, asset pricing risk factors, holding-based fund beta, and capital flow to fund.

Relative return, measured at monthly interval, is computed as the difference between the fund's raw total return and the total return of the Stock Exchange of Thailand. [3] Tracking error is the standard deviation of the monthly relative return. For asset pricing risk factors, we use the Carhart (1997) 4-factor adaptation of the Fama and French (1993) 3-factor model that includes the momentum (returns persistence) factor.[4] For each stock in the sample, we estimate its beta using

[3] More than 80% of the funds are benchmarked to the SET Index, which is the market-value weighted index of all listed stocks in the Stock Exchange of Thailand. The second most popular benchmark is the SET50 Index, which includes 50 stocks with the largest market capitalization. For simplicity in this article, we will use the SET Total Return Index, which incorporates not just price returns but also from distribution of dividends, as the common benchmark.

[4] The construction methodology is based on Kenneth French's website and our stock universe includes both stocks listed in the Stock Exchange of Thailand and the Market for Alternative Investment which has more relaxed listing requirements and contains smaller companies.

past returns.[5] With data on each fund's holdings of individual stocks, we can compute the value-weighted, fund-level systematic risk loading, which we refer to as the holding-based fund beta.

Finally, as we are interested in how investors select mutual funds, we compute monthly flows using the levels of TNA in each month and the one-month return, as described in Equation (1).

$$Flow_{i,t+1} = TNA_{i,t+1} - TNA_{i,t}(1 + r_{i,t+1}) \tag{1}$$

This definition measures the *amount* of flow in to the fund in each month, which is different from the popular measure in the literature which measures flow as *percentage change*. Next, we compute another measure of flow by aggregating the monthly flow in each year and then dividing the sum by the fund's TNA at the end of the previous year to get the percentage change as commonly used in previous studies.

In this article, we do not provide an overall table of summary statistics; rather, we will focus on different aspects of the open-ended equity mutual fund industry and present the facts as we proceed. We divide the analysis into 3 topics: fund returns, fund investment strategy and fund flows, and we rely on both univariate and multivariate analyses to present our findings. The results of our analyses are best explored in conjunction with a Power BI visualization accessible via http://bit.ly/2PjAo2L.

3. Results

Fund Returns

Over the sample period, the average monthly relative returns across the 294 funds in the sample is -0.20% per month, where 233 funds (79% of all funds) have negative relative returns and 67 of them are statistically significant at 5% level. Across the 6 Morningstar Categories (Aggressive Allocation, Conservative Allocation, Equity Fix Term, Equity Large-Cap, Equity Small/Mid-Cap, Moderate Allocation), Equity Small/Mid-Cap funds have the highest average relative return at 0.10% per month, while Moderate Allocation funds have the lowest average of -0.59%. It is worth noting that total return reported by Morningstar already accounts for operating

[5] We use the beta calculation method based on Frazzini and Pedersen (2014), where each stock's beta is calculated as the ratio of its covariance to the market return and the product of the stock's and market returns standard deviation.

expenses of the funds but does not include the front-end and bank-end fees that investors may incur when buying and selling the units. Table 1 presents the results of the univariate analysis.

Table 1: Fund lifetime return (measured in monthly percentage point)

Morningstar Category	Relative return	4-factor alpha	Number of funds…	…with neg. rel. returns	… and statistically significant	… with negative alpha	… and statistically significant
Aggressive Allocation	-0.25	-0.15	47	44	11	38	5
Conservative Allocation	-0.55	0.02	14	13	1	8	0
Equity Fix Term	-0.54	-0.54	24	24	13	24	13
Equity Large-Cap	-0.13	-0.09	163	126	30	128	15
Equity Small/Mid-Cap	0.10	0.12	30	10	1	11	0
Moderate Allocation	-0.59	-0.13	16	16	11	16	3
All Funds	-0.20	-0.11	294	233	67	225	36

Next, we evaluate the fund returns with respect to the Carhart (1997) 4-factor asset pricing model to get the risk-adjusted return, alpha. Specifically, for each fund i, we estimate α_i using the regression specification described by Equation 2, where r_{it}^e is the fund's excess return (raw return minus one-month treasury bill) in each month. To account for serial correlation, standard errors are computed using the Newey-West produced with one-month lag.

$$r_{it}^e = \alpha_i + \beta_i^{MKT} MKTRF_t + \beta_i^{SMB} SMB_t + \beta_i^{HML} HML_t + \beta_i^{UMD} UMD_t + \varepsilon_{it} \qquad (2)$$

The average alpha is also negative: of the 294 funds, 225 funds have negative alpha, 36 of which are statistically significant at 5% level. The correlation between average monthly relative return and 4-factor alpha is 0.7810 and statistically significant at 1% level. These results are similar to Jenwittayaroje (2017), who studies Thai equity mutual funds between 1995 and 2014 and also find only a handful of funds that deliver positive alpha. One slight difference is that we use the 4-factor asset pricing model, while to Jenwittayaroje (2017) uses the 3-factor model without the momentum factor. Overall, the results suggest that Thai equity mutual funds do not deliver returns that are on par with passive investing in the broad index.[6] This is our first stylized fact.

Further investigation of the factor loadings reveals an interesting insight: while relative returns are increasing in beta (which is expected, as funds that take on more market risk should perform better, as shown in Figure 2), fund alphas are decreasing in beta (as shown in Figure 3).

[6] We repeat the same analysis using annual data and the results are similar – funds on average deliver negative relative returns and alphas.

In other words, funds that try to increase returns by taking on more market risk deliver less risk-adjusted returns on average. This result echoes the stock-level finding by Saengchote (2017) that Thai stocks with high betas tend to have low alphas.

Figure 2: Fund relative return versus market risk (4-factor model)

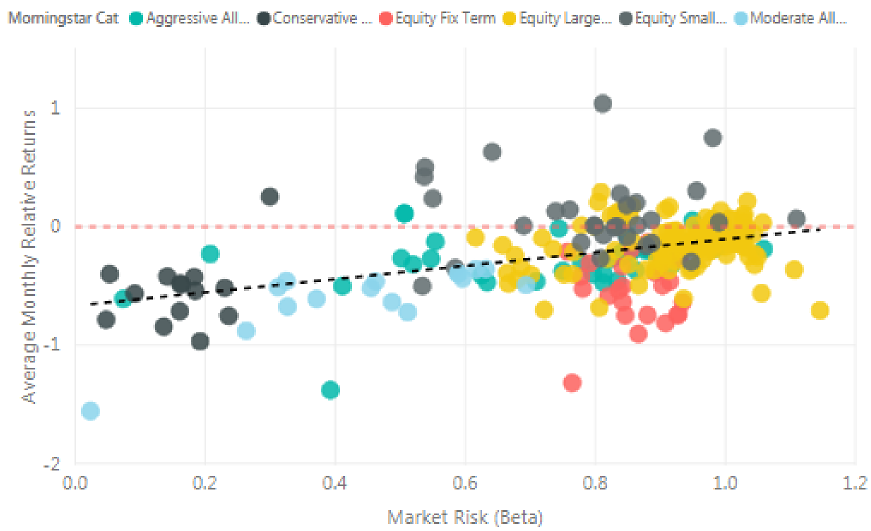


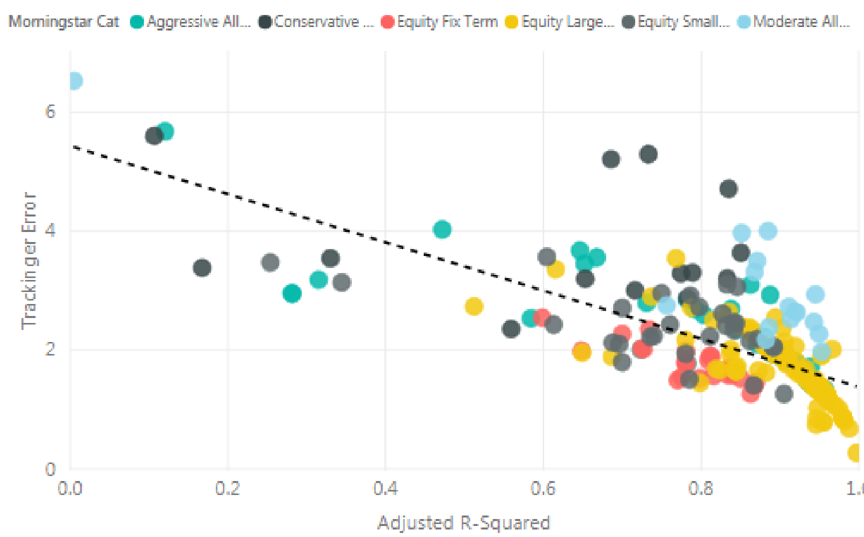
Figure 3: Fund alpha versus market risk (4-factor model)

Fund Investment Strategy

The majority of equity mutual funds in Thailand are marketed as actively managed funds (94% of our sample), which means that fund managers will attempt to use their skills to outperform the market, whether through stock selection or market timing. While we do not directly observe their activities, there are several statistical methods that we can use to infer their trading strategies.

The first method is to use the adjusted R-squared value from the single factor asset pricing model – that is, how much variation of the fund's return is explained by the stock market return. High adjusted R-squared value means the fund's return is very similar to the market, a measure of degree of indexing. The second method is to compute the standard deviation of the relative returns. Funds that have relative returns consistently close to zero tracks the market closely. This measure is also referred to as "tracking error" or "active risk". More than two-thirds of the funds in the sample (198 out of 294) have adjusted R-squared value of at least 85%, suggesting that they are *de facto* indexers, also commonly known in the literature as "closet indexers".[7] The adjusted R-squared value is also highly correlated with tracking error (-0.7223 and statistically significant at 1% level). The result is presented in Figure 4. This is our second stylized fact.

Figure 4: Fund's tracking error (standard deviation of relative return) plotted against degree of indexing (adjusted R-squared value from single factor regression model)



Another way to infer fund investment style is to directly look at each fund's stock holdings. Mutual fund in Thailand have to submit their investment positions periodically to the Securities and Exchange Commission, but the same information is also made available through their annual reports. We obtain data on fund holding in December 2016 from Morningstar database. In order to identify the characteristics of the stocks that funds hold, we rank Thai stocks based on dimensions that correspond to the 4-factor asset pricing model and classify them in to quintiles. For example, the fifth quintile for market capitalization corresponds to large cap stocks. In

[7] See, for example, Sebastian and Attaluri (2014) and Cremers et al. (2016).

addition, we include the holding-based fund beta and proportion of fund TNA that is allocated to stocks that belong to the SET100, the index that contains 100 largest stocks in the Stock Exchange of Thailand. The cross-sectional median is computed and reported in Table 2.

Table 2: Median fund market risk and characteristics of stocks held

Morningstar Category	Number of funds	Holding-based fund beta	TNA invested in to SET100	Quintiles of stocks on each dimension (1 corresponds to stocks with small market capitalization, low book-to-market ratio and low past 12-month returns, while 5 corresponds to the opposites)		
				Market cap ranking	Book-to-market ratio ranking	Momentum ranking
Aggressive Allocation	47	1.06	74%	4.72	2.75	3.59
Conservative Allocation	14	0.29	79%	4.85	2.59	3.57
Equity Fix Term	24	1.24	73%	4.69	2.48	3.63
Equity Large-Cap	163	1.06	79%	4.80	2.67	3.60
Equity Small/Mid-Cap	30	1.03	68%	4.68	2.57	3.62
Moderate Allocation	16	0.98	83%	4.84	2.63	3.64
All Types	294	1.06	76%	4.78	2.66	3.60

The result shows that equity mutual funds in Thailand prefer to invest in large stocks, as evidenced by both the proportion of capital allocated to SET100 stocks (76%) and the weighted-average ranking of stocks held in portfolio (4.78 is closer to 5). The book-to-market ratio is often used to distinguish value stocks (high book-to-market ratio) from growth stocks (low book-to-market ratio). Fund holdings are slightly tilted toward growth stocks (2.66 is closer to 1). Similarly, funds tend to hold stocks that experience strong past returns (3.60 is closer to 5). This is our third stylized fact.[8]

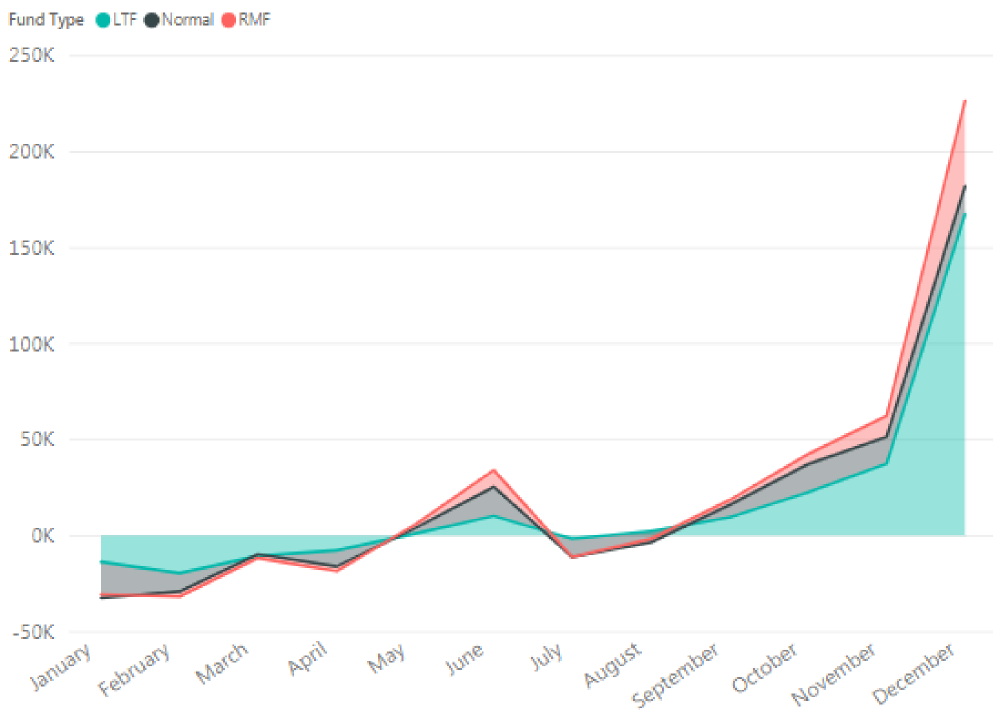
Fund Flows

Lastly, we turn our attention to fund flows. First, we look at the aggregate fund flow over 2005 to 2016 by month. During this period, more than 264 billion baht of capital is invested in equity mutual fund, 76% of which is accounted for by LTF flows. As the lockup periods for tax-deductible investments (LTF and RMF) are defined based on calendar dates (for example,

[8] The coefficients of the 4-factor pricing model confirm this finding. The median factor loading for SMB and HML are negative, signifying more exposure to large cap and growth stocks, and the median factor loading for MOM is positive. The results can be explored in the companion Power BI visualization.

investment made in December of year t to January of year t+1 is counted as 2 years when it is effectively 2 months), Thai investors tend to make such investments in the last quarter of each year to minimize the effective lockup period, as illustrated by Figure 5.

Figure 5: Aggregate fund flow over 2005 to 2016 by month (unit: million baht)



Next, we examine the determinants of fund flows. Sirri and Tufano (1998) find convex relationship between past fund returns and future fund flow. In this analysis, fund flow is aggregated in each year and flow is calculated as percentage compared to last year's ending TNA, while fund relative return is ranked into quintiles and enter the regression equation as dummy variables to allow for convex relationship between performance and flow. The 5th (bottom) performance quintile is omitted as baseline category. We modify their regression specification to include a dummy variable for funds that operated by bank-owned asset management companies and include both style and year fixed effects to account for unobservable factors that could affect fund flows. Standard errors are clustered at fund level to account for potential autocorrelation. The regression output is reported in Table 3.

Table 3: Determinants of fund flows

This table report results from regressions of percentage change in fund flow in year *t+1* on indicator variables of fund performance quintiles in year *t* and fund characteristics measured at the end of year *t*. The 5th (bottom) performance quintile is omitted as baseline category. All regressions include year and style fixed effects. Standard errors, reported in parenthesis, are clustered by fund. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	All	Non-Tax	Tax	LTF	RMF
4th performance quintile	6.1014**	7.4888*	3.3660	2.7113	3.9665
	(2.7202)	(3.9579)	(2.3399)	(3.2592)	(3.6806)
3rd performance quintile	5.0363**	4.7859	5.6054*	5.6472	8.0622***
	(2.4887)	(3.1792)	(3.0406)	(5.0911)	(2.9713)
2nd performance quintile	5.3621**	5.0245	4.6596*	3.0542	8.2704**
	(2.3992)	(3.2743)	(2.4133)	(3.6458)	(3.2626)
Top performance quintile	14.6249***	13.1649***	20.0810***	21.8704***	18.4900***
	(2.7349)	(3.4858)	(3.6190)	(4.5708)	(6.4049)
Lagged std dev of monthly returns	-2.2631**	-1.7302	-0.1520	0.2417	-0.7397
	(1.0194)	(1.2270)	(1.3836)	(2.1719)	(1.6506)
Lagged expense ratio	4.0369***	2.4117**	9.3810*	11.1106	5.4918
	(1.2164)	(1.0703)	(4.9741)	(7.0673)	(3.4045)
Log of lagged fund size	-2.3615***	-2.9985**	-3.6426***	-3.4018**	-4.0331***
	(0.9089)	(1.2039)	(1.1529)	(1.4860)	(1.1930)
Fund owned by bank	15.3721***	13.7992***	14.2213***	13.5981***	16.4218***
	(2.5327)	(3.1170)	(3.3788)	(4.7934)	(3.4035)
Observations	2,144	1,396	748	433	315
Style FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Adjusted R-squared	0.113	0.131	0.203	0.225	0.229

The regression result reveals two interesting insights. First, fund flows in Thailand respond more strongly to best-performing funds, as evident in the coefficient on the variable *top performance quintile*, similar to Sirri and Tufano (1998). Second, funds that are operated by asset management companies that are owned by bank experience greater inflow on average, likely caused by greater distribution channel that commercial banks in Thailand have. By December 2016, bank-owned asset management companies hold almost 90% of open-ended equity mutual funds' TNA. This is our fourth stylized fact.

Another interesting result is that investors seem to focus less on expense ratio relative to other factors when they select funds: funds with higher expense ratio tend to experience greater inflows. When the subsamples are partitioned by tax status, the relationship disappears for tax-privileged funds, reflecting the fact that these funds tend to experience more inflow and also have higher expense ratio in general, but the negative relationship persists for non-privileged funds. Barber et al. (2005) find that investors care more about "visible" fees such as front- and back-end load fees, but not operating expenses, so this could potentially be one reason behind this puzzling finding.

4. Conclusion

In this article, we outline four stylized facts regarding open-ended equity mutual funds in Thailand. First, most funds do not beat the market, whether it is raw or risk-adjusted returns. Second, most funds effectively act as *de facto* indexers, delivering returns that are very similar to the market. Third, the majority of capital is allocated to stocks with large market capitalization, and growth stocks, and momentum stocks. Fourth, funds that experienced higher returns and funds operated by bank-owned asset management companies tend to experience greater inflows. From these stylized facts, several potential research questions arise. For example, the convex flow-performance relationship gives fund managers an incentive to chase returns by taking on additional risk, is there evidence of such behavior in the market? Why do investors allocate more capital to funds that have higher expense ratios? Most funds tend to hold similar stocks, so does the need to deploy capital impact some stocks more than others? We leave these questions for future research.

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Chapter 2:

Institutional Capital Allocation and Equity Returns: Evidence from Thai Mutual Funds' Holdings

ABSTRACT

Information about mutual funds' stock holdings can provide useful signal for investors. In this study, we show that portfolio of stocks that are not favored by mutual funds tend to perform poorly, with monthly returns of 0.38% to 0.82% lower than stocks more widely held. When compared against asset pricing models, portfolio of such stocks can have monthly alphas as low as -0.33%, and the reason seems unrelated to stock-picking ability. One possible explanation is that demand from institutional investors can drive up stock prices, highlighting the importance of investor clientele in emerging market asset pricing.

Keywords: mutual funds returns, investment horizon, asset pricing, institutional ownership

JEL Classification Code: G11, G23

1. Introduction

Stock selection is a demanding task, both in terms of time required and skills involved. Combined with the fact that investing in individual stocks is risky while portfolio investing offers more stable returns through diversification, this challenge makes investment vehicles such as mutual funds or exchange-traded funds (ETFs) an attractive choice for individual investors. In doing so, we delegate the task of investment management to experts who, for a fee, select a handful of stocks in promise of superior performance.

Studies on fund managers' stock selection skills and fund performance yield mixed results, partly because there are various ways one could measure them.[9] The broad perception, however, is that their edges are not commensurate with the fees charged, leading to the recent global popularity of passive investing through index mutual funds and ETFs. The focus of our study is not on skills or fund performance per se but rather on the potentially informative signal that could be learned from their investment choices, which is observable to the public. In other words, if investors pay managers to pick stocks on their behalf, what can we learn from their stock holdings?

The setting of our study is Thailand, where total net assets (TNA) of open-ended equity mutual funds grew by 7.9 times between 2005 and 2016 while total equity market capitalization grew only by 3 times during the same period. We investigate the characteristics of stocks that mutual funds hold and whether the extent of holdings are predictive of such stocks' future returns. Our study is similar to Chen et al. (2000) who investigate the returns of U.S. stocks that are widely held by mutual funds and find no evidence of outperformance. Our measure of mutual fund ownership is slightly different; rather than basing ownership on the fraction of outstanding shares held, we use the dollar amount allocated to each stock to more directly address the vote of confidence that fund managers place on each stock.

2. Data and Empirical Methodology

We explore the relationship between mutual fund capital allocation and stock returns using data of individual mutual fund's stock holdings. We compile data from multiple sources: fund returns, characteristics, TNAs, and periodic stock holdings are obtained from Morningstar

[9] For example, Carhart (1997) and Fama and French (2010) find evidence against skills, while Chen et al. (2010) and Kosowski et al. (2006) find opposite results. These mixed results also highlight the difficulty in how to define and measure skills.

database from 2005 to 2016. During the sample period, there are 303 unique open-ended equity mutual funds; 90% are classified as large-cap funds, 50% as large-cap growth funds, and 94% are actively-managed funds. We obtain stock total returns, prices and financial statements data from Datastream database and construct asset pricing risk factors using the double-sorting methodology of Fama and French (2018).

The holding-level data allows us to do two things: quantify the holding value of individual stock for each fund over time and identify how long stocks are held for. Motivated by successes of long-term investment professionals such as Warren Buffett, we classify funds based on their holding horizon (long and short). However, there is mixed evidence regarding which types of funds perform better. For example, Yan and Zhang (2007) find outperformance among U.S. stocks traded by short-term funds, while Lan et al. (2018) find outperformance for U.S. stocks held by long-horizon funds.

The calculation of the holding horizon measure is similar to Lan et al. (2018) and follows a two-step process. First, for each stock i that fund j holds, we identify the date τ_{ij} that the stock is first added to the fund portfolio. This measure uses only information available at the time in order to prevent the look-ahead bias. Then, in each month t, we calculate h_{ijt} which measures the horizon (number of months) that the fund has held the stock, as described by Equation 1.

$$h_{ijt} = \begin{cases} t - \tau_{ij} & \tau_{ij} \leq t \\ 0 & otherwise \end{cases} \tag{1}$$

Next, we define the weight w_{ijt} as the value of stock i holding (V_{ijt}), calculated as the number of shares held times current price, relative to the fund's TNA at month t, and compute the fund-level holding horizon measure HH_{jt} as the weighted average horizon from the first stage, as described by Equation 2, where N_{jt} is the number of stocks that fund j holds in month t. Then in each year at September, we classify funds into terciles based on the values of HH_{jt}.[10] Funds in the bottom tercile are classified as short-horizon funds, while funds in the top tercile are long-horizon funds. The median TNA and holding horizon for funds classified as short-, medium- and long-horizon funds are reported in Table 1.

$$HH_{jt} = \sum_{i=1}^{N_{jt}} w_{ijt} h_{ijt}, \qquad where\ w_{ijt} = \frac{V_{ijt}}{TNA_{jt}} \tag{2}$$

[10] In Thailand, the majority of mutual fund investments are made in the last quarter of each year. Consequently, we use more recent stock holdings data available before September to calculate holding horizon for each fund.

[TABLE 1 ABOUT HERE]

For each stock, we can now compute the value of mutual fund capital allocated by type of fund, $VMC_{it}^{h} = \sum_{j=1}^{M_t} V_{ijt}^{h}$, where $h \in \{All, Long, Short\}$. Conditional on being in the mutual fund investment set, we rank the stocks based on the amount of capital allocated into terciles at the end of the first month of every quarter (that is, January, April, August, and October) and add the forth group for stocks not held by mutual funds. With classifications based on VMC_{it}^{h}, we can analyze the characteristics and returns of stocks in each group. On average, mutual funds invest in about 51% of listed stocks. However, among those stocks, the top tercile stocks (which amount to about 115 stocks in 2016) receive between 95% to 99% of allocated capital. The majority (about 76%) of these are members of the large cap index, consistent with fund styles.[11] These statistics are direct consequences of the highly-skewed distribution of stocks in the Thai equity market: in December 2016, 100 largest listed companies represent 80% of combined market capitalization, and the top 50% already account for more than 96% of the market.

For the stock-level analysis, we form value-weighted portfolios based on each type of rankings above and compute excess returns r_{pt}^{e} by deducting monthly returns by the one-month T-Bill rate obtained from Bloomberg. If mutual fund managers are skillful in stock selection, then we expect to see stocks favored by mutual fund perform better on average. In addition to assessing r_{pt}^{e} and their annualized Sharpe ratios, we estimate the portfolio alphas with respect to the Carhart (1997) 4-factor model, Fama and French (2016) 5-factor model, and Fama and French (2018) 6-factor model.

[TABLE 2 ABOUT HERE]

For the fund-level analysis, we use the terciles ranked on HH_{jt} to form equally-weighted portfolios of funds that have short-, medium- and long-horizon and rebalance the portfolios every September. Similar to the stock-level analysis, we report portfolio excess returns, annualized Sharpe ratio, and alphas with respect to the 4-, 5- and 6-factor models.

3. Results

[FIGURE 1, TABLE 3 ABOUT HERE]

[11] The SET100 index is constructed from 100 companies with the largest market capitalization and listed in the main exchange (Stock Exchange of Thailand). However, stocks not listed on the main exchange can also be very large but are on the secondary exchange (Market for Alternative Investment) because other requirements such as minimum free float are not met.

Table 3 reports the results of the stock-level analysis. The average monthly excess returns, visualized as bar charts in Figure 1, exhibit an interesting pattern. Average returns of stocks not held by mutual funds are substantially lower than those held by funds, while top tercile stocks (which account for most of capital allocation) have the lowest average returns in all horizons. When benchmarked against asset pricing models, stocks not held by mutual funds have negative alphas, ranging between -0.33% to -0.29% per month, while top tercile stocks have small positive alphas of around 0.06% per month.[12] Further investigation by fund horizon reveals that the top tercile alphas are present only for stocks favored by long-horizon funds. The results are similar to Lan et al. (2018), although our magnitude of outperformance is substantially lower. Adjusted R-squared values are extremely high across all asset pricing models, suggesting that the edge exists, albeit very small. The results that mutual fund capital allocation influences stock returns and that stocks favored by long-horizon fund managers perform slightly better seem to support the view of superior stock selection ability. This naturally leads to our next question: do long-horizon funds perform better?

[TABLE 4 ABOUT HERE]

For fund-level analysis, the average monthly excess returns of horizon-sorted portfolios are reported in Table 4. While the average monthly returns of longer-horizon funds are higher, they are not statistically significant, and neither are the differences across the fund categories. In addition, portfolio alphas are statistically insignificant for all horizons against all asset pricing model: there is no evidence that mutual fund managers of any horizon can systematically deliver abnormal returns on a risk-adjusted basis.[13] [14] Similar to the stock-level analysis, the asset pricing models perform very well: the adjusted R-squared values are very high across all portfolios.

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[12] We do not report factor loadings with respect to the pricing models, but the loadings correspond to the characteristics of the stocks reported in Table 2. For example, stocks in the top tercile are more exposed to the market factor (high beta), negatively exposed to the size factor (large cap) and negatively exposed to the value factor (growth).

[13] In Panel B of Table 4, we report factor loadings of the fund portfolios as we believe the results allow us to better understand fund performance. The significant loadings are market, size and momentum factors. The majority of Thai mutual funds investment policies specifically spell out large cap stocks as their objective, so the size loading is not surprising. The exposure to momentum factor is consistent with the finding of Carhart (1997) and explains the returns better than the profitability and investment factors, which do not seem to be priced in the Thai market.

[14] Jenwittayaroje (2017) studies Thai equity mutual funds between 1995 and 2014 and also find only a handful of funds that deliver positive net alphas.

Taken together with earlier stock-level result, this finding seems puzzling: it appears that the superior returns of stocks held by mutual funds may not be attributable to managerial skills. Given that average characteristics of stocks not held by funds compared with stocks minimally held (bottom tercile) are not substantially different, what could be causing this returns gap? In this study, we do not investigate the cause further, but one possible explanation is that mutual fund capital increases the demand for stocks with specific characteristics (e.g. larger, more liquid) and thus drive up their prices, as documented by Gompers and Metrick (2001).[15] Even though the majority of funds are classified as actively managed, limited investment opportunities in local market may effectively turn them into index funds. However, it is worth noting that portfolios of stocks widely held by mutual funds appear to be well-priced with respect to several asset pricing models, suggesting that institutional investors in emerging markets may play a role in enhancing market efficiency, making investor clienteles potentially an important part of asset pricing.[16]

4. Conclusion

In this study, we use holding-level microdata to investigate the role of institutional capital allocation in an emerging equity market. We document several interesting facts about Thai mutual funds. First, funds only invest in about half of all listed stocks (more than 600 by the end of 2016). Second, most (95% to 99%) of mutual fund capital is allocated to just 33% of all stocks they invest in, most of which are large-cap, growth stocks.[17] Third, mutual fund returns, on average, are well-explained by market, size and momentum factors. While there is no evidence in support of fund managers' superior stock selection abilities, our analysis suggests that mutual funds stock holdings can be used as a useful investment signal for individual investors.

[15] There is counter evidence by Frazzini and Lamont (2008) that mutual fund flow represents "dumb" money that destroy retail investors' wealth over the long run, but their definition of flow is based on abnormal changes in funds' stock holdings.
[16] For an example, Cao et al. (2018) document that institutional investors can help arbitrage away mispriced stocks, and some types of institutions (e.g. hedge funds) contribute more than others.
[17] This concentration is mainly caused by highly skewed distribution of company size described earlier and the general preference toward large cap stocks in fund objective.

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Figure 1: Average Monthly Excess Returns of Stocks Ranked by Mutual Fund Holdings

This figure plots the average monthly excess returns for listed stocks in Thailand. One month after the end of each quarter (i.e., January, April, July and October), stocks are ranked into terciles (low, medium, high) based on the amount of capital allocated by mutual funds. Stocks that are not held by mutual funds are assigned a separate ranking (no holding) where the returns are represented as dotted line. Value-weighted portfolios are formed and held until the next quarterly rebalancing date. Excess return for each stock is computed as actual return minus one-month T-Bill rate.

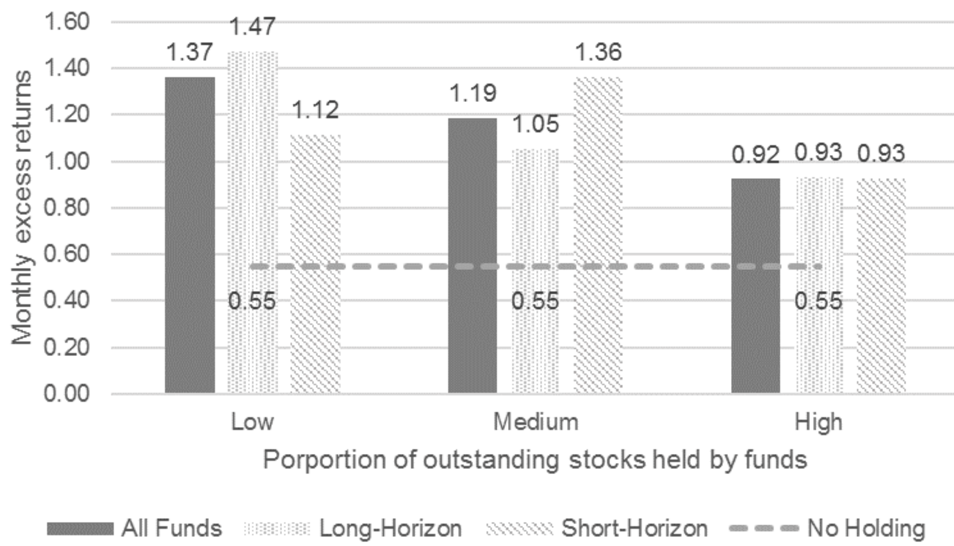

Table 1: Fund Characteristics by Holding Horizon

This table reports the characteristics of the median fund when ranked in each year by their holding horizon. Holding horizon of each fund at t is calculated as the value-weighted average length of time (in months) that each stock in the fund's portfolio has been held. At the end of each month, funds are ranked into terciles (short, medium, long) based on their holding horizon. The median values of total net assets (in THB million) and holding horizon (in months) for funds in each group at the end of December for each year is reported.

	Median Total Net Assets (THB million)				Median Holding Horizon (months)			
Year	Short	Medium	Long	All	Short	Medium	Long	All
2005	276	368	322	321	10.4	32.3	70.7	30.3
2006	336	317	286	306	16.0	40.4	74.9	39.4
2007	266	486	329	363	15.0	40.3	72.3	40.5
2008	208	271	204	222	13.2	45.8	73.4	45.4
2009	268	439	275	324	21.1	54.2	86.6	55.9
2010	314	534	315	378	21.9	60.5	95.7	58.6
2011	286	545	324	345	20.0	63.7	101.7	63.8
2012	170	1,137	526	417	9.6	62.0	107.6	61.5
2013	171	1,277	678	447	11.8	57.4	110.9	61.1
2014	228	774	926	519	12.0	52.6	109.9	52.6
2015	182	475	1,017	430	14.0	46.7	117.8	49.4
2016	217	505	1,107	434	10.4	50.9	120.3	45.8

Table 2: Characteristics of Stocks Held by Mutual Funds

This table reports the characteristics of stocks that are held by mutual funds. One month after the end of each quarter (i.e., January, April, July and October), stocks are ranked into terciles (low, medium, high) based on the proportion of outstanding stocks held by mutual funds as reported in the most recent book-closing date. Funds that have holding horizon values in the top tercile are classified as long-horizon funds, and short-horizon funds are funds in the bottom tercile. The average values of market capitalization (in THB million), book-to-market ratio and beta at the time of ranking are reported for each group. Stocks that are not held by mutual funds are assigned to a separate group. The proportion of stocks in each group that are members of the SET100 index (100 companies with the largest market capitalization) and the proportion of shares held by each class of mutual funds are also reported.

Fund holding	Member of SET100 (%)	Market Cap. (THB mm)	Book-to-Market Ratio	Beta	Shares Held by Funds (%)
Stocks with no fund holding	4.47	3,157	0.98	0.90	0.00
All mutual funds					
Low	2.97	3,685	1.08	0.96	0.12
Medium	18.12	6,943	0.93	0.98	1.51
High	76.33	78,184	0.64	1.11	5.09
Long-horizon funds					
Low	2.44	3,604	1.01	0.92	0.04
Medium	17.96	7,029	0.98	1.02	0.47
High	77.22	78,333	0.66	1.12	1.71
Short-horizon funds					
Low	4.90	4,691	1.05	0.90	0.01
Medium	20.07	7,956	0.95	1.03	0.17
High	73.59	76,782	0.64	1.13	0.87
All stocks	21.00	18,818	0.92	0.97	

Table 3: Mutual Fund Holdings and Future Stock Returns

This table reports the excess returns and the alphas of the stock portfolios sorted on the proportion of mutual fund ownership. Portfolios are rebalanced every January, April, July and October. The returns reported are monthly and value-weighted by market capitalization, with time series average excess returns r_t^e (actual returns minus one-month T-Bill rate) reported with corresponding t-statistic and annualized Sharpe ratio. For the asset pricing tests, we report the portfolio alphas of a regression of excess portfolio returns on the Carhart (1997) 4-factor model, Fama and French (2016) 5-factor model, and Fama and French (2018) 6-factor model. Panel A reports the results for all mutual funds, panel B for long-horizon funds and panel C for long-horizon funds respectively. The sample period is May 2005 to January 2017. Standard errors are computed using the Newey-West procedure with one-month lag, and t-statistics are reported in brackets. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively.

	No	*A: All Mutual Funds*			*B: Long-Horizon Funds*			*C: Short-Horizon Funds*		
Statistic	Holding	Low	Medium	High	Low	Medium	High	Low	Medium	High
r_t^e	0.546	1.365***	1.185***	0.924*	1.471***	1.054**	0.931*	1.115***	1.362***	0.928*
t-stat	[1.286]	[2.752]	[2.449]	[1.826]	[2.927]	[2.210]	[1.838]	[2.379]	[2.612]	[1.838]
SR_t	0.375	0.803	0.715	0.533	0.854	0.645	0.536	0.694	0.762	0.536
α 4F	-0.331**	0.175	-0.0698	0.0602*	0.267	-0.173	0.0653**	-0.0386	0.183	0.0593
t-stat	[-2.009]	[0.806]	[-0.413]	[1.833]	[1.163]	[-1.089]	[2.059]	[-0.185]	[0.983]	[1.570]
Adj-R^2	0.860	0.847	0.889	0.996	0.847	0.890	0.996	0.822	0.888	0.995
α 5F	-0.320*	0.134	-0.0437	0.0610*	0.232	-0.145	0.0649*	-0.0756	0.143	0.0656
t-stat	[-1.850]	[0.624]	[-0.263]	[1.727]	[1.044]	[-0.961]	[1.925]	[-0.382]	[0.800]	[1.627]
Adj-R^2	0.861	0.844	0.885	0.996	0.846	0.888	0.996	0.827	0.890	0.995
α 6F	-0.285*	0.186	-0.0979	0.0560*	0.272	-0.184	0.0598*	-0.0654	0.160	0.0565
t-stat	[-1.725]	[0.867]	[-0.596]	[1.686]	[1.219]	[-1.194]	[1.875]	[-0.331]	[0.876]	[1.502]
Adj-R^2	0.864	0.848	0.890	0.996	0.848	0.890	0.997	0.826	0.890	0.995

Table 4: Returns of Long- and Short-Horizon Mutual Funds

This table reports the excess returns, alphas and factor loadings of the 3 fund portfolios sorted on holding horizon. Portfolios are rebalanced every September and the stock holding data used to calculated holding horizon is at least 3 months from the book-closing date. The returns reported are monthly and equally-weighted, with time series average excess returns r_t^e (actual returns minus one-month T-Bill rate). For the asset pricing tests, we report in Panel A the portfolio alphas of a regression of excess portfolio returns on the Carhart (1997) 4-factor model, Fama and French (2016) 5-factor model, and Fama and French (2018) 6-factor model. The sample period is October 2005 to December 2016. Panel B reports the factor loadings on the 6 factor models excluding the alphas already reported in Panel A. Standard errors are computed using the Newey-West procedure with one-month lag, and t-statistics are reported in brackets. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively.

Panel A: Tests of Returns using Asset Pricing Models

Statistic	Short-Horizon	Medium-Horizon	Long-Horizon
r_t^e	0.610	0.708	0.735
t-stat	[1.517]	[1.555]	[1.533]
SR_t	0.452	0.464	0.457
α 4F	-0.113	-0.0418	-0.103
t-stat	[-1.477]	[-0.741]	[-1.490]
Adj-R^2	0.973	0.987	0.984
α 5F	-0.0656	-0.0127	-0.0546
t-stat	[-0.661]	[-0.185]	[-0.585]
Adj-R^2	0.964	0.984	0.978
α 6F	-0.108	-0.0387	-0.0958
t-stat	[-1.346]	[-0.676]	[-1.322]
Adj-R^2	0.972	0.986	0.983

Panel B: Factor Loadings of the 6-Factor Model

Factor	Short-Horizon	Medium-Horizon	Long-Horizon
Market	0.778***	0.875***	0.927***
(RMRF)	[32.71]	[67.84]	[57.79]
Size	-0.050*	-0.092***	-0.077***
(SMB)	[-1.958]	[-4.688]	[-3.131]
Value	-0.013	-0.020	-0.010
(HML)	[-0.565]	[-1.000]	[-0.408]
Profitability	-0.015	-0.008	-0.027
(RMW)	[-0.436]	[-0.296]	[-0.766]
Investment	0.008	-0.021	0.006
(CMA)	[0.263]	[-0.710]	[0.168]
Momentum	0.106***	0.065***	0.103***
(UMD)	[4.612]	[3.659]	[4.818]

Chapter 3:
Chasing Returns with High-Beta Stocks

ABSTRACT

One of the proposed explanations for the low-beta anomaly – a prevalent yet puzzling empirical finding that stocks with low systematic risk tend to earn higher returns than the Capital Asset Pricing Model (CAPM) predicts and vice versa – is that leveraged-constrained and index-benchmarked mutual funds drive up demand for high-beta stocks, leading to systematic mispricing. We find evidence that Thai mutual fund managers, on average, favor high-beta stocks and tend to alter their portfolio composition of high-beta stocks in response to fund flows. In addition, funds that hold high-beta stocks perform poorly compared to their peers: a one standard deviation increase in high-beta stock holdings is associated with a 1.3 percentage point decrease in future relative returns.

Keywords: high-beta stocks, mutual fund returns, low-beta anomaly

JEL Classification Code: G11, G23

1. Introduction

For many individual investors around the world, mutual funds provide a convenient way to participate in the capital market. Numerous studies have documented how mutual fund investors tend to asymmetrically reward funds with stellar returns than penalize funds with poor returns (e.g. Chevalier and Ellison (1997), Huang et al. (2007), Sirri and Tufano (1998)). As fund managers tend to be rewarded by the size of their TNA, this convex flow-performance relationship induce them to engage in risk-shifting behavior and make riskier investments in order to "chase returns" and attract inflows (e.g. Brown et al. (1996), Ha and Ko (2017)). In order to increase risk, mutual fund managers typically have few options, as usage of leverage, derivatives and short-selling is restricted, and even if permitted, tend not to be employed.[18] Because of this limitation, managers may resort to chasing returns by investing in riskier stocks instead.

The demand for high-beta stocks from leverage-constrained and index-benchmarked investors such as mutual fund managers has been proposed by Baker et al. (2011) as candidate explanation for the low-beta anomaly, a puzzling empirical finding that stocks with low systematic risk tend to earn higher returns than the Capital Asset Pricing Model (CAPM) predicts – a phenomenon first documented by Black (1972) and continues to be the subject of investigation today. Recent studies by Boguth and Simutin (2018) and Christoffersen and Simutin (2017) show that U.S. mutual fund managers do indeed tilt their portfolios toward riskier stocks, and their increased risk-taking is related to the returns to the betting-against-beta portfolio proposed by Frazzini and Pedersen (2014), shedding light on one potential source of the low-beta anomaly.[19]

In this article, we investigate the source of the low-beta anomaly in Thailand by examining the behavior of open-ended equity mutual funds through two research questions: (1) do fund managers change their funds' exposure to systematic risk in response to fund flows, and (2) do funds that have higher exposure to high-beta stocks experience worse relative returns? Mutual funds in Thailand are leverage-constrained and their performances are benchmarked against indices, which make them susceptible to returns-chasing behavior. We find that managers tend to

[18] For example, in the US, section 18 of the Investment Company Act of 1940 restricts the ability of funds to issue "senior securities", which are defined as "any bond, debenture, note, or similar obligation or instrument constituting a security and evidencing indebtedness". In Thailand, the Securities and Exchange Commission restricts fund's leverage to 10% of total net assets.

[19] The betting-against-beta (BAB) portfolio by Frazzini and Pedersen (2014) involves taking a long position on low-beta stocks and short position on high-beta stocks in a way that has net zero investment and net zero average beta.

adjust fund beta in response fund flows, but only for tax-privileged funds which are larger and more popular.

The second research question is our main contribution: our article explicitly investigates the relationship between stock holdings and future fund returns. We compute funds' holdings of low-beta stocks and high-beta stocks as percentage of TNA, and find that fund managers tend to invest disproportionately more in high-beta stocks (24%) than low-beta stocks (5%). We find that fund performance is related to the composition of stock holdings: funds that have more extreme beta (low and high) stocks tend to have worse future relative return. This result is similar to Stambaugh et al. (2012, 2015), who find evidence of long-short arbitrage asymmetry in several anomalies. The asymmetry suggests that the low-beta anomaly will likely persist in absence of investors able and willing to take short positions in high beta stocks, potentially suppressing returns for individual investors.

2. Data and Empirical Methodology

To examine the relationship between fund performance and risk-taking, we rely on multiple data sources. We obtain fund returns, investment objectives, fees, total net assets, fund holdings, and other fund characteristics from the Morningstar database from 2005 to 2016. We focus on open-ended equity funds that have at least 5 years of data and TNA of at least THB 100 million (approximately USD 3 million). The equity holdings are then matched to contemporaneous stock prices in Datastream, and betas estimated from past returns. [20] This allows us to compute the value-weighted, fund-level systematic risk loading, as well as examine the detailed composition of stock holdings. Annual relative returns are computed as the differences between the funds' raw returns and the benchmark index returns obtained from the Stock Exchange of Thailand.[21] Annual fund flows are calculated based on changes in assets, adjusted for the returns during the period, and scaled by lagged assets to control for differences in size, as describe by Equation 1.

$$Flow_{i,t+1} = \frac{TNA_{i,t+1} - TNA_{i,t}(1 + r_{i,t+1})}{TNA_{i,t}} \qquad (1)$$

[20] We use the beta calculation method based on Frazzini and Pedersen (2014), where each stock's beta is calculated as the ratio of its covariance to the market return and the product of the stock's and market returns standard deviation.

[21] More than 80% of the funds are benchmarked to the SET Index, which is the market-value weighted index of all listed stocks in the Stock Exchange of Thailand. The second most popular benchmark is the SET50 Index, which includes 50 stocks with the largest market capitalization.

In Thailand, certain open-ended equity funds are tax-privileged: individuals who invest in such funds can deduct annual contributions (up to a certain limit based on their income level) from their taxable income, as long as they keep their funds invested for specified periods of time.[22] The policy was instigated in 2004 to encourage capital market participation and has proved hugely popular since, as evidenced by the differences in TNA. According to the Securities and Exchange Commission's Capital Market Report, TNA of tax-privileged mutual funds in December 2017 is THB 500 billion, representing 51% of all equity funds' TNA. As the lockup periods are defined based on calendar dates (for example, investment made in December of year t to January of year t+1 is counted as 2 years when it is effectively 2 months), Thai investors tend to make their tax-deductible investments in the last quarter of each year to minimize the effective lockup period. For this reason, we separate the analysis for tax-privileged and general funds (which we will refer to as "tax" and "non-tax" funds) and define the end of year for data aggregation at September. There are 161 funds, 65 of which are tax funds, with 1,420 fund-year observations.

Summary statistics of key variables used in our analysis are reported in Table 1. While there are more non-tax funds, tax funds tend to be larger in size and have higher expense ratios. On average, non-tax funds have slightly better returns, but tax funds tend to experience greater net inflows. Fund betas are also quite similar for both types. In each year, we rank the stocks based on their beta and classify the top 20% as high-beta stocks, and bottom 20% as low-beta stocks. In our sample, approximately 5% of TNA is invested in low-beta stocks and, surprisingly, 24% in high-beta stocks.

[TABLE 1 ABOUT HERE]

For our first research question, we consider 2 versions of regressions of model, first with forward fund beta on fund flow, and second with *change* in fund beta on fund flow, as described by Equation 2 and 3, where X_{it} is a vector of control variables that includes contemporaneous fund beta, log of fund size (TNA), and expense ratio. In Equation 3, dX_{it} represents the first-differenced values of the variables used in Equation 2, except fund flow and relative return. To mitigate

[22] There are two main classes of tax-privileged investments: the Long Term Equity Fund (LTF), which are subjected to a 5-year lockup period (amended to 7 years for investments beginning 2016), and Retirement Mutual Fund (RMF), which are subjected to a minimum 5-year lockup period and cannot be redeemed until the investor's age reaches 55. If investments are sold prior to the respective lockup periods, investors must return the tax deductions claimed. While the tax deduction limits are separate for LTFs and RMFs, LTFs are more popular in Thailand, as more than 86% of tax-privileged assets in the sample are held through LTFs, which have much shorter effective lockup period.

potential omitted variable bias, we include year (δ_t) and style (ψ_i) fixed effects in all regressions, and cluster standard errors by funds to account for serial correlation in the variables. Based on our prediction, we expect to see negative α.

$$Beta_{i,t+1} = \psi_i + \delta_t + \alpha\, Flow_{it} + \gamma' X_{it} + \eta RRet_{it} + \varepsilon_{it} \tag{2}$$

$$dBeta_{i,t+1} = \psi_i + \delta_t + \alpha\, Flow_{it} + \gamma' dX_{it} + \eta RRet_{it} + \varepsilon_{it} \tag{3}$$

For the second question, we use a similar specification as Equation 2 and regress forward relative returns on proportions of assets allocated to high-beta stocks, controlling for fund beta, as follow:

$$RRet_{i,t+1} = \psi_i + \delta_t + \beta_1 PctLow_{it} + \beta_2 PctHigh_{it} + \alpha\, Flow_{it} + \gamma' X_{it} + \eta RRet_{it} + \varepsilon_{it} \tag{4}$$

Here, our main coefficients of interest are β_1 and β_2. Based on the findings of the literature on the low-beta anomaly, we expect β_1 to be positive and β_2 to be negative.

3. Results

Table 2 reports the result of Equation 2. The α is negative and statistically significant as we expect, but only for tax funds. The α of the first-differenced specification of Equation 3, reported in Table 3, is also negative only for tax funds by less statistically significant. The results of Table 2 and 3 combined suggest that suggesting that fund flows can affect fund managers' risk-taking strategy: tax funds that experience lower (higher) fund flow tend to have higher (lower) beta in the subsequent period, and the fund beta increase (decrease) in response. Given the substantial differences in size of TNA for tax and non-tax funds, the stakes and thus incentives are larger to act.

[TABLE 2, 3 ABOUT HERE]

Next, we turn to a more pertinent issue: some mutual funds appear to adjust systematic risk exposure through overweighting high-beta stocks, so does this influence their future returns? Table 4 reports the result of Equation 4. In column 1-3, we first report results without the inclusion of beta composition as baseline: current fund beta is positively related to future relative returns, supporting the returns-chasing behavior of fund managers by increasing systematic risk exposure, and past relative returns are related to future relative returns, similar to Grinblatt and Titman (1992) and Vidal-García et al. (2016).

[TABLE 4 ABOUT HERE]

When we include the holding proportions, the result supports only one side of our prediction. On average, both types of funds that hold more high-beta stocks tend to perform worse. A one standard deviation increase in allocation to high-beta stocks leads to a 1.3 percentage point decrease in relative return.[23] Interestingly, non-tax funds that hold low-beta stocks also tend have worse performance, which seems inconsistent with international evidence on the low-risk anomaly. However, anomalies in Thailand are still little-studied. Indeed, Saengchote (2017) finds that the low-beta anomaly in Thailand is more about high-beta stocks earning low returns than low-beta stocks earning high returns, which is more consistent with the underperformance of the high-exposure funds in this study. As mutual funds cannot short stocks, their long positions can lead to overpriced stocks that cannot be arbitraged away, similar to the findings of Stambaugh et al. (2012, 2015).

4. Conclusion

Capital market frictions can artificially affect demand for assets and compel investors to make decisions that are inconsistent with traditional asset pricing models, such as "reaching for yield" in bond market and "chasing returns" in equity mutual funds.[24] In this article, we contribute to the growing evidence that frictions in mutual fund management and the beta anomaly are intertwined. The finding suggests that short-selling against mutual funds can be profitable, similar to the finding of Arif et al. (2015). Given that short-selling volatile stocks is risky, as documented by Engelberg et al. (2018), underperformance of high-beta stocks will likely persist, to the detriment of mutual fund investors.

[23] In unreported analysis, we rank mutual funds in each year based on their exposure to high beta stocks into 3 portfolios and compute value-weighted relative returns. The cumulative relative return between 2006 to 2016 for the low-, medium- and high-exposure portfolios are 59%, 47% and 34% respectively.

[24] For evidence of "reaching for yield" in bond market, see Becker and Ivashina (2015) and Choi and Kronlund (2017).

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Table 1: Summary Statistics

This table reports the average, standard deviation, and the key percentiles of fund characteristics. *t* or *t+1* denote the year (ending in September) in which the characteristics are measured. Fund beta is calculated as the value-weighted average betas based on the stock holdings reported as of (or latest available prior to) September in each year. Relative return is computed relative to the relevant benchmark (mostly SET Index and SET50 Index) in each year. Fund flow at t+1 is computed as ($TNA_{i,t+1}$ – $TNA_{i,t}$ $(1+r_{i,t+1})$) / $TNA_{i,t}$. Fund size (total net assets) and fund expenses are retrieved from Morningstar. In each year, stocks are ranked based on their beta and divided into quintiles. Low-beta stocks are classified as those in the bottom quintile and high-beta stocks top quintile respectively. Tax funds are mutual funds which are tax-privileged.

Tax funds

Variable	Mean	SD	P10	P50	P90
Relative return t+1 (in decimals)	0.03	0.06	-0.03	0.02	0.10
Fund flow t+1 (in decimals)	0.13	0.31	-0.10	0.08	0.39
Fund beta t	0.95	0.22	0.68	0.93	1.24
Fund size (TNA) t (in THB millions)	2,951	5,665	99	885	6,843
Expenses t (in %)	1.81	0.45	1.19	1.87	2.25
% low-beta stocks t (in decimals)	0.05	0.06	0.00	0.02	0.14
% high-beta stocks t (in decimals)	0.25	0.14	0.06	0.26	0.43
Observations	572				
Number of funds	65				

Non-Tax funds

Variable	Mean	SD	P10	P50	P90
Relative return t+1 (in decimals)	0.04	0.06	-0.03	0.04	0.12
Fund flow t+1 (in decimals)	0.02	0.60	-0.31	-0.07	0.27
Fund beta t	0.98	0.21	0.76	0.95	1.24
Fund size (TNA) t (in THB millions)	917	1,684	76	312	2,440
Expenses t (in %)	1.66	0.48	1.02	1.80	2.22
% low-beta stocks t (in decimals)	0.05	0.07	0.00	0.02	0.14
% high-beta stocks t (in decimals)	0.24	0.13	0.06	0.25	0.40
Observations	848				
Number of funds	96				

Table 2: Fund Flow and Mutual Fund Risk-Taking

This table report results from regressions of fund beta in year *t+1* on fund flow in year *t* and fund characteristics measured at the end of year *t* (ending in September), as specified in Equation 2. Fund beta is calculated as the value-weighted average betas based on the stock holdings reported as of (or latest available prior to) September in each year. All regressions include year and style fixed effects. Fund beta in year *t* is included to account for potential serial correlation of beta. Standard errors, reported in parenthesis, are clustered by fund. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively. See Table 1 for definition of other variables.

Depvar: Fund beta (t+1)	(1) Pooled	(2) Tax	(3) Non-Tax
Fund flow	-0.0098	-0.0260**	0.0078
	(0.0079)	(0.0104)	(0.0123)
Fund beta	0.2737***	0.2921***	0.2139***
	(0.0395)	(0.0506)	(0.0724)
Log fund size	-0.0066*	-0.0117**	-0.0046
	(0.0038)	(0.0055)	(0.0054)
Expenses	-0.0197**	-0.0256	-0.0143
	(0.0100)	(0.0168)	(0.0128)
Relative return	0.2073**	0.3403***	-0.0034
	(0.0944)	(0.1252)	(0.1384)
Observations	1,420	572	848
Adjusted R-squared	0.512	0.499	0.532

Table 3: Fund Flow and Change in Mutual Fund Risk-Taking

This table report results from regressions of change in fund beta from year *t* to year *t+1* on fund flow in year *t* and changes in fund characteristics measured at the end of year *t* (ending in September), as specified in Equation 3. Fund beta is calculated as the value-weighted average of betas based on the stock holdings reported as of (or latest available prior to) September in each year. All regressions include year and style fixed effects. Standard errors, reported in parenthesis, are clustered by fund. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively. See Table 1 for definition of other variables.

Depvar: Fund beta (t, t+1)	(1) Pooled	(2) Tax	(3) Non-Tax
Fund flow (t)	-0.0151	-0.0664*	0.0073
	(0.0213)	(0.0385)	(0.0226)
Fund beta (t-1, t)	-0.5513***	-0.5180***	-0.5742***
	(0.0192)	(0.0310)	(0.0268)
Log fund size (t-1, t)	0.0170	0.0165	0.0148
	(0.0224)	(0.0758)	(0.0241)
Expenses (t-1, t)	-0.0178	0.0119	-0.0504
	(0.0268)	(0.0460)	(0.0349)
Relative return (t)	0.0478	0.0629	0.0582
	(0.1022)	(0.1673)	(0.1270)
Observations	1,269	519	750
Adjusted R-squared	0.725	0.692	0.752

Table 4: High-Beta Stocks and Future Returns

This table report results from regressions of fund relative return in year *t+1* on proportion of stock holdings in year *t* and fund characteristics measured at the end of year *t* (ending in September), as specified in Equation 4. Relative return is computed relative to the relevant benchmark (mostly SET Index and SET50 Index). In each year, stocks are ranked based on their beta and divided into quintiles. Low-beta stocks are classified as those in the bottom quintile and high-beta stocks top quintile respectively. The proportion of stock holdings are computed as the market value of stocks with low-/high-beta relative to the fund's total net assets. All regressions include year and style fixed effects. Standard errors, reported in parenthesis, are clustered by fund. Stars correspond to statistical significance level, with *, ** and *** representing 10 percent, 5 percent and 1 percent level respectively. See Table 1 for definition of other variables.

	(1)	(2)	(3)	(4)	(5)	(6)
Depvar: Relative return (t+1)	Pooled	Tax	Non-Tax	Pooled	Tax	Non-Tax
% low beta stocks				-0.0597*	0.0562	-0.1606***
				(0.0340)	(0.0600)	(0.0394)
% high beta stocks				-0.0991***	-0.0852**	-0.1043***
				(0.0234)	(0.0358)	(0.0301)
Fund flow	-0.0044**	-0.0053	-0.0050**	-0.0045**	-0.0053	-0.0059**
	(0.0021)	(0.0044)	(0.0025)	(0.0022)	(0.0043)	(0.0026)
Fund beta	0.0049	0.0121	-0.0055	0.0207***	0.0288***	0.0017
	(0.0077)	(0.0106)	(0.0114)	(0.0075)	(0.0105)	(0.0107)
Log fund size	-0.0027***	-0.0028*	-0.0020	-0.0031***	-0.0042***	-0.0016
	(0.0010)	(0.0016)	(0.0013)	(0.0009)	(0.0015)	(0.0012)
Expenses	-0.0087**	-0.0062	-0.0090***	-0.0081**	-0.0051	-0.0089***
	(0.0033)	(0.0077)	(0.0030)	(0.0034)	(0.0078)	(0.0030)
Relative return	0.1557***	0.1573***	0.1387***	0.1421***	0.1430***	0.1304***
	(0.0257)	(0.0385)	(0.0347)	(0.0251)	(0.0399)	(0.0344)
Observations	1,420	572	848	1,420	572	848
Adjusted R-squared	0.391	0.393	0.378	0.406	0.408	0.401

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RESEARCH PAPER

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Research Paper Submitted to SEC Working Papers Forum

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RESEARCH QUESTION

Did fund managers of the three largest asset management companies in Thailand in terms of total net asset value add value to the return of the domestic equity funds during three-year period from 2015 to 2017?

ABSTRACT

This paper evaluates the impact of management on the return of domestic equity mutual funds of the three biggest asset management companies from 2015 to 2017 by examining the performance of 29 equity mutual funds of the three companies by using Fama and French three-factor model and Carhart four-factor model. Moreover, the paper also provides evidence on the performance of equity mutual funds in a less efficient and developed market, Thailand. Since Thailand is an emerging market, it serves as an opportunity to prove the investment ability of the fund managers as the less developed market will usually enable the active fund managers to successfully select security and timing, and thereby beat the market. Overall, the results of the Fama and French three-factor model and Carhart four-factor model indicated that, even in a less developed market like Thailand, most of the equity funds still could not manage to create a significant positive alpha to the investors, which generally interpreted as a result from a superior management of that fund, meaning that management of funds does not add sufficient value to the return of equity mutual funds. Finally, for individual investors, the results provided by this study can be guidelines for selecting mutual funds for investment.

INTRODUCTION

Mutual fund is usually perceived as a way to invest money for those who just started invest and those who are less confident about their skills in choosing stocks because mutual funds are managed by professional managers who are believed to produce a superior performance to the investors. According to the Securities and Exchange Commission of Thailand, mutual fund can be grouped into 10 categories including money market fund, general fixed income fund, long-term fixed income fund, short-term fixed income fund, balanced or mixed fund, flexible portfolio fund, fund of funds or feeding fund, equity fund, warrant fund, and sector fund. However, this research is focusing on the performance of equity mutual fund, which is the fund that the 65 percent of its net asset value is comprised of equity instruments such as common stock, preferred stock, and warrant, and the rest 35 percent can be used to invest in other securities such as bond, or deposit. This type of fund is accounted for 29.87% of the total net asset value as of July 2018.

Mutual fund business in Thailand has been growing rapidly in the last decade especially in the period of low interest rate. In the first four months of 2018, total assets under management or AUM have grown from 5.0163 trillion in January baht by 55.82 billion baht to 5.0722 baht in April. This is because of the low interest rate environment that encourages investors to shift their money out from low-risk asset such as fixed income asset to a more risky asset hoping to gain higher interest income. However, this year Thailand interest rate is expected to move up accordingly to the increase in interest rate of the US and other developed economies as they are promoting policy normalization; thus, with the higher pressure on Thai interest rate, this might affect mutual fund market as a whole in the near future since the low-risk asset will give a higher return. Currently, Kasikorn Asset Management remained in top spot with a 19.73% market share of total net assets at the end of July 2018, follow by SCB Asset Management and BBL Asset Management, which are second and third with 18.42% and 14.39% market share, respectively.

According to the very classical theory of random walk hypothesis that since stock prices follow the random walk, predicting the future movement of prices is impossible, which make beating the market not achievable. Nonetheless, many asset management companies in Thailand still believe that they can beat the market and add value to the return of mutual funds by claiming themselves to be an active player. The reason is that, given that Thailand is an emerging economy, Thai stock market is perceived as a less efficient and developed market that share prices do not reflect all information and alpha generated is said to be very likely. However, many investors still question those asset management companies about their overconfidence on this issue. According to Swedroe (2012), one of the mistakes that investors make is that they are overconfident of their own skills. They are too optimistic about their prospects and believe that they pick the right stocks at the right time; thus, beating the market is potentially possible. Nevertheless, if every fund managers and investors expect their portfolio to outperform the market, it is simply beyond the bounds of possibility because those managers and investors collectively are the market, and it is not impossible for everyone that

that excess return as there are only few investors who can beat the market, but still everyone think that he or she will be one of the few.

This research aims to test the proposition of the impact of management on the mutual fund return. There are many ways to measure the performance of mutual fund such as Sharpe ratio, Treynor ratio, Jensen's alpha, and so on. This research will focus on using the asset pricing model of French and Fama's three-factor model, and Carhart's four-factor model to evaluate the performance the equity mutual funds of the three-biggest asset management company in Thailand, including BBL asset management, SCB asset management, and Kasikorn asset management, that whether or not the fund generate excess return from the model, and this will outline the portfolio manager's investment ability either the superiority or inferiority.

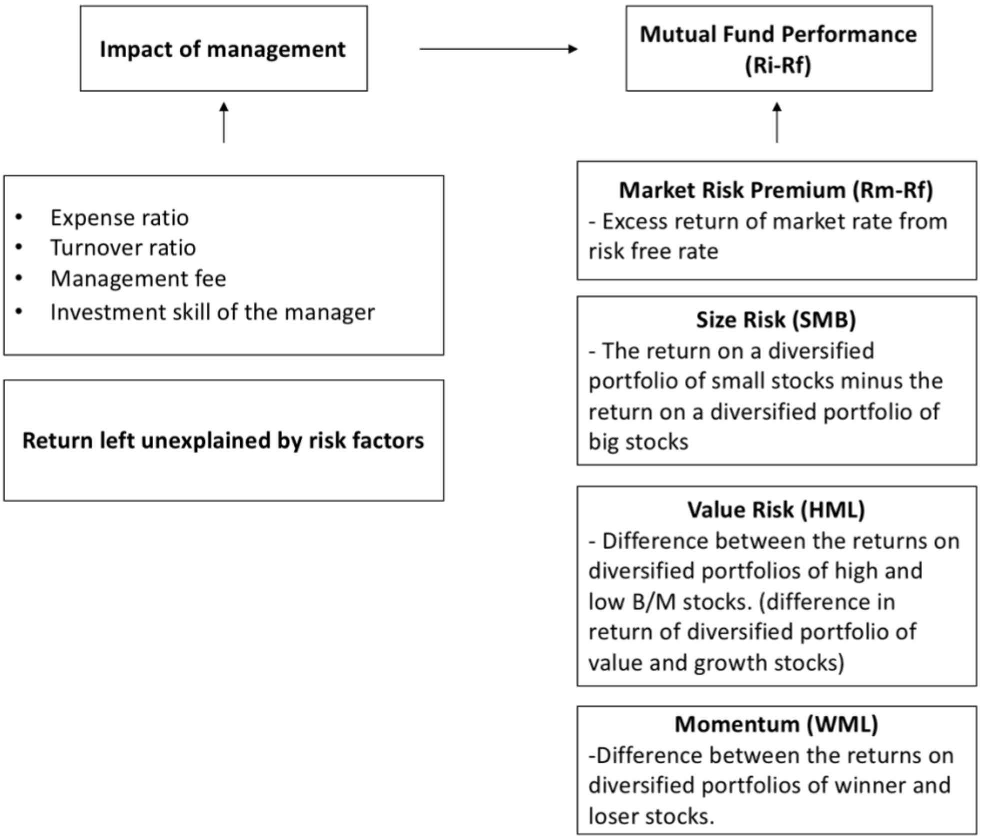
LITERATURE REVIEW

Most of the previous studies on mutual funds' performance suggests that it is impossible for fund managers to beat the market and create alpha in a highly developed and efficient market. For example, Barras, Scaillet, and Wermers (2010) confirmed this statement by using the Carhart's four factor model to compute fund performance. The results showed that for every category of funds, which includes growth active growth and growth and income, the alphas are negative. Furthermore the results also revealed that 75% of funds have a zero-alpha, and after 2006, none of funds manage to get positive alphas for their investors. Similarly, Cremers and Pareek (2016) also stated that funds that are highly active, or traded frequently generally underperform the passive benchmark, but those with patient investment strategy, which the holding durations are over two year, on average outperform the benchmark over 2 percent a year. The results from this finding found an increase in alpha, or excess return, as holding duration increases; hence, this means that the active manager failed to add value to the US equity funds. The inability of mutual funds to beat the market in the developed market might stem from an increase in the size of the active mutual fund industry. The reason is that if there are many investors or fund managers who believe that they can beat the market, it is simply impossible as the investors and fund managers collectively are the market. Pastor, Stambaugh, and Taylor (2015) confirmed this since the result of their finding indicates that as the size of the active mutual fund industry increases, a fund's ability to outperform passive benchmarks declines.

On the other hand, in a less efficient market such as emerging market, many researchers found that a certain level of market inefficiency might enable the active fund managers to successfully select security and timing, and thereby beat the market. For example, Lau and Lia (2010) evaluated mutual funds' performance in Malaysia by using the single market model (capital asset pricing model or CAPM), the Fama and French three-factor model, and the Carhart four-factor. The results found that mutual fund performances exhibit superior returns, especially for 3-year investment horizon. Moreover, among the three models, Carhart four-factor model works the best in explaining the mutual funds return as it gave the highest coefficient and significance. Apart from the Malaysian market, Chinese equity mutual funds can also provide higher return than the market. Rao, Tauni, and Umar (2015), likewise, used CAPM and Carhart four-factor to analyze Chinese equity mutual funds' performance. The outcome is similar to the Malaysian market, from CAPM, overall Chinese equity mutual funds are able to beat the market and give the average alpha of 0.0021; in the same way, alpha from Carhart four-factor model is also positive. Furthermore, Kiymaz (2015) also found that Chinese funds generate positive alphas for their investors, and the highest return is provided with aggressive allocation funds. While many studies confirmed that the less efficient market of emerging countries allow fund manager to earn abnormal return, fund managers in some emerging markets still cannot add sufficient value to the mutual funds return. Białkowski and Otten (2010) suggested a different situation in Poland. Overall, the fund managers cannot manage to add sufficient value to their domestic equity funds to make up the expense ratio they charge. The after fee net alpha of the Polish domestic equity is on average -1.37. In a similar way, (Mahmud & Mirza, 2011) evaluated performance of stock funds in Pakistan. With consistently negative and insignificant alphas, no stock fund manages to outperform the market. These results show that even though Poland and Pakistan are less efficient emerging market, fund managers are still cannot manage to create positive alphas for their investors.

There are also many studies on the performance of Thai equity mutual fund that the fund managers can manage to produce superior returns to their investors given that Thailand an emerging market with less developed and efficient stock market. Chotivetthamrong (2015) studied on the performance 36 Thai star funds from 2003 to 2007 by using French and Fama's model, plus liquidity factor. The result found that the 5-star domestic equity funds had a higher positive alpha than other lower star funds, but the average alpha of every rating was still positive; thus, this means that during the period of 2003 to 2007, fund manager could deliver a superior performance to their investors. Moreover, the alphas of the individual 36 domestic equity star funds she analyzed were all exhibited positive values. However, Chotivetthamron (2015) also found that the positive alpha of the high rated fund was declined as the time went by; she explained that when fund had the bigger fund size, manager cannot manage the fund as well as he can in the past. In the same way, Soongswang and Sanohdontree (2011) conducted the analysis on open-ended Thai equity mutual funds from 2002 to 2007 by using Treynor ratio, Sharpe ratio, Jensen's alpha and Data Envelopment Analysis (DEA) technique. The result suggests that, during the 5-year period between 2002 to 2007, open-ended equity mutual fund was a good alternative for individual investor since the performances of the equity funds' return measured by the first three methods indicate that the funds significantly outperformed the market. Nevertheless, by using DEA technique some funds created excess returns while some were not. Still, on average fund managers had delivered a superior performance to the open-end equity funds.

CONCEPTUAL FRAMEWORK



The conceptual framework above links the impact of management to the equity mutual fund's performance. According to CAPM, or the capital asset pricing model, only market risk premium is used to explain pricing and asset return. However, Fama and French three-factor model added another two factors, which is size risk and value risk that is left unexplained in CAPM. Moreover, Carhart's four factor model added another variable which is momentum to explain the return. Thus, from the conceptual framework, the mutual fund return that is left unexplained by Carhart's four factors could be perceived as the impact of management, assuming market risk, size risk, value risk, and momentum are four measures necessary in explaining return of mutual funds. In another word, the investor would expect a large positive unexplained return from investing in the actively managed fund. If it turns out to be negative, it could be the result of high expense ratio, high management fee, and a low ability of the manager to pick the right stock and style of investment that lead to unnecessary high turnover ratio.

DATA

I took the historical data of stocks in SET index and mutual funds from the Bloomberg terminal. The total return index gross dividend (TRI) was used to compute the returns as it has taken cash and dividend distributions into account. The TRI measures the performance of a particular security by assuming all dividend distributions are reinvested to track the real price movement of the security. I evaluated the mutual funds' performance on monthly basis; thus, all the returns are shown in monthly basis.

The market return (Rm) is calculated by using the historical monthly TRI of SET index from 01/2015 to 12/2017, the monthly risk-free rate (Rf) is the 3-month government bond yield from 01/2015 to 12/2017, but the bond yields is presented as an annual rate; therefore, I had to convert the yields to monthly basis, the difference between Rm and Rf is the factor used to evaluate mutual fund performance which will be explained in the following section. Additionally, the TRI of each security listed in the SET index from 01/2015 to 12/2017 is also used to calculate the returns of portfolios to complete the models.

According to Figure 1, the annualized return of SET TRI was the highest in 2016, with 19.79% annualized return. The three-year average return from 2015 to 2017 was 6.51% annually, and the five-year average return from 2013-2017 was 5.39%. (risk free)

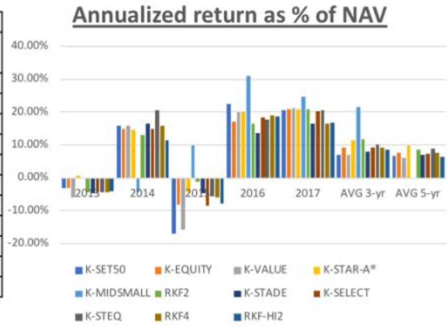
The domestic equity mutual funds are used to evaluate the performance of fund managers of the three biggest asset management companies in Thailand, including BBL asset management (BBLAM), Siam Commercial Bank asset management (SCBAM), and Kasikorn asset management (KAsset). The domestic equity funds that are used to determine whether or not the fund managers create a superior return to their investors are those that have already been registered before the 1st of January 2015

KASSET

As of the 31st of July 2018, KAsset is the largest asset management company in Thailand with 985,154.07 million baht total net assets, which has made up 19.73% of Thai mutual fund. Its equity mutual funds have total net asset value of 199,005.30 million baht, which is accounted for 13.35% of total equity fund market. The company has 173 funds under management, 57 of which are equity fund.

Figure II Summary Statistics of performance of the KAsset's equity mutual funds from 2013-2017

Fund Name	Management Strategy	Morningstar rating	Annualized return (%of NAV)							
			2013	2014	2015	2016	2017	AVG 3-yr	AVG 5-yr	yearly SD
K-SET50	Passive	3	-3.19%	15.74%	-17.13%	22.42%	20.66%	6.97%	6.52%	14.63%
K-EQUITY	Active	3	-3.23%	14.78%	-8.17%	17.03%	20.75%	9.07%	7.59%	14.01%
K-VALUE	Active	3	-5.93%	15.70%	-15.91%	20.00%	21.07%	6.90%	5.86%	12.91%
K-STAR-A®	Active	4	0.66%	14.51%	-4.41%	19.84%	20.99%	11.49%	9.82%	14.05%
K-MIDSMALL	Active	5	-	-4.29%	9.86%	31.04%	24.59%	21.50%	-	13.45%
RKF2	Active	4	-4.45%	13.02%	-1.29%	16.55%	20.88%	11.62%	8.47%	13.84%
K-STADE	Active	3	-4.80%	16.30%	-4.69%	13.48%	16.54%	8.02%	6.89%	13.82%
K-SELECT	Active	3	-4.42%	14.96%	-8.53%	18.18%	20.18%	9.12%	7.38%	14.19%
K-STEQ	Active	4	-4.43%	20.45%	-5.73%	17.60%	20.56%	10.15%	9.00%	14.25%
RKF4	Active	3	-4.48%	15.83%	-6.11%	18.81%	16.30%	9.06%	7.50%	13.66%
RKF-HI2	Active	3	-4.22%	11.47%	-7.85%	18.75%	16.86%	8.54%	6.43%	14.02%



According to figure 2, 11 equity mutual funds are used to evaluate the performance of the company's fund managers, all of which have been registered before January 2015. All of the equity funds exhibit an active management strategy except K-SET50, which has the passive management strategy. The funds are sorted by largest total asset value to smallest total asset value.

The returns of each fund from 2013 to 2017 are also presented in figure 2. As expected for a 5-star equity fund, K-MIDSMALL produced the highest average return for 3-year period. During 2015, when the whole stock market went down, the fund managers still managed to produce 9.86% return for K-MIDSMALL equity fund, and its standard deviation is not the highest among the equity funds that have been registered before 2015. The most interesting thing here is that K-VALUE, which is an actively managed fund, gave a lower average return than the K-SET50, which is a passive managed fund; thus, due to this fact, many investors have doubted about the management ability of the fund managers. The average Morningstar rating of the 11 funds is 3.45.

Figure III Summary Statistics of fees and loads of the KAsset's equity mutual funds

Fund name	Magement fee as a % of NAV per yr			% of NAV per yr (not exceeding)		% of NAV/Unit (not exceeding)	
	2015	2016	2017	Management fee	Total expense ratio	Front-end load	Back-end Load
K-SET50	0.5350%	0.5300%	0.5400%	1.0700%	1.6371%	2.00%	2.00%
K-EQUITY	2.0063%	2.0000%	2.0063%	2.0063%	3.2796%	2.00%	1.00%
K-VALUE	2.0063%	2.0063%	2.0063%	2.0063%	3.3652%	2.00%	1.00%
K-STAR-A®	2.0063%	2.0000%	2.0063%	2.0063%	3.3170%	2.00%	2.00%
K-MIDSMALL	1.9700%	2.0100%	2.0100%	3.2100%	3.7450%	2.00%	2.00%
RKF2	2.0063%	2.0063%	2.0063%	2.0063%	3.2796%	2.00%	1.00%
K-STADE	2.1200%	2.0063%	2.0063%	2.0063%	3.2796%	2.00%	1.00%
K-SELECT	2.0063%	2.0063%	2.0063%	2.0063%	3.3652%	2.00%	1.00%
K-STEQ	2.0063%	2.0063%	2.0063%	2.0063%	3.3705%	2.00%	1.00%
RKF4	2.0063%	2.0063%	2.0063%	2.0063%	3.2796%	2.00%	1.00%
RKF-HI2	2.0063%	2.0000%	2.0063%	2.0063%	3.2796%	2.00%	1.00%

The fee and loads collected by each equity fund are shown in figure 3. Obviously, the management fee for actively managed funds is higher than the passive funds. SET 50 has the current actual management fee of 0.54% of NAV per year whereas most of the active funds have the actual management fee of 2.0063% of NAV per annum. Among those funds, K-MIDSMALL, which is the best equity mutual fund of KAsset in terms of the 3-year average return, has the highest management fee of 2.01% of NAV per annum in 2016 and 2017, and the fee can go up by as much as 3.21%. Moreover, the front and bank end loads are applied to all equity funds.

SCBAM

As of the 31st of July 2018, SCBAM is the second largest asset management company in Thailand with 919,419.37 million baht total net assets, which accounted for 18.42% of Thai mutual fund. Its equity mutual funds have total net asset value of 126,907.47 million baht which is made of 8.51% of total equity fund market. The company has 197 funds under management, 69 of which are equity fund.

Figure IV Summary Statistics of performance of the SCBAM's equity mutual funds from 2013-2017

Fund Name	Management Strategy	Morningstar rating	Annualized return (%of NAV) 2013	2014	2015	2016	2017	AVG 3-yr	AVG 5- yr	yearly SD
SCBSET	Passive	3	-4.45%	16.61%	-12.26%	21.24%	17.02%	7.57%	6.76%	14.58%
SCBDV	Active	4	-4.60%	16.93%	-10.49%	21.21%	23.20%	10.16%	8.32%	14.67%
SCBSET50	Passive	3	-3.39%	16.80%	-16.25%	22.35%	20.09%	7.16%	6.79%	15.80%
SCBSE	Active	5	-4.06%	16.66%	1.48%	23.88%	17.75%	13.97%	10.62%	15.78%
SCBBANKING	Passive	1	-14.22%	32.21%	-27.52%	20.31%	17.34%	0.77%	3.02%	19.47%
SCBENERGY	Passive	3	-13.32%	0.51%	-19.52%	42.15%	23.69%	12.27%	4.27%	18.81%
SCBDA	Active	2	-8.46%	15.74%	-10.53%	24.11%	19.64%	9.93%	7.08%	14.41%
SCBPMO	Active	2	-8.92%	16.48%	-11.08%	24.88%	19.02%	9.74%	6.99%	14.57%

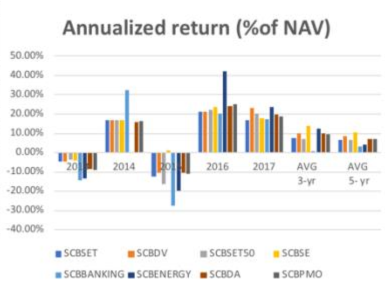


Figure 4 depicts the domestic equity mutual funds of SCBAM that has been registered before 2015, four of which, namely SCBSET, SCBSET50, SCBBANKING, and SCBENERGY, and the rest are actively managed domestic equity funds are passive managed funds. Thus, the result can also compare whether or not active management strategy is better than the passive in terms of adding excess return to the funds. The funds are ranked by largest total asset value to smallest total asset value. The average Morningstar rating of the 8 funds is 2.875, which is lower than the average star obtained from the KAsset's domestic equity mutual funds.

The return from 2013 to 2017 and the standard deviation of each fund are also shown in Figure 4. The actively managed funds seem to produce higher average annualized return than passively managed fund for both 3 years and 5 years. Although SCBSE, the 5-star equity mutual fund, gave the highest 3-year and 5-year average annualized return of 13.07% and 10.62%, respectively, the standard deviation of the fund is not the highest. The highest SD goes to SCBBANKING with 19.47% yearly; however, its return is the lowest among the SCBAM's equity mutual funds; hence, this might be the reason why it gained only 1 star from the Morning Star rating.

Figure V Summary Statistics of fees and loads of the SCBAM's equity mutual funds

Fund name	Management fee as a % of NAV per yr			% of NAV per yr (not exceeding)		% of NAV/Unit (not exceeding)	
	2015	2016	2017	Management fee	Total expense ratio	Front-end load	Back-end Load
SCBSET	1.000%	0.990%	0.940%	1.011%	3.200%	-	0.107%
SCBDV	1.330%	1.320%	1.320%	1.357%	2.140%	0.535%	0.535%
SCBSET50	0.390%	0.390%	0.390%	1.070%	2.140%	-	-
SCBSE	2.170%	2.170%	2.170%	2.247%	3.210%	1.070%	1.070%
SCBBANKING	1.140%	1.140%	1.140%	1.766%	2.140%	1.070%	1.070%
SCBENERGY	1.140%	1.140%	1.140%	1.766%	2.140%	1.070%	1.070%
SCBDA	1.770%	1.760%	1.760%	1.819%	3.210%	2.000%	1.000%
SCBPMO	1.880%	1.890%	1.880%	1.946%	3.210%	2.140%	1.070%

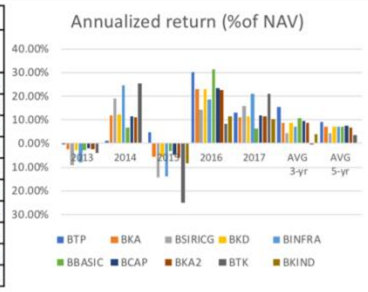
The fee and loads collected by each fund are summarized in figure 5. The management fee for actively managed funds is higher than the passive funds. While the management fee of the KAsset's equity funds are not that different from each other, the management fees of the SCBAM's domestic equity mutual funds are quite different from fund to fund. SCBSE, a five-star equity mutual fund, has the highest actual management fee of 2.17% of NAV per annum, followed by SCBPMO with 1.88% actual management fee. All funds collect front-end and back-end load except for SCBSET 50, which has neither front-end nor back-end load, and SCBSET, where front-end load is not collected.

BBLAM

As of the 31st of July 2018, BBLAM is the third largest asset management company in Thailand with 718,365.56 million baht total net assets, which is composed of 14.39% of market share. Its equity mutual funds have total net asset value of 204,159.03 million baht which is composed of 13.69% of total equity fund market. The company has 78 funds under management, 32 of which are equity mutual fund. The company claims itself to be an active management company; thus, all of its equity mutual funds are actively managed.

Figure VI Summary Statistics of performance of the BBLAM's equity mutual funds from 2013-2017

Fund name	Management Strategy	Morningstar rating	Annualized return (%of NAV) 2013	2014	2015	2016	2017	AVG 3-yr	AVG 5-yr	yearly SD
BTP	Active	5	-0.37%	1.29%	4.72%	30.31%	13.27%	15.62%	9.30%	13.37%
BKA	Active	4	-2.23%	11.83%	-5.59%	22.84%	11.01%	8.79%	7.08%	12.23%
BSIRICG	Active	3	-9.07%	19.17%	-14.37%	14.32%	15.79%	4.27%	4.20%	11.21%
BKD	Active	4	-2.75%	12.40%	-5.76%	22.89%	11.52%	8.90%	7.14%	12.34%
BINFRA	Active	3	-8.07%	24.44%	-13.92%	18.68%	20.87%	7.28%	7.15%	13.58%
BBASIC	Active	5	-2.89%	6.60%	-3.20%	31.52%	6.50%	10.68%	7.02%	12.49%
BCAP	Active	4	-2.12%	11.40%	-4.79%	23.53%	12.00%	9.62%	7.51%	12.23%
BKA2	Active	4	-2.36%	11.10%	-5.94%	22.78%	11.55%	8.81%	6.92%	12.36%
BTK	Active	3	-4.02%	25.40%	-24.94%	8.39%	21.01%	-0.52%	3.45%	13.21%
BKIND	Active	1			-8.46%	11.33%	10.27%	3.97%		10.32%



As shown in figure 6, the BBLAM's domestic equity mutual fund that has been registered before 2015 are all actively managed fund. The 10 funds are sorted by largest total asset value to smallest total asset value.

Figure 6 summarizes the return and standard deviation for the 10 equity mutual funds. As the table shows, BTP equity fund gives the highest average 3-year and 5-year annually return of 15.62% and 9.3% per year, respectively; conversely, BTK produces the lowest 3-year and 5-year average return, although it has the third highest yearly standard deviation. The average Morningstar rating of the 10 BBLAM's domestic equity funds is 3.6, which is the highest among the three biggest asset management company in Thailand; thus, I anticipate the large positive alpha from the return including management fee from this company as a result of their effective active management strategy.

Figure VII Summary Statistics of fees and loads of the BBLAM's equity mutual funds

Fund name	Management fee as a % of NAV per yr 2015	2016	2017	% of NAV per yr (not exceeding) Management fee	Total Expense ratio	% of NAV/Unit (not exceeding) Front-end load	Back-end Load
BTP	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BKA	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BSIRICG	1.605%	1.605%	1.605%	1.873%	2.675%	0.500%	1.000%
BKD	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BINFRA	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BBASIC	1.605%	1.605%	1.605%	1.605%	2.401%	1.000%	1.000%
BCAP	1.070%	1.070%	1.070%	1.070%	2.943%	-	-
BKA2	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BTK	1.605%	1.605%	1.605%	1.605%	2.323%	1.000%	1.000%
BKIND	2.140%	1.605%	1.605%	2.140%	3.210%	-	1.000%

Moreover, figure 7 highlights the fee and loads collected for each funds, the actual management fee is stood at 1.605% of NAV per year for all chosen funds except BCAP, with

1.07% of NAV per annum. The maximum management fee for BKIND is the highest, with 2.14% of NAV per year; however, this fund only gains 1 star from the Morningstar rating. Even though BCAP has lowest management fee, its maximum total expense ratio is the highest among the 7 funds, which is at 2.9425% of NAV per annum. Additionally, BBLAM also collects both front-end load and back-end load from their customers, except for BCAP and BKIND.

The return of the securities, SET index, risk free asset, mutual fund in month *t* can be expressed as follow:

Variable	Calculation
Return of stock, SET index, and mutual fund in monthly basis	$R_{it} = \frac{TRI_t}{TRI_{t-1}} - 1$
Risk-free rate in monthly basis	$R_{ft} = (1 + R_f)^{\frac{1}{12}} - 1$ R_f is a three-month government bond yield in yearly basis

METHODOLOGY

The most simple and popular way to measure the performance of equity mutual funds is to use the capital asset pricing single index model (CAPM). The measure of excess performance, assuming there is only one factor, which is market risk, necessary in explaining return of the funds, is expressed by alpha (α_{CAPM}), or Jensen's alpha.

$$\boxed{CAPM\colon (R_{it} - R_{ft}) = \beta^{i,mkt}(R_{mt} - R_{ft}) + \alpha_{i,CAPM} + e_{it}}$$

From this model, $R_{it} - R_{ft}$ is the excess return of the equity mutual fund portfolio in month t, $R_{mt} - R_{ft}$ is the excess return of the market portfolio in month t, where R_{ft} is the risk-free rate in month t (i.e. the one-month Thai government bond yield), ($\alpha_{i,CAPM}$) is the coefficient that measure the outperformance of that particular mutual fund from the market, and $\beta^{i,mkt}$ reflects the sensitivity of fund to the stock market; in other words, beta reflects the intensity of investing in the stock market. However, from this model, alpha represents the unexplained return by having only one factor in this model; thus, alpha could mislead the investment decision.

Therefore, I evaluate the mutual fund performance by using the Fama and French's three-factor model. Two variables were added to the CAPM to provide a better explanation of mutual funds' performance, and a better understanding of how each equity mutual fund exposes to risks.

$$Three\ Factor\ Model: (R_{it} - R_{ft}) = \beta^{i,mkt}(R_{mt} - R_{ft}) + \beta^{size}(SMB_t) + \beta^{value}(HML_t) + \alpha_{i,FF} + e_{it}$$

The two factors added are SMB and HML. SMB_t is the difference in the return of a portfolio of small stocks and a portfolio of big stocks in month *t*, which was designed to capture risk associated with size, and HML_t is the difference in return of a portfolio of value stocks, or high book-to-market stocks, and a portfolio of growth stocks, or low book-to-market stocks in month *t.* In the same way as CAPM, $\beta^{i,mkt}$ indicates the intensity of investing in stock market, β^{size} reflects the intensity of how much this investment tilts towards small stocks, and β^{value}shows how much this investment tilts towards value stock portfolio. The alpha, again, explains the return that is left unexplained by the model, assuming market, size, and value risk are three risk measures necessary, which is usually interpreted as a result from active management of that fund.

However, in finance literature, the Carhart's four factor model is the standard model in evaluating the mutual fund performance. Carhart (1997) argued that returns of mutual fund were a function of market-capitalization weighted return of stocks, size, and book-to-market, and momentum factors. According to Brown and Reily (2009), SML and HML are the important

factors in explain funds' performance, but when adding the forth factor, momentum, the model can explain the return of fund better by 15%.

$$Four\ Factor\ Model: (R_{it} - R_{ft}) = \beta^{i,mkt}(R_{mt} - R_{ft}) + \beta^{size}(SMB_t) + \beta^{value}(HML_t) + \beta^{mom}(WML_t) + \alpha_{i,CH} + e_{it}$$

The forth factor added is WML, which is the difference in return between a portfolio of past 1-year winner stocks and past 1-year loser stocks in month *t.* The four betas describe the proportion of the mean return attribute to four strategies. The alpha, therefore, outlines the portfolio manager's investment ability either the superiority or inferiority. Managers with superior investment ability will add value to the fund's performance; thereby, the alpha will have a significant positive value whereas inferior managers will face a significant negative alpha as they fail to add value to the return for their investors.

The investor would expect a high positive alpha from investing in the actively managed fund because if alpha is not significantly differed from zero, or it turns out to be negative, it is better not to invest in this expensive mutual fund, assuming the 4 risk measures are the only factors necessary in explaining return on mutual fund.

Additionally, if the alphas turnout to be positive but the alpha from the Carhart's four factors model ($\alpha_{i,CH}$) has a very low algebraic value, compare to the alpha from Fama and French three-factor model ($\alpha_{i,FF}$) , this could indicate that investing in mutual fund is not adding value to the return from the index fund; instead, this high return is the result of the exposure to market, size and value factor, which we can get very cheaply from the index funds or other providers.

The three factors, including SMB, HML and WML, are taken from the Bloomberg terminal. The SMB factor is calculated by ranking all stocks in the SET index from largest to smallest market capitalization. The stocks above the 70th percentile are the component of the big portfolio and the stocks below the 30th percentile make a small portfolio. Their market capitalization weighted return difference between the small and big portfolio gives the SMB factor. Likewise, the HML factor is calculated by sorting all stocks in the SET index according to book-to-market value. The stocks above the 70th percentile make a portfolio of high book-to-market value and those stocks below the 30th percentile make a portfolio of low book-to-market value. The market capitalization weighted return difference between the two portfolios provides the HML factor. For WML factor, all funds are ranked according to their past 12-month return. The top 30 percent comprises the portfolio of winner stocks, and the bottom 30 is in the portfolio of loser stocks. Again, the market capitalization weighted return difference winner and loser portfolios give the WML factor. All returns are the total return index that taken corporate activities such as dividend payments, stock splits, and mergers into account. The portfolios of small stocks, big stocks, high book-to-market, low book-to-market, winner stocks, and loser stocks are rebalanced at the end of every year. The time regression analysis is used to compute those betas and alphas of the models and compare the result to evaluate the performance of the fund managers of the top three asset management companies in

Thailand that whether or not, after collecting fees from the investors, fund managers still manage to produce positive alphas to their investors, and this usually indicates the portfolio manager's investment ability either the superiority or inferiority. The table below summarizes the variable needed to run the models:

Variable Type	Variable	Measurement
Dependent Variable	Ri-Rf	Number/ Percentage
Independent Variable	Rm-Rf	Number/ Percentage
Independent Variable	SMB	Number/ Percentage
Independent Variable	HML	Number/ Percentage
Independent Variable	WML	Number/ Percentage

Moreover, the first set of models consider mutual fund returns net of costs, meaning that management fees were already deducted from the fund's total return index; consequently, this may not be enough to judge the investment ability of the fund managers. Thus, the same Fama and French's three factors, and Carhart's four factors analysis are re-run against the monthly excess return of the selected equity mutual funds plus the management fees. Thus, by comparing the two sets of alphas, I can indicate whether or not the negative alpha, a non-significant alpha, or a low significant positive alpha is the result of a too high management fee. According to Morningstar (2015), Thai equity funds are fairly expensive among peers, and, similarly, as Mateepithaktham, and Thisadoldilok (2016) said in the SEC working paper forum that a fair fee rate could take more than one-third of long-term return; hence, evaluating mutual funds' performance by using the return that has already deduced the management fee might misjudge the managers' investment skill. Therefore, by doing the models again considering management fee, this can judge the abilities of mutual fund managers excluding the effect of high management fees that could eat up all the excess return created.

HYPOTHESIS

From the FF's three-factor model, which control for the market, size, and value exposure, $Three\ Factor\ Model\text{:}\ (R_{it} - R_{ft}) = \beta^{i,mkt}(R_{mt} - R_{ft}) + \beta^{size}(SMB_t) + \beta^{value}(HML_t) + \alpha_{i,FF} + e_{it}$, I expect more than half of the equity mutual funds of the top three asset management corporations to exhibit a significant positive alpha ($\alpha_{i,FF}$). This reflects the well-management ability of the company, controlling for size and value exposure. In other words, I expect that the high return of the fund is the result of the superior performance of the fund manager that can cover all the expense ratio they charged, instead of the exposure to size and value factor, which we can get very cheaply from the index funds or other providers. Therefore, I proposed,

H1:More than half of the company's domestic equity mutual fund exhibited $\alpha_{i,FF} > 0$, this could be statistically tested by setting

$H0$: The equity mutual fund has no excess return, or $\alpha_{i,FF} = 0$

Ha: The fund has return left unexplained by the model, or $\alpha_{i,FF} \neq 0$

Moreover, the Carhart's four factor model that adds momentum variable to the FF's model, $(R_{it} - R_{ft}) = \beta^{i,mkt}(R_{mt} - R_{ft}) + \beta^{size}(SMB_t) + \beta^{value}(HML_t) + \beta^{mom}(WML_t) + \alpha_{i,CH} + e_{it}$. This model is considered as a standard model in evaluating the mutual fund performance in many finance literature. Thus, I expect more than half of equity mutual funds of the top three asset management corporations to exhibit a significant positive alpha ($\alpha_{i,CH}$). This reflects the superiority of the investment ability of the portfolio manager that can add value to the funds' performance, controlling for size, value, and momentum exposure. Therefore, I proposed,

H2: More than half of the company's domestic equity mutual fund exhibited $\alpha_{i,CH} > 0$, this could be statistically tested by setting

$H0$: The equity mutual fund has no excess return, or $\alpha_{i,CH} = 0$

Ha: The fund has return left unexplained by the model, or $\alpha_{i,CH} \neq 0$

In addition, the same Fama and French's three factors, and Carhart's four factors analysis are re-run against the monthly excess return of the selected equity mutual funds *plus* the management fees. Thus, by comparing the two sets of alphas, I can indicate whether or not the negative alpha, a non-significant alpha, or a low significant positive alpha is the result of a too high management fee. The results of these models will notify the investment ability of the fund managers in stock selection. Consequently proposed,

> H3: More funds will generate a significant positive alpha compare to the models that management fees were already deducted from the monthly return.

ANALYZES AND DISCUSSIONS

KASSET

KAsset, the biggest asset management company in Thailand, with its NAV accounted for up to 19.73% of the total NAV of Thai mutual fund market. Its investment philosophy relies on the belief that primacy of risk management will bring about a superior performance, the stock market is inefficient and enable the managers to *create alpha*, and a combination of top-down and bottom-up approaches together with team specialization.

Table 1: Three-factor model regression result of KAsset's equity funds

Variable	KSET50	KEQUITY	KVALUE	KSTAREQ
RmRf	1.0490455***	.91022127***	.88642357***	.89946881***
SMB	-.21562512***	-.08251815	-.17081068**	-.0595082
HML	-.00920761	-.10947503	-.1130283	-.10116858
_cons	-.00177217	.00168485	.00016512	.00362251**
N	36	36	36	36
r2_a	.96269311	.88948988	.85264003	.87522026

legend: * p<.1; ** p<.05; *** p<.001

Variable	KMIDSMALL	RKF2	KSTADE	KSELECT
RmRf	.87703101***	.82928337***	.8092034***	.8631339***
SMB	.29131038	.02222797	-.06143674	-.09550186
HML	-.02016151	-.0560037	.04972158	.01379673
_cons	.01062493**	.003668	-.00006152	.00080997
N	36	36	36	36
r2_a	.51768109	.79359667	.77019457	.80325345

legend: * p<.1; ** p<.05; *** p<.001

Variable	KSTEQ	RKF4	RKFHI2
RmRf	.91672705***	.85345637***	.85563311***
SMB	-.02168049	-.07600319	-.08625312
HML	-.10961601	-.15490593	-.11391321
_cons	.00259276	.00249702	.00309072
N	36	36	36
r2_a	.74742776	.78629101	.77646532

legend: * p<.1; ** p<.05; *** p<.001

Table 2: Four-factor model regression result of KAsset's equity funds

Variable	KSET50	KEQUITY	KVALUE	KSTAREQ
RmRf	1.0379224***	.92345164***	.86598525***	.91543878***
SMB	-.18847285***	-.11481443	-.12091929	-.09849203
HML	-.016684	-.10058223	-.12676592	-.09043436
WML	-.05172527	.06152466	-.09504346*	.07426448
_cons	-.00161068	.00149276	.00046187	.00339064*
N	36	36	36	36
r2_a	.96466131	.89156704	.86130654	.87950661

legend: * p<.1; ** p<.05; *** p<.001

Variable	KMIDSMALL	RKF2	KSTADE	KSELECT
RmRf	.92523992***	.85701339***	.84916926***	.89477395***
SMB	.17362901	-.04546299	-.15899626*	-.17273747*
HML	.01224212	-.03736495	.07658465	.0350636
WML	.22418387*	.12895178**	.18585159**	.14713439**
_cons	.00992498**	.00326538	-.00064179	.00035058
N	36	36	36	36
r2_a	.54626965	.81377071	.81908933	.82939174

legend: * p<.1; ** p<.05; *** p<.001

Variable	KSTEQ	RKF4	RKFHI2
RmRf	.95288549***	.86940227***	.85823146***
SMB	-.10994583	-.11492826	-.09259588
HML	-.0853121	-.14418789	-.11216673
WML	.1681461**	.07415253	.01208301
_cons	.00206777	.00226549	.003053
N	36	36	36
r2_a	.77489958	.78769386	.76947209

legend: * p<.1; ** p<.05; *** p<.001

According to table 1 and 2 that illustrate the regression results of KAsset's equity funds, 4-factor model has higher adjusted r-square; thus, this means that Carhart four-factor explains fund behavior in a better way. The high adjusted R2 of all KAsset's equity mutual funds, apart from KMIDSMALL which has adjusted r-square for 3 and 4 factor model of 51.76% and 54.63%, respectively, suggests that the model does a good job in explaining mutual fund performance.

Regression results of the French and Fama's three-factor model are presented in table 1. The average market beta of the KAsset's domestic equity funds was 0.886. This indicates that, overall, the KAsset's equity mutual funds from 2015 to 2017 were less risky than the market. However, Out of the 11 funds, KSET50, which is a passive fund, had a greater-than-one alpha, meaning that the fund's return was more volatile than the market. For the size factor, KSET50 and KVALUE were the only 2 funds that have significant SMB factor, which both indicate that the funds prefer large-cap stock as the SMB factors are negative. The HML factors were all insignificant in explaining the funds' return.

The results of the 3-factor model are illustrated that KSTAREQ and KMIDSMALL are the only 2 equity funds that could reject the null hypothesizes, which states that the equity mutual fund has no excess return, at 95% confidence level, whereas the rest 9 failed to reject the null hypothesis, which can be concluded that there is no excess return left after controlling for market, size, and value risk. The monthly alpha during the 3-year period from 2015 to 2017, corresponding to the 3-factor model, of KSTAREQ and KMIDSMALL was 0.362% and 1.062%, respectively.

Regression results of the Carhart' four-factor model, which can explain fund behaviour in a better way as it exhibits the higher adjusted R2 for all funds, are presented in table 2. The average market beta of the KAsset's domestic equity funds was 0.905. This indicates that, overall, the KAsset's equity mutual funds were less risky than the market. Similar to the three-factor model, the market beta of KSET50 was greater than 1. Three funds, namely KSET50, KSTADE, and KSELECT, had a significant negative SMB factor. This reflects the preference of large-cap stocks over small-cap stocks of the KAsset's fund managers. Moreover, similar to the results from the three-factor model, HML factor is not a significant factor in explaining the return of KAsset's domestic funds. However, WML factor seems to be the important factor of explaing the return of the equity mutual funds as 6 of the 11 funds, namely KVALUE, KMIDSMALL, RKF2, KSTADE, KSELECT, and KSTEQ, show the significant value of the momentum factor. All, except for KVALUE, had positive price momentum.

In the same way, the 4-factor model, which can explain fund behavior in a better way, also notifies that, overall, the fund manager did not create any excess return to the equity mutual fund. The 2 funds still managed to produce a positive alpha during 2015-2017; however, the p-value of the 2 alphas drop from the 3-factor model. The KMIDSMALL's alpha was still significant at 5% level, but, the alpha of KSTAREQ was significant at 10%, comparing to 5% from the previous model. The alpha of KSTAREQ exhibited a value of 0.339% monthly, and the alpha of KMIDSMALL had a value of 0.992% per month during the 3-year period from

2015 to 2017. The alpha of both funds drops after adding factor WML to the model. WML factor was a significant factor in explaining the return of KMIDSMALL; nevertheless, WML is not a significant factor that explains the return of KSTAREQ, but the market factor has increased the intensity after adding the fourth value; thus, with higher r-square value of the 4-factor model, this could indicate that the result of the bigger positive alpha than that three-factor model of KSTAREQ was due to the market exposure that is explained in the 4-factor model; consequently, the alpha from the 4-factor model dropped.

To conclude, from the evidence, the majority of the KAsset's domestic equity funds underperformed relevant indices since only KSTAREQ and KMIDSMALL were the only 2 funds that could generate alpha. Even in a less developed market like Thailand, fund managers of KAsset still failed to add sufficient value to make up for the expense they charged. These results are in line with the previous study of mutual fund performance in Poland by Białkowski and Otten (2010), which is also an emerging market.

Table 3: Three-factor model regression result of KAsset's equity funds with management fees

Variable	KSET50	KEQUITY	KVALUE	KSTAREQ
RmRf	1.0490394***	.91022127***	.88642357***	.89946881***
SMB	-.21562866***	-.08251815	-.17081068**	-.0595082
HML	-.00922817	-.10947503	-.1130283	-.10116858
_cons	-.0013261	.00335677*	.00183704	.00529443**
N	36	36	36	36
r2_a	.96268528	.88948988	.85264003	.87522026

legend: * p<.1; ** p<.05; *** p<.001

Variable	KMIDSMALL	RKF2	KSTADE	KSELECT
RmRf	.87728195***	.82928337***	.80849012***	.8631339***
SMB	.29107706	.02222797	-.06077352	-.09550186
HML	-.02015634	-.0560037	.04970686	.01379673
_cons	.01228704**	.00533991**	.00164705	.00248188
N	36	36	36	36
r2_a	.51781136	.79359667	.76955882	.80325345

legend: * p<.1; ** p<.05; *** p<.001

Variable	KSTEQ	RKF4	RKFHI2
RmRf	.91672705***	.85345637***	.85563311***
SMB	-.02168049	-.07600319	-.08625312
HML	-.10961601	-.15490593	-.11391321
_cons	.00426468	.00416893*	.00476264*
N	36	36	36
r2_a	.74742776	.78629101	.77646532

legend: * p<.1; ** p<.05; *** p<.001

Table 4: Four-factor model regression result of KAsset's equity funds with management fees

Variable	KSET50	KEQUITY	KVALUE	KSTAREQ
RmRf	1.0379203***	.92345164***	.86598525***	.91543878***
SMB	-.18848603***	-.11481443	-.12091929	-.09849203
HML	-.01670191	-.10058223	-.12676592	-.09043436
WML	-.05170691	.06152466	-.09504346*	.07426448
_cons	-.00116466	.00316467*	.00213379	.00506256**
N	36	36	36	36
r2_a	.96465099	.89156704	.86130654	.87950661

Variable	KMIDSMALL	RKF2	KSTADE	KSELECT
RmRf	.92549055***	.85701339***	.84845683***	.89477395***
SMB	.17339642	-.04546299	-.15833511*	-.17273747*
HML	.0122471	-.03736495	.07657051	.0350636
WML	.22418248*	.12895178**	.18585555**	.14713439**
_cons	.01158709**	.0049373**	.00106677	.0020225
N	36	36	36	36
r2_a	.54639686	.81377071	.81849096	.82939174

legend: * p<.1; ** p<.05; *** p<.001

Variable	KSTEQ	RKF4	RKFHI2
RmRf	.95288549***	.86940227***	.85823146***
SMB	-.10994583	-.11492826	-.09259588
HML	-.0853121	-.14418789	-.11216673
WML	.1681461**	.07415253	.01208301
_cons	.00373969	.00393741	.00472491*
N	36	36	36
r2_a	.77489958	.78769386	.76947209

legend: * p<.1; ** p<.05; *** p<.001

However, after adding the management fee back to the return of every KAsset's equity mutual funds, the overall performance has improved.

According to the regression result of French and Fama's three-factor model in table 3 after adding the management fee back to the monthly return of each fund, 4 more funds were able to create a positive alpha, compare to the previous models that only KMIDSMALL and KSTAREQ exhibited a significant positive alpha. KMIDSMALL, which is a 5-star rated fund, had the highest value of monthly alpha of 1.229% at a 95 percent confidence level. Follow by KSTAREQ, RKF2, RKFHI2, , RKF4, and KEQUITY with 0.529%, 0.534%,0.476%, 0.417% and 0.336%, respectively, and at 95% confidence level for the first two and 90% confidence level for the rest.

Similarly, the 4-factor model shown in table 4, which is considered as a better model in explaining the risk factors associated with mutual fund returns due to a higher r-square value of all funds, also indicates result in the same way as the 3-factor model. The only difference is that RKF4 was not able to create any excess return to the investor after adding back the management fee. Likewise, KMIDSMALL had the highest alpha value of 1.1587% at 5% significance level, follow by KSTAREQ, RKF2, RKFHI2, and KEQUITY, with 0.5063%, 0.494%, 0.472%,0.3165% significant positive alpha at 5% level for KSTAREQ and RKF2, and at 10% level for the rest two.

As a result, by looking at the Carhart's model, which can explain the risk factors associated with the funds return better than the three-factor model because of the higher adjusted r-square value of all funds, the result shows 3 more funds in addition to KMIDSMALL and KSTAREQ, namely RKF2, RKFHI2, and KEQUITY were able to create an excess return to the investors, all of which is an actively managed fund, after the management fees were subtracted. Consequently, this can reflect that the fund managers still had some investment ability in selecting securities that could generate a superior return to the investors although I expected more funds to generate significant positive alpha as KAsset's has the highest average star rated from Morningstar, but, unfortunately, they charged too high fee, which prevents them from producing a superior return during the 3 year-period between 2015 to 2017.

SCBAM

SCBAM fund management process focused on both top-down and bottom-up approach. The top-down process uses Strategic and Tactical Asset Allocation whereas the bottom-up approach involves the analysis process from their management and financial analyst team, where the team approach is the main thing driving this process. The company has an investment committee and risk management committee who are central in making an investment decision. Their decision is based on the idea of a disciplined and prudent investment. Unlike BBLAM, SCBAM relies on both passive and active management strategy in managing equity funds.

Table 5: Three-factor model regression result of SCBAM's equity funds

Variable	SCBSET	SCBDV	SCBSET50	SCBSE
RmRf	.988305***	.89828614***	1.0569396***	.90560132***
SMB	-.03839088**	-.18692595***	-.18731837***	.04860836
HML	.00751517	-.01632895	-.01458334	.08481738
_cons	-.00103687**	.00160302	-.00141653	.00370555
N	36	36	36	36
r2_a	.99480131	.95255183	.96369695	.70786956

legend: * p<.1; ** p<.05; *** p<.001

Variable	SCBBANKING	SCBENERGY	SCBDA	SCBPMO
RmRf	1.0173368***	1.3267023***	.93923208***	.95022012***
SMB	-.25323906	-.28588235*	-.06497595	-.09390379
HML	-.02193955	.55266655**	.04314197	.05251852
_cons	-.0061751	-.00440364	.00075202	.00044678
N	36	36	36	36
r2_a	.51233805	.76708922	.83184508	.80803705

legend: * p<.1; ** p<.05; *** p<.001

Table 6: Four-factor model regression result of SCBAM's equity funds

Variable	SCBSET	SCBDV	SCBSET50	SCBSE
RmRf	.99246487***	.90102261***	1.0492059***	.95456864***
SMB	-.04854544**	-.19360586***	-.16843968***	-.07092435
HML	.01031124	-.01448963	-.01978159	.11773078
WML	.01934451*	.01272527	-.03596403	.22771068**
_cons	-.00109727**	.00156329	-.00130424	.00299459
N	36	36	36	36
r2_a	.9951534	.9512805	.9640461	.75924551

legend: * p<.1; ** p<.05; *** p<.001

Variable	SCBBANKING	SCBENERGY	SCBDA	SCBPMO
RmRf	1.0054079***	1.3188865***	.95502918***	.9796373***
SMB	-.2241197	-.2668033	-.10353781	-.16571321*
HML	-.02995759	.54741313**	.05376	.07229128
WML	-.05547259	-.03634573	.07346062	.13679746*
_cons	-.00600191	-.00429016	.00052266	.00001967
N	36	36	36	36
r2_a	.49880979	.76026638	.83343863	.82498182

legend: * p<.1; ** p<.05; *** p<.001

As can be seen from the results of the 2 models from table 5 and 6, unlike the KAsset's result, the 4-factor model did not serve as a better model than the three-factor model in explaining the return of mutual funds for every fund. SCBSET, SCBSET50, SCBSE, SCBEBERGY, and SCBPMO are the SCBAM's equity mutual funds that favour the Carhart's four-factor model since their r-square value are higher than that of the three-factor model. However, the three-factor model works better in explaining the fund performance for SCBDV and SCB banking. All funds except SCBBANKING, which exhibits adjusted r-square value of 51.23% and 49.88% from the three-factor and four-factor model, respectively, had a relatively high value of adjusted r-square value; thus, this can refer that the model did a good job in explaining the SCBAM's domestic equity mutual funds behavior.

According to the regression result of the three-factor model in table 5, the average market beta of the SCBAM's domestic equity funds was 1.00995. This indicates that, overall, the SCBAM's equity mutual funds were theoretically more volatile than the market. SCBSET50, SCBBANKING, and SCBENERGY, which are all a passive fund, presented a greater-than-one alpha, However, all the actively managed funds were less volatile than the market. For size factor, SCBDV, SCBSET50, SCBSET, and SCBENERGY were the funds that had a significant SMB factor at 99 percent confidence level for the first two, 95 percent, and 90 percent confidence level for the last two. All the SMB betas were negative; thus, this displays a preference of large stocks for the 4 funds. The HML factors were all not significantly differed from zero, except for SCBENERGY that exhibited a positive significant value of 0.553 at 5% significance level, which indicates that the fund tilted towards value stock.

The results of the 3-factor model are presented that all funds did not deliver any superior return to the investor, and SCBSET also created a negative significant alpha of -0.104% at 5 percent significance level. All funds except SCBSET failed to reject the null hypothesis, which can be concluded that there is no excess return left after controlling for market, size, and value risk.

Regression results of the Carhart' four-factor model are presented in table 6 The average market beta of the SCBAM's domestic equity funds from 2015 to 2017 was 1.0195. This refers that, on average, the SCMAB's equity mutual funds are riskier than the market. In the same way as the three-factor model, the market beta of SCBSET50, SCBBANKING, and SCBENERGY is greater than 1. Four funds, including SCBSET, SCBDV, SCBSET50, and SCBENERGY exhibit a significant negative SMB factor. This reflects the preference of large-cap stocks over small-cap stocks of the SCBAM's fund managers. Moreover, similar to the results from the three-factor model, HML factor was only significant for SCBENERGY with a value of 0.5474 at 95% confidence level. Furthermore, the WML factor was also a significant factor for three funds, namely SCBSET, SCBSE, and SCBPMO, all of which had positive price momentum.

In the same way as the three-factor model, the 4-factor model also displays that the fund manager of SCBAM did not create any excess return to all of the equity mutual fund during the three-year period before December 2017. SCBSET, which is a passive fund, created a significant negative alpha of -0.1097% at 95% confidence level whereas the rest failed to reject the null hypothesis and can be concluded that the funds did not generate any excess return to the investors. Thus, the management ability of SCBAM's fund managers in stock selection should be doubted, according to this two model.

To conclude, from the evidence, all of the SCBAM's domestic equity funds underperformed relevant indices. The performance of SCBAM's funds during this period was even worse than that of KAsset's, although only 2 of the 11 KAsset's equity funds could manage to generate positive alpha. The regression results of the SCBAM's funds' performance are also in line with the previous study of mutual fund performance in Poland by Białkowski and Otten (2010) that even in a less developed market, fund managers still failed to add sufficient value to make up for the expense they charged.

Table 7: Three-factor model regression result of SCBAM's equity funds with management fee

Variable	SCBSET_MF	SCBDV_MF	SCBSET50_MF	SCBSE_MF
RmRf	.98811579***	.89822341***	1.0569396***	.90560132***
SMB	-.03816902**	-.18686762***	-.18731837***	.04860836
HML	.00761346	-.01633025	-.01458334	.08481738
_cons	-.00022261	.00270624**	-.00109153	.00551388*
N	36	36	36	36
r2_a	.99481971	.95254382	.96369695	.70786956

legend: * p<.1; ** p<.05; *** p<.001

Variable	SCBBANKING_MF	SCBENERGY_MF	SCBDA_MF	SCBPMO_MF
RmRf	1.0173368***	1.3267023***	.93916935***	.95025756***
SMB	-.25323906	-.28588235*	-.06491762	-.09392942
HML	-.02193955	.55266655**	.04314068	.05253973
_cons	-.0052251	-.00345364	.00222191	.00201577
N	36	36	36	36
r2_a	.51233805	.76708922	.83183026	.80804968

legend: * p<.1; ** p<.05; *** p<.001

Table 8: Four-factor model regression result of SCBAM's equity funds with management fee

Variable	SCBSET_MF	SCBDV_MF	SCBSET50_MF	SCBSE_MF
RmRf	.99225619***	.90095995***	1.0492059***	.95456864***
SMB	-.04827604**	-.19354771***	-.16843968***	-.07092435
HML	.01039644	-.01449088	-.01978159	.11773078
WML	.01925394*	.01272562	-.03596403	.22771068**
_cons	-.00028272	.00266651**	-.00097924	.00480292*
N	36	36	36	36
r2_a	.99516772	.95127228	.9640461	.75924551

Variable	SCBBANKING_MF	SCBENERGY_MF	SCBDA_MF	SCBPMO_MF
RmRf	1.0054079***	1.3188865***	.95496653***	.97967075***
SMB	-.2241197	-.2668033	-.10347966	-.16572911*
HML	-.02995759	.54741313**	.05375876	.07230981
WML	-.05547259	-.03634573	.07346097	.13677893*
_cons	-.00505191	-.00334016	.00199255	.00158871
N	36	36	36	36
r2_a	.49880979	.76026638	.83342421	.82498699

legend: * p<.1; ** p<.05; *** p<.001

After adding the management fee back to the return of every SCBAM's domestic equity mutual funds, the overall performance has improved.

According to the regression result of French and Fama's three-factor model in table 7 after including the management fee in the monthly return of each funds, still, 2 actively managed funds, namely SCBDV and SCBSE which are 4 and 5 star fund, correspondingly, could manage to create a positive monthly alpha of 0.271% and 0.551% at 5% and 10% significance level, respectively. Moreover, SCBSET, which delivered a negative alpha to the investors from the previous model, after adding the management fee back to the return, SCBSET's alpha was now insignificantly different from zero.

Likewise, the 4-factor model also indicates a result in the same way as the 3-factor model. As shown in table 8, SCBDV and SCBSE could generate a significant positive alpha value of 0.267% and 0.480% at 5% and 10% significance level, respectively.

As a result, by looking at the regression result after adding management fee back to the return of the SCBAM's domestic equity mutual funds return, 2 funds were able to create an excess return to the investors, all of which is an actively managed fund. Therefore, this can reflect that, for this 2 funds, the company charged a too high fee to deliver a superior return.

However, the overall performance of the SCBAM's domestic equity mutual funds during the three year period between 2015 to 2017 was still not good. According to the three- and four-factor model, all funds were not able to generate any excess return to the investor, if management fees were included, and even though the fees were included, only 2 funds can produce a significant positive monthly alpha to the investors. Thus, the fund manager's ability to pick stocks should be doubted that whether or not they had an investment skill. Nevertheless, there are many ways to judge the investment ability of the fund managers, this is just the only way.

BBLAM

According to the corporate profile, BBLAM's success was based on the belief that an active management will produce the best long-term returns to the investors. They believe that they have a distinctive stock selection process that could generate alpha. This belief of active management strategy is central to BBLAM's investment philosophy. The company also believes that their experienced and skillful fund managers, together with a well-disciplined investment process will consistently add value to the return of the portfolios.

Table 9: Three-factor model regression result of BBLAM's equity funds

Variable	BTP	BKA	BSIRICG	BKD
RmRf	.67252051***	.75489375***	.77356549***	.76433578***
SMB	.18969969	.00547182	-.11881999	.00709965
HML	-.32620079**	-.07776818	.14730646	-.08369187
_cons	.01042782**	.00211688	-.00377979	.0022089
N	36	36	36	36
r2_a	.45137296	.80434116	.72215845	.80822558

legend: * p<.1; ** p<.05; *** p<.001

Variable	BINFRA	BBASIC	BCAP	BKA2
RmRf	1.0323943***	.7965741***	.76088447***	.76953667***
SMB	.15989936	.01429555	.0183312	.01474739
HML	-.16756841	.05391307	-.08199041	-.07825746
_cons	.0004317	.00210837	.00276867	.00206037
N	36	36	36	36
r2_a	.8028298	.69744307	.81133796	.80430186

legend: * p<.1; ** p<.05; *** p<.001

Variable	BTK	BKIND
RmRf	.95502823***	.67498818***
SMB	-.1287272	-.14417267*
HML	-.09030003	.05759294
_cons	-.006336*	-.00263745
N	36	36
r2_a	.66680106	.77796423

Table 10: Four-factor model regression result of BBLAM’s equity funds

Variable	BTP	BKA	BSIRICG	BKD
RmRf	.71709378***	.7667793***	.72007296***	.77734819***
SMB	.08089317	-.02354167	.0117591	-.02466457
HML	-.29624085*	-.0697793	.11135143	-.07494557
WML	.20727721*	.0552709	-.24875411***	.06051108
_cons	.00978066**	.00194431	-.00300313	.00201997
N	36	36	36	36
r2_a	.49178229	.80407786	.8136583	.80914159

legend: * p<.1; ** p<.05; *** p<.001

Variable	BINFRA	BBASIC	BCAP	BKA2
RmRf	1.0288823***	.78955747***	.77401754***	.78235585***
SMB	.16847228	.03142365	-.01372755	-.01654515
HML	-.16992897	.04919684	-.07316301	-.06964104
WML	-.01633147	-.03262916	.06107215	.05961252
_cons	.00048269	.00221024	.00257799	.00187425
N	36	36	36	36
r2_a	.79674429	.68930219	.81256686	.80475138

legend: * p<.1; ** p<.05; *** p<.001

Variable	BTK	BKIND
RmRf	.91698397***	.66835083***
SMB	-.03585844	-.12797041
HML	-.1158715	.05313164
WML	-.17691566*	-.03086541
_cons	-.00578363*	-.00254108
N	36	36
r2_a	.68870188	.77302473

legend: * p<.1; ** p<.05; *** p<.001

The results of the 2 models are shown in table 9 and 10. Similar to SCBAM, the 4-factor model did not serve as a better model than the three-factor model in explaining the return of every mutual fund. BTP, BSIRICG, BKD, BCAP, BKA2, and BTK are the BBLAM’s equity mutual funds that the Carhart’s four-factor model perform better than the French and Fama’s model since their adjusted r-square value are higher than that of the three-factor model. However, the three-factor model works better in explaining the fund behavior of BKA, BINFRA, BBASIC, and BKIND. All funds except BTP, which exhibits adjusted r-square value of only 49.178% and

45.137% from the three-factor and four-factor model, respectively, had a relatively high value of adjusted r-square value; thus, this can indicate that the model did a good job in explaining the BBLAM's domestic equity mutual funds behavior.

According to table 9 that presents the regression results of the three-factor model, the average market beta of the BBLAM's domestic equity funds was 0.7955, which was the lowest among the three biggest asset management companies. This indicates that, overall, the BBLAM's equity mutual funds were theoretically less volatile than the market. BINFRA was the only fund that its return was more volatile than the market, or it was riskier than the marker as the fund exhibited a greater-than-one alpha. However, all the other actively managed funds were less volatile than the market. For the SMB factor, BKIND was the only fund that had a significant SMB factor of 0.1442 at 10% significance level, this indicates that this fund was tilted towards large-cap stocks. The HML factors were all not significantly differed from zero, except for BTP that showed a negative significant value of -0.3262 at 5% significance level, which can be indicated that the fund preferred growth stocks than value stocks.

The results of the 3-factor model present that only BTP, which is a 5-star rated fund, could generate a 5-per cent significant monthly positive alpha of 1.043% to the investors. Other funds did not deliver any superior return to the investor, although the company claims themselves to be an actively managed company. In addition, BTK also produced a negative significant alpha of -0.6336% at a 10 per cent significance level. All funds except BTP and BTK failed to reject the null hypothesis, which can be concluded that the alpha is insignificantly different from zero, and there is no excess return left after controlling for market, size, and value risk.

Regression results of the Carhart' four-factor model are presented in table 10. The average market beta of the BBLAM's domestic equity funds during the 3-year period before December 2017 was 0.7941. This means the BBLAMB's equity mutual funds are less risky than the market. Similarly, the market beta of BINFRA was greater than 1. However, the SMB factors were all insignificant. Moreover, similar to the results from the three-factor model, HML factor was only significant for BTP with a negative significant value of -0.296 at 99% confidence level. Furthermore, the WML factor was also a significant factor for three funds, including BTP, BSIRICG, and BTK. BTP and BSIRICG had a negative price momentum while BTK exhibited a positive price momentum.

In the same way as the three-factor model, the 4-factor model also shows that the fund manager of BBLAM did not create superior returns to the investors during the three-year period from 2015 to 2017 since BTP was the only fund that could deliver a positive monthly alpha of 0.9781% at 5 percent significance level to the investors, and BTK also created a significant negative alpha of -0.578% at 90% confidence level whereas the rest failed to reject the null hypothesis and can be concluded that the funds did not generate any excess return to the investors. Thus, the stock selection ability of BBLAM's fund managers should be doubted, according to this two models.

In conclusion, from the evidence, only 1 BBLAM's domestic equity funds could outperform relevant indices and generate a significance positive alpha to the buyers. Again, even in a less developed and efficient market like Thailand, fund managers of BBLAM still cannot manage to add sufficient value to cover the expense they charged. These results are in line with the previous study of mutual fund performance in Poland by Białkowski and Otten (2010).

Table 11: Three-factor model regression result of BBLAM's equity funds with management fees

Variable	BTP	BKA	BSIRICG	BKD
RmRf	.67252051***	.75489375***	.77356549***	.76433578***
SMB	.18969969	.00547182	-.11881999	.00709965
HML	-.32620079**	-.07776818	.14730646	-.08369187
_cons	.01176532**	.00345438*	-.00244229	.0035464*
N	36	36	36	36
r2_a	.45137296	.80434116	.72215845	.80822558

legend: * p<.1; ** p<.05; *** p<.001

Variable	BINFRA	BBASIC	BCAP	BKA2
RmRf	1.0323943***	.7965741***	.76088447***	.76953667***
SMB	.15989936	.01429555	.0183312	.01474739
HML	-.16756841	.05391307	-.08199041	-.07825746
_cons	.0017692	.00344587	.00366034*	.00339787*
N	36	36	36	36
r2_a	.8028298	.69744307	.81133796	.80430186

legend: * p<.1; ** p<.05; *** p<.001

Variable	BTK	BKIND
RmRf	.95502823***	.67163195***
SMB	-.1287272	-.14105198*
HML	-.09030003	.05752371
_cons	-.0049985	-.00112751
N	36	36
r2_a	.66680106	.77473926

legend: * p<.1; ** p<.05; *** p<.001

Table 12: Four-factor model regression result of BBLAM's equity funds with management fee

Variable	BTP	BKA	BSIRICG	BKD
RmRf	.71709378***	.7667793***	.72007296***	.77734819***
SMB	.08089317	-.02354167	.0117591	-.02466457
HML	-.29624085*	-.0697793	.11135143	-.07494557
WML	.20727721*	.0552709	-.24875411***	.06051108
_cons	.01111816**	.00328181	-.00166563	.00335747*
N	36	36	36	36
r2_a	.49178229	.80407786	.8136583	.80914159

legend: * p<.1; ** p<.05; *** p<.001

Variable	BINFRA_MF	BBASIC	BCAP	BKA2
RmRf	1.0288823***	.78955747***	.77401754***	.78235585***
SMB	.16847228	.03142365	-.01372755	-.01654515
HML	-.16992897	.04919684	-.07316301	-.06964104
WML	-.01633147	-.03262916	.06107215	.05961252
_cons	.00182019	.00354774	.00346966*	.00321175
N	36	36	36	36
r2_a	.79674429	.68930219	.81256686	.80475138

legend: * p<.1; ** p<.05; *** p<.001

Variable	BTK	BKIND
RmRf	.91698397***	.6649986***
SMB	-.03585844	-.1248595
HML	-.1158715	.0530651
WML	-.17691566*	-.03084679
_cons	-.00444613	-.0010312
N	36	36
r2_a	.68870188	.76970813

legend: * p<.1; ** p<.05; *** p<.001

After adding the management fee back to the return of every BBLAM's domestic equity mutual funds, the overall performance has improved.

According to the regression result of French and Fama's three-factor model in table 1, after adding the management fee back to the monthly return of each funds, 4 additional funds, namely BKA, BKD, BCAP, and BKA2 could manage to create a significant positive monthly alpha of 0.345%, 0.355%, 0.366% and 0.34% at 10 percent significance level, respectively. In addition, BTP, which is the fund that could manage to generate a positive alpha of 1.043% to the investors even though the management fee was subtracted from the monthly return, after including the management fee to the monthly return, alpha generated has increased to 1.177% at 5 per cent significance level. Moreover, BTK, which delivered a negative alpha to the investors from the previous model, after adding the management fee back to the return, BTK's alpha was now insignificantly different from zero.

Likewise, from table 12 that shows the 4-factor model also indicates result similar to the 3-factor model. More funds could manage to produce a positive alpha after management fee was added back; however, according to this mode, there are only 3 funds that created an excess return. BTP could generate the highest positive alpha of 1.111% at 95% confidence level. Follow by BCAP and BKD with a positive alpha value of 0.347%% and 0.336% at 10% significance level, correspondingly.

As a result, by looking at the regression result after adding management fee back to the return of the BBLAM's domestic equity mutual funds return, 5 funds were able to create an excess return to the investors basing on the three-factor model, and only 3 funds could manage to generate a significant positive alpha, according to the Carhart's four-factor model. However, by looking at the adjusted r-square value, 4-factor model did not serve as a better model in explaining the risk factors associated with the mutual fund returns for every fund. BKA, BKD, BKA2, which are the funds that produced a significant excess return after management fee was included, are the funds that 3-factor model could explain their behavior better, according to the r-square value. Thus, the less amount of funds that could deliver an outperformance from the 4-factor model might mislead the judgement of the fund manager's ability in picking stocks. Nevertheless, since the company all funds are actively managed, the results, although by only looking at the 3-factor model that gave more favorable results, did not appear in the way I expected. I expected this company to do much better as it claimed itself to be an actively managed funds' company; thus, I anticipated the fund managers to be able to generate high monthly alpha to every fund. Therefore, this can reflect that, not only the company charged too high fee to deliver superior return, the overall performance of the BBLAM's domestic equity mutual funds during the three year period between 2015 to 2017 was still not good as expected since though the fees were included, not so many funds could produce a significant positive monthly alpha to the investors. Thus, the fund manager's ability to pick stocks should be doubted that whether or not they had an investment skill and whether or not they are actually an active manager. Nevertheless, there are many ways to judge the investment ability of the fund managers, this is just the only way.

OVERALL RESULTS

Figure VIII Summary of number and percentage of domestic equity mutual funds of each company that could generate a significant positive alpha from 2015 to 2017

		KAsset	SCBAM	BBLAM
NAV	Fama&French's model	2	0	1
	Carhart's model	2	0	1
Add back management fee	Fama&French's model	6	2	5
	Carhart's model	5	2	3
Total number of domestic equity fund		11	8	10

		KAsset	SCBAM	BBLAM
NAV	Fama&French's model	18.18%	0.00%	10.00%
	Carhart's model	18.18%	0.00%	10.00%
Add back management fee	Fama&French's model	54.55%	25.00%	50.00%
	Carhart's model	45.45%	25.00%	30.00%

Figure 8 demonstrates the summary of regression results. Overall, KAsset delivered the most superior performances to the investors from 2015 to 2017. A superior performance arises from a superior investment ability that adds value to the fund's return; thereby, the alpha will have a significant positive value. However, the results are not what I have expected as I expected all three companies to have more significant positive alphas.

Back to my research question that whether or not the fund managers of the three-biggest asset management companies in term of net asset value added value to the return of their domestic equity mutual funds during the three-year period from 2015 to 2017, the results found that the superior returns were not due to the performance of fund managers but instead due to the exposure of market risk , size, risk, value risk, and momentum.

From H1, stating that, by using Fama and French approach that assumes market, size, and value risk are the only three risk measures necessary in explaining the return of mutual funds, more than half of the company's domestic equity mutual fund exhibited $\alpha_{i,FF}$>0, this hypothesis is false as fund managers of the three asset management companies could not manage to add sufficient value to the return of mutual funds. The worst case was SCBAM, where the fund managers could not generate any alphas to any of the domestic equity funds. This results actually in line with the average star received from Morningstar rating that SCBAM received the lowest average star of 2.875. Nevertheless, even though BBLAM got the highest rating from Morningstar of 3.6, based on this approach, KAsset delivered a better performance than BBLAM from 2015 to 2017. Consequently, although the results were not that impressive as only 2 funds exhibited a significant positive alpha, KAsset's fund managers could use their management ability to generate the most superior performance among the three companies. it is not true for all funds.

Moreover, according to H2, saying that by using Carhart's 4-factor approach that controls for market, size, value and momentum exposure more than half of the company's domestic equity mutual fund exhibited $\alpha_{i,CH}$>0, it is definitely a false since no company could manage to produce a significant positive alpha to more than half of the total company's equity mutual funds. Similar to the three-factor model, KAsset could deliver the best performance among the three companies during the three-year period before December 2017 although the company could not manage to gain a positive alpha to more than half of its funds. Thus, based on this approach, it can be concluded that the result of management was not that impressive to add sufficient value to the mutual funds' performance, this means the high return of the equity mutual funds was the result of the exposure to market, size, value and momentum factor, which we can get very cheaply from the index funds or other providers.

Figure IX Stocks performance by sectors from 2015 to 2017

There was a similar characteristic among the three funds that could manage to produce a significant positive alpha. During the three-year period from 2015 to 2017, by looking at the performance of stocks listed in SET index by sector, industrial sector performed the best, followed by service, resource, agricultural and food, property and construction, financial, consumer product, and technology sector. Consumer product and technology industry were the only 2 sectors that produced an overall negative return during this thee-year period. The three fund, namely KMIDSMALL, KSTAREQ, and BTP, did not include the two unperformed sectors as their top 5 holdings sector, unlike other funds of KAsset and BBLAM that information and communication technology stocks (ICT) which is in the technology sector were among the top 5 stock-category holdings; for example, BTK, which is the equity mutual fund from BBLAM that produced a significant alpha during the three-year period, held up to 37% of their stock portfolio in ICT stocks. This could indicate that the fund manager of these three funds selected the right stocks and policy; thus, they could manage to produce a significant positive alpha. However, for SCBAM, most of their domestic equity mutual did not have a large portion of their stocks in the consumer product and technology sector but still failed to generate an alpha. Therefore, this could roughly interpret that SCBAM's fund manager could select the right stocks but might choose the wrong time when trading; thus, the return become somewhat not that impressive.

However, H3 was true for all companies. H3 states that more funds will generate a positive significant alpha compare to the models that management fees were already deducted from the monthly return. According to figure 8, more funds could manage to deliver a significant positive alpha after manage fees were added back to the monthly returns. From the three-factor model, significant positive alphas were additionally appeared to 4 funds for KAsset, 2 funds for SCBAM and another 4 for BBLAM. In the same way, by looking at the results of the Carhart's model, after the fees were included, three additional funds could manage to produce alpha for KAsset, two for SCBAM and also two for BBLAM. Consequently, this could indicate that the fund managers of the three companies still had some investment skills in stock selection but charged a too high fee to some funds that had a potential to generate a significant positive alpha; as a result, the return generated could not cover the fees that were being charged.

The summary of all funds that could manage to produce a significant positive alpha from 2015 to 2017 is shown in figure9. By calculating the monthly return of each mutual fund from their net asset value, only 3 funds, including KMIDSMALL, BTP and KSTAREQ, which are all highly rated funds of 5 and 4 stars, from 29 funds could outperform the benchmark whereas the rest 26 delivered either zero or negative alphas. Therefore, this provides the evidence to prove that despite the less developed and efficient market like Thailand, fund managers, overall, still could not manage to add sufficient value to the mutual fund performance or create alpha, to the investors. The low number of alpha, generally, indicates the inferiority of the management of the funds. Nonetheless, the more in-depth of evaluation of the fund managers' investment capabilities was done by adding back management fee. The fund manager could add value to the mutual fund performance of 13 funds and 10 funds from 29 funds by using the 3-factor and 4-factor approach, respectively, to judge the managers' skills. However, the results turned out to be not very impressive because Thailand is still an emerging market, meaning that the market is still not efficient compared to more developed ones, and the fund managers still could not successfully select the right securities and timing, and thereby beat the market.

Figure X Summary of all funds that could manage to produce a significant positive alpha during 2015 to 2017

3-FACTOR MODEL (NAV)		
FUND NAME	**ALPHA**	**STAR**
KMIDSMALL	1.0625%	5
BTP	1.0428%	5
KSTAREQ	0.3623%	4

4-FACTOR MODEL (NAV)		
FUND NAME	**ALPHA**	**STAR**
KMIDSMALL	0.9925%	5
BTP	0.9781%	5
KSTAREQ	0.3391%	4

3-FACTOR MODEL (+MF)		
FUND NAME	**ALPHA**	**STAR**
KMIDSMALL	1.2287%	5
BTP	1.1765%	5
SCBSE	0.5514%	5
RKF2	0.5340%	4
KSTAREQ	0.5294%	4
RKFHI2	0.4763%	3
RKF4	0.4169%	3
BCAP	0.3660%	4
BKD	0.3546%	4
BKA	0.3454%	4
BKA2	0.3398%	4
KEQUITY	0.3357%	3
SCBDV	0.2706%	4

4-FACTOR MODEL (+MF)		
FUND NAME	**ALPHA**	**STAR**
KMIDSMALL	1.1587%	5
BTP	1.1118%	5
KSTAREQ	0.5063%	4
RKF2	0.4937%	4
SCBSE	0.4803%	5
RKFHI2	0.4725%	3
BCAP	0.3470%	4
BKD	0.3357%	4
KEQUITY	0.3165%	3
SCBDV	0.2667%	4

VALIDITY TEST

Table 13

	RmRf	SMB	HML	WML
RmRf	1.0000			
SMB	0.0732	1.0000		
HML	0.1067	0.3780	1.0000	
WML	-0.1617	0.3419	0.0256	1.0000

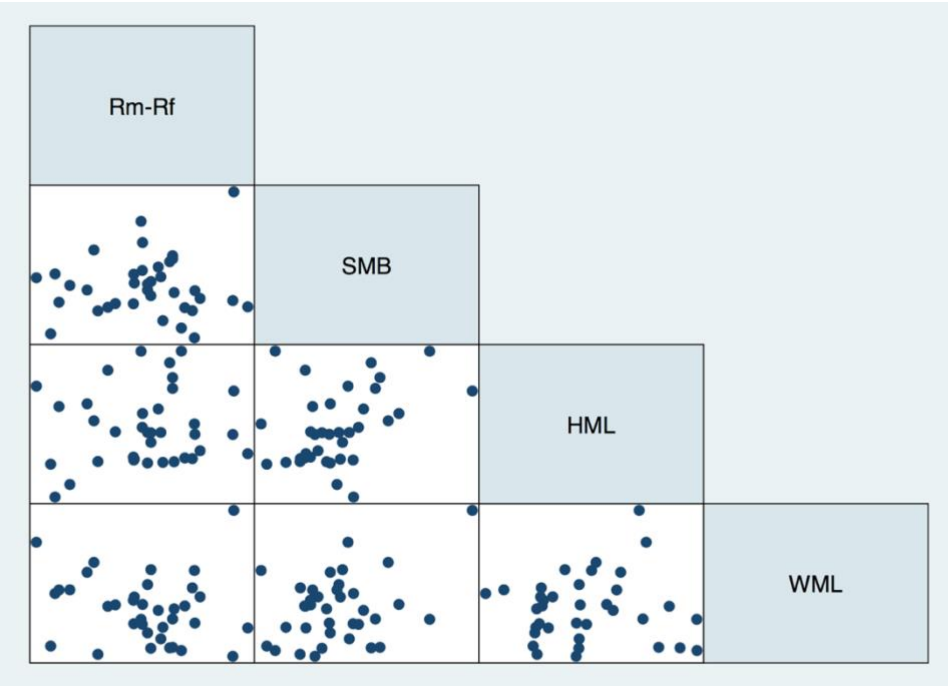


Table 14

Variable	VIF	1/VIF
SMB	1.35	0.738686
WML	1.19	0.838773
HML	1.19	0.841530
RmRf	1.05	0.951291
Mean VIF	1.20	

Both tests from table 13 and 14 are performed. According to table 13, the low correlation of less than 0.5 in absolute value between exogenous variables indicates a good sign because if one of the exogenous variables is highly correlated with another variable it can mislead the regression results. Moreover, the VIF test in table 14 shows that there is no trouble of multicollinearity in the regression models. Because of the VIF values are close to one (if VIF>10, it indicates a trouble of multicollinearity in the regression model).

Moreover, the test for heteroskedasticity and serial correlation are done by using STATA. There is no problem of heteroskedasticity and auto-correlation as all the tests could not reject the null hypothesis of no serial correlation and constant variance, or homoskedasticity.

CONCLUSION

This study investigates the impact of management on the performance of the mutual fund in Thailand from 2015 to 2017. The result also offers an opportunity to evaluate the funds' performance in an emerging market like Thailand, which is less efficient and developed and believed to provide an opportunity to a superior skilled fund manager to add sufficient value to the fund's performance. The Fama and French three-factor model and the Carhart four-factor model are used for performance analysis of domestic equity mutual funds of the three biggest asset management company in terms of total net asset value

Overall, the funds' management of the three biggest management companies in Thailand, namely, KAsset, SCBAM and BBLAM, did not add value to the mutual funds' performance during the three-year period from 2015 to 2017 since the domestic equity funds could hardly manage to produce alphas to the investors and, by basing on the Carhart's four-factor model, less than half of each company total domestic equity mutual funds could outperform the relevant indices and generate a significant positive alphas. These alphas are generally interpreted as a result from management of the funds. The results actually contradict with the finding of Chotivetthamrong (2015), Soongswang and Sanohdontree (2016), and Soongswang and Sanohdontree (2011) as the result of this studies found that fund manager could deliver a superior performance to their investors since the alphas of the domestic equity funds they analyzed exhibited a significant positive value. The reason behind this might be that, since my study period is very recent, when funds had become bigger in size, it might be harder for the managers to manage the fund as well as he could in the past; thus, this could be the reason why the previous study found many significant positive alphas. From my study, the fund that could perform the best during the three year period before 2017 was KMIDSMALL, which is the fund that has just been registered in late 2014, while the rest have been registered a long time ago.

Furthermore, the more in-depth analysis of the portfolio manager's investment ability was done by re-running the Fama and French's three-factor model and the Carhart's four-factor model with the set of returns that added management fees back. The results found that more alpha was presented. Therefore, this could indicate that the fund managers of the three largest asset management companies in Thailand still had some investment ability in stock selection but, unfortunately, charges too high management fee to some funds that could potentially generate a significant positive alpha to the mutual fund buyers; consequently, the return that generates could not cover the fees that were being charged.

In conclusion, overall, the regression results of the equity mutual funds' performance of the three biggest asset management companies in Thailand are in line with previous study of mutual fund performance in Poland by Białkowski and Otten (2010) and in Pakistan by Mahmud & Mirza (2011) that even in an emerging market, fund managers still fail to add sufficient value to the mutual funds' performance since most of the equity mutual funds of the three biggest management companies in Thailand failed to generate significant positive alphas to the investor, according to the Fama and French, and Carhart approach. Additionally, on average, based on asset pricing model approach, KAsset performed the best whereas SCBAM delivered the worst value-added return to the investors during the three-year period from 2015 to 2017.

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SEC WORKING PAPERS FORUM 2018

REGULATING BY MARKET FORCES

Performance Comparison of VaR and LVaR for Market-Risk Measurement in the Thai Financial Market

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Performance Comparison of VaR and LVaR for Market-Risk Measurement in the Thai Financial Market

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ABSTRACT

The use of the Value-at-Risk (VaR) model for market risk measurement in the Thai financial market, in which most securities are thinly trading, may be inappropriate. The resulting VaR tends to underestimate the risk level. This study compares the performance of the VaR with the Liquidity-Adjusted VaR (LVaR) in risk measurement. The LVaR raised the risk level for thin-traded securities over normal securities. The LVaR passes all the performance tests, while the VaR fails some tests. The study concludes the better performance of the LVaR over the VaR. Finally, the study applied the LVaR to check for the conservatism levels of the Thai regulators, reflected in their prescribed market-risk weights.

Keywords: Liquidity-Adjusted Value at Risk, Backtesting, Standardized Supervisory Haircut

Introduction

Market risk is defined as the risk of losses arising from movements in market prices (Bank for International Settlements or BIS, 2013). The risk can cause losses to investors. Hence, investors must manage the risk to the acceptable extent. A widely accepted approach for market risk measurement, introduced by Markowitz (1952), used the conventional statistical parameters: Standard Deviation of securities' return as a proxy. However, the Standard Deviation as a mean of communication can be difficult for investors to comprehend. J.P. Morgan/Reuters (1996) suggested an alternative approach by using Value-at-Risk (VaR). VaR represents the maximum loss or the lowest return of an investment within a certain limited investment horizon at a certain high confidence level. VaR has gained acceptance globally and played a significant role in financial industries, including Thailand's.

VaR can be computed through several approaches. One of the most popular approaches is Variance-Covariance (VCV) approach as known as Parametric VaR. The approach utilizes statistical parameters to explain the random-walk characteristic of securities returns, under the assumption that the returns are normally distributed. The popularity emerges because VCV VaR can be computed and applied straightforwardly.

Computing VCV VaR begins with setting assumptions that returns of securities are Joint Normal Distribution. Hence, the VCV VaR will rely on two parameters: expected return and standard deviation of return. The VaR can be written as equation (1.1) and for portfolio VCV VaR as equation (1.2)

$$VaR^{p} = T \cdot \mu_i + \sqrt{T} \cdot Z_{\alpha}\sigma_i \qquad (1.1)$$

$$VaR^p = T \cdot (w_1 \quad \cdots \quad w_n)\begin{pmatrix}\mu_1\\ \vdots\\ \mu_n\end{pmatrix} + \sqrt{T} \cdot Z_\propto \sqrt{(w_1 \cdots w_n)\begin{pmatrix}\sigma_1^2 & \cdots & \sigma_1\sigma_n\rho_{1n}\\ \vdots & \ddots & \vdots\\ \sigma_n\sigma_1\rho_{n1} & \cdots & \sigma_n^2\end{pmatrix}\begin{pmatrix}w_1\\ \vdots\\ w_n\end{pmatrix}} \quad (1.2)$$

Where VaR^p is the market risk of portfolio p, which the investor intends to hold for T periods within the $1-\alpha$ confidence level.

μ_i is the expected return of securities $i = 1, \dots, n$ for T holding periods.

Z_α is the coefficient variable of confidence level at $1-\alpha$

σ_i is the standard deviation of securities $i = 1, \dots, n$ for T holding periods.

ρ_{ij} is the correlation of $i = 1, \dots, n$ and $j = 1, \dots, n$,and $\rho_{i,j=i} = 1.00$

T is the holding period

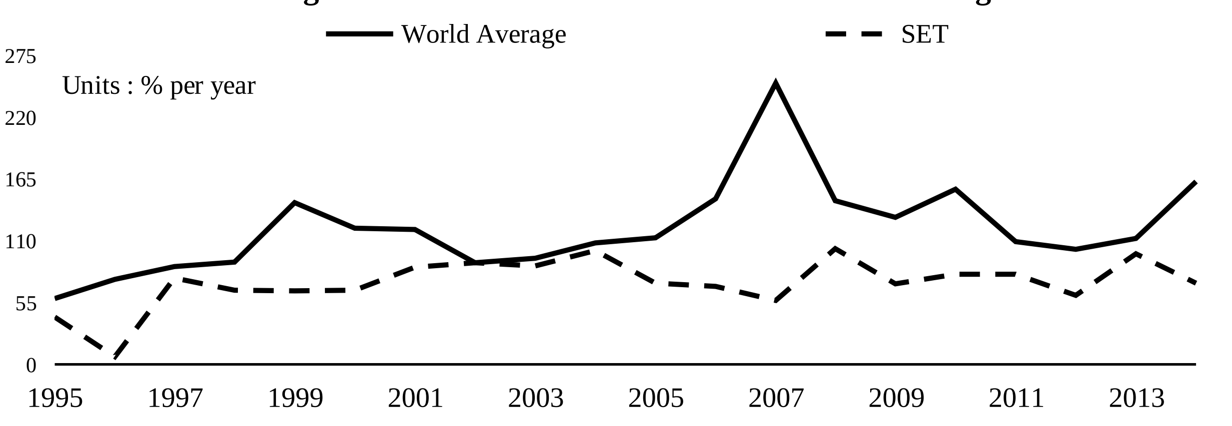
w_i is the weight of securities i invested in portfolio p

In addition, if the investment horizon is short, for example, 1 day or 1 week, the expected return is generally small and not significantly different from 0.00 (J.P. Morgan/Reuters, 1996). VaR computation, thus, can be shortened, as showed in equation (2).

$$VaR^p = \sqrt{T} \cdot Z_\propto \sqrt{(w_1 \cdots w_n)\begin{pmatrix}\sigma_1^2 & \cdots & \sigma_1\sigma_n\rho_{1n}\\ \vdots & \ddots & \vdots\\ \sigma_n\sigma_1\rho_{n1} & \cdots & \sigma_n^2\end{pmatrix}\begin{pmatrix}w_1\\ \vdots\\ w_n\end{pmatrix}} \quad (2)$$

Still, as a market risk measurement, VaR in application shows some difficulties. Because VaR was developed within the assumptions that securities are highly liquid, the liquidity levels inevitably affect the appropriateness of the parameters. In other words, the parameters do not conform to the existing liquidity levels in certain markets, for example, the Stock Exchange of Thailand (SET). As showed in figure 1, according to an observation from World Bank (2016), SET, which has been clustered in emerging markets, always has lower Stock Turnover than that of the world average.

Figure 1 : Stock Turnover of SET and World average

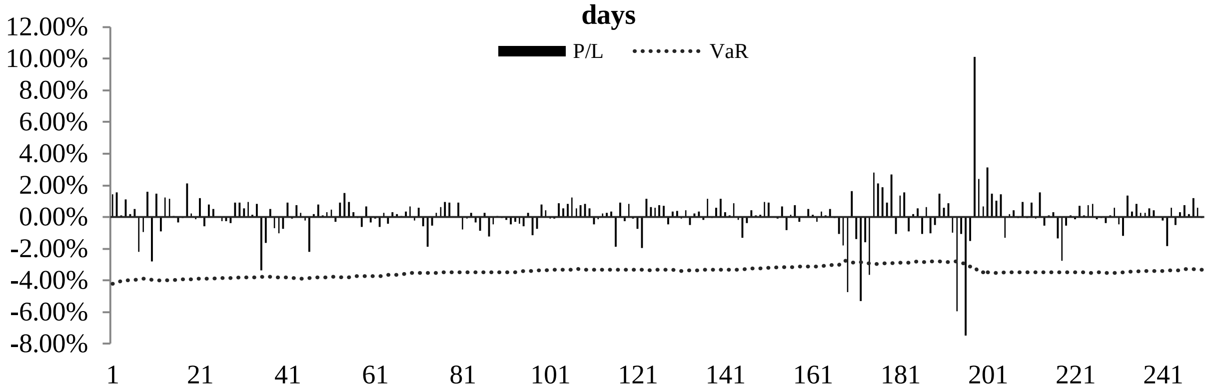


Source : World Bank (2016)

The liquidity level of securities in SET has an impact on VaR efficacy in determining risk exposure. The resulting VaR tends to underestimate the risk level.

Low liquidity level, especially when the market participants are totally absent from market, makes the price recorded in that day unchanged or distorted. Yet, the prices might change according to the varied market circumstances. When the unchanged price was recorded for many trading days, the standard deviation of the time series of returns, hence, from thin-traded securities will be small. The failure to determine the actual risk exposure may cause investors losses when they adopt the failing VaR into practice. Investors misunderstand the risk profile of that investment to be low, therefore deciding to engage in that investment. The actual losses in turn may be more severe than VaR anticipated. Furthermore, proceeding with the conventional VaR, the number of maximum loss violations may exceed the acceptable level at chosen $1 - \alpha$ confidence level. As depicted in figure 2, forming an equally-weighted portfolio of 40 low-liquid securities and backtested for historical 250 trading days, if the chosen $1 - \alpha$ confidence level had been 99%, the maximum loss violations would have occurred at 2.5 times, but the actual violations, given the simulated portfolio, were in total 5 times.

Figure 2: Profit, Loss and VaR of a low-liquid portfolio in 250 historical trading days



*The author used Variance-Covariance approach at 99% confidence level

Source : Bloomberg, data from 1/1/2016 to 31/12/2016

Erwan (2002) warned that VaR may be inaccurate if it failed to take trading liquidity risk into account. Accordingly, financial institutions may reserve less capital than they should, making them more exposed to market risk than that the capital can bear. Besides, International Organization of Securities Commissions or IOSCO (2012) recommended that VaR computation consider the trading liquidity risk of that securities. Hence, from equation (1.1) and (1.2), the low-liquid VaR should be raised in order to reflect the actual market risk (Tian, 2008). As a market risk measurement, several empirical studies suggested approaches to incorporate liquidity risk into VaR. The result transformed VaR into Liquidity-Adjusted VaR (LVaR). A study from Orlova (2008), for example, showed empirical evidence of the better performance of LVaR over VaR.

According to the low liquidity level of SET, VaR without liquidity consideration will generally suggest an underestimated market risk level. Hence, VaR adjustment for the application in SET is crucial. The author aims to empirically revisit whether and how vital VaR adjustment into LVaR is, so the reader would be truly aware of its importance. In this study, the author will compare the performance of VaR and LVaR in both high and low -liquid securities.

In addition to the role of VaR as a market risk measurement, VaR has played a major role in determining economic capital of financial institutions (BIS, 2016). Moreover, for Thai financial industry, regulators, Bank of Thailand or BOT, The Securities and Commissions of Exchange or SEC, and Office of Insurance Commission or OIC, proposed standardized supervisory haircuts to reflect the market risk of each securities, which used to determine the economic capital that Thai financial institutions are required to reserve. The haircut levels are varied by the characteristics of securities, and one of the criteria is the liquidity level of the securities.

Particularly, for securities listed in SET, from Table 1, BOT and SEC prescribed different risk levels depending on securities that formed SET50 and SET100 indices, and not in the SET100 Index (Non-SET100). According to SET Index methodology (SET, 2016), securities that are selected to form SET50 and SET100 indices are the 50 and 100 largest market capitalization and most liquid securities. Therefore, it can be implied that regulators attach significance to raising prescribed risk level so as to cope with the illiquid securities.

More importantly, regulators must make the safety and stability of Thai economy a priority. Governing financial institutions, thus, relies on conservative approach (BOT, 2016). It can be implied that the haircuts are prescribed under certain high confidence level, and regulators might adjust some safety factors into the haircuts. Although the conservative haircuts will provide financial institutions with such safety and stability by requiring more economic capital, the conservatism may unreasonably and unnecessarily be excessive. Since the economic capital is mainly composed of equity capital, which generally possess the highest cost of capital compared to other sources of funds. The higher economic capital is required, the higher cost incurred to financial institutions. Consequently, this incremental cost will convert to higher charged fees, lower competitive competency, and finally affect Thai economic growth.

Hence, in this study, after comparing the performance of VaR and LVaR, the author will extend the study to revisit the haircuts prescribed by Thai regulators. As the regulators also attach significance to the liquidity level of securities when identifying the risk level, the author will compare the risk exposure suggested by the haircuts with that theoretically anticipated by LVaR at the same confidence level as regulators'

Table 1 : Definitions and Values of Standardized Supervisory Haircuts of Thai regulators

Regulator	Haircut Definition	Holding Period	SET50	SET 100	Non-SET100
Bank of Thailand[1]	Market Risk	10 days	15%	15%	25%
Securities and Exchange Comisssion[2]	General Market Risk	10 days	8%	8%	8%
	Specific Risk		7%	12%	22%
	Total Market Risk		15%	20%	30%
Office of Insurance Commission[1]	Market Risk	10 days	16%	16%	16%

Source : [1]Bank of Thailand (2016) and Office of Insurance Commission[1] (2016)

[2] The author inferred from International Organization of Securities Commissions or IOSCO (2015). IOSCO is the international organization in which the members are regulators from many countries across the globe, including Thai SEC. IOSCO assumed 10 days holding period at 99% confidence level. The author adopted IOSCO's assumptions as the SEC (2016) did not provide assumptions used to prescribe the haircut level

Value at Risk and Liquidity-Adjusted Value at Risk model

An efficacious LVaR should be able to take both dimensions of liquidity risk into account (Bangia, Diebold, Schuermann, & Stroughair, 1998) as follows:

1.) Exogenous Liquidity Risk is the risk which is outside the control of the market maker or trader. For example, the foreign exchange market in G7 countries usually has thick trading frequency as well as narrow and stable bid-ask spread.

2.) Endogenous Liquidity Risk is the risk which is in the trader's control and usually the result of sudden unloading of large positions which the market is unable to absorb easily. In general, the risk varies according to certain periods of time or certain characteristics of securities, noticeably from the sizes of position of the same securities but in different periods.

LVaR model has been revisited by several scholars, which make it available for practitioners and researchers to adopt

The author started from the LVaR model of Bangia et al. (1998), which was the very first model developed and popularized among researchers and practitioners. The model is easy to compute and straightforward. The model utilizes bid-ask spread to represent the trading liquidity level of securities. Moreover, according to Bangia et al. (1998) study, the backtesting results indicated that, in thin-traded market, especially such emerging markets as South-East Asian Telecommunication Sector, the model significantly anticipated higher risk level than VaR and outperformed VaR in the Traffic Light Test, a backtesting framework suggested by BIS (1996). The backtesting result lied in the Green zone, while VaR lied in the Red zone.

Later, Francios-Heude and Van Wynendaele (2001) argued and pointed out that Bangia et al. (1998) model still had some weaknesses, that is, the liquidity adjustment by Bangia et al. (1998) assumed that the bid-ask spreads of securities are perfectly correlated with price movements. Furthermore, Bangia et al. (1998) only considered the Exogenous Liquidity Risk but failed to incorporate the Endogenous Liquidity Risk. Francios-Heude and Van Wynendaele (2001), therefore, improved Bangia et al. (1998) model by incorporating Endogenous Liquidity Risk into their LVaR. Francios-Heude and Van Wynendaele (2001) defined the Endogenous Liquidity Risk through price-impact cost, which tends to occur when suddenly unloading of large positions while market is unable to absorb, and also relaxed Bangia et al. (1998) the price movement assumption to reflect the actual behavior of trading activities. However, the model from Francios-Heude and Van Wynendaele (2001) used intraday data to explain Endogenous Liquidity Risk, making the model unpopular. Since the intraday data is costly and generally has barriers to gain access, it imposes limitations not only on proving its effectiveness but also on applying it into practice.

Jarrow and Subramanian (1997) model is more sophisticated, yet interesting. The model can take both Exogenous and Endogenous Liquidity Risk into consideration. Botha (2008) adopted this model and suggested a more practical approach to implement the Jarrow and Subramanian (1997) model by using closed-form formula. Besides, the Traffic Light Test significantly indicated a better performance over the conventional VaR.

In this study, the author proposes Botha (2008) LVaR model. The model can incorporate both dimensions of liquidity risk, which prevail in every financial market. If the investment is short, the expected return will be small and not significantly different from 0.00. Therefore, the LVaR can be written as equation (3)

$$LVaR_{\propto}^{p} = \sqrt{(LVaR_1, \cdots, LVaR_n)\begin{pmatrix} 1 & \cdots & \rho_{1n} \\ \vdots & \ddots & \vdots \\ \rho_{n1} & \cdots & 1 \end{pmatrix}\begin{pmatrix} LVaR_1 \\ \vdots \\ LVaR_n \end{pmatrix}} \qquad (3)$$

Where $LVaR_{\propto}^{p}$ is the market risk of portfolio p which the investor intends to hold for T period within the $1-\alpha$ confidence level

$LVaR_n$ is the market risk of securities n, for $n = 1, \dots, n$

ρ_{ij} is the correlation of securities $i = 1, \dots, n$ and $j = 1, \dots, \mathrm{n}$,and $\rho_{i,j=i} = 1.00$

$LVaR_i$ of securities i that will be formed into $LVaR_{\propto}^{p}$ of portfolio as described in equation (3) can be computed as in equation (3.1)

$$LVaR_{\alpha}^{i,t} = Z_{\alpha}\left(\sigma_{i,t}\sqrt{\mathrm{E}(\mathrm{S}_{i,t})} + \sigma_{\ln|c(\mathrm{S}_{i,t})|}\right) \qquad (3.1)$$

Where $LVaR_{\alpha}^{i,t}$ is the risk level of securities i at day t at given $1-\alpha$ confidence level

$\mathrm{E}(\mathrm{S}_{i,t})$ is the expected time to liquidate all i positions at day t

$c(\mathrm{S}_{i,t})$ is the difference between market value of i at day t after immediately liquidate all i position (the Liquidity Discount)

$\sigma_{i,t}$ is the standard deviation of securities i at day t

$\sigma_{\ln|c(\mathrm{S}_{i,t})|}$ is the standard deviation of the liquidity discount of i

In implementing Botha (2008) model, the author is aware of Jarrow and Subramanian (1997) suggestion that, for any investor, block selling would not result in higher expected utility. Thus, the best expected time to liquidate is the time required to liquidate as large as that market is able to absorb. Hence, the author can straightforwardly compute the time to liquidate in equation (3.2) (Riskdata, 2008)

$$E(\mathrm{s}_{i,t}) = \frac{|\mathrm{s}_{i,t}|}{\theta \mu_{vol,t}} \qquad (3.2)$$

Where $|\mathrm{s}_{i,t}|$ is the absolute position of securities i at day t

$\mu_{vol,t}$ is the 3-month historical average trading volume at day t

θ is the percentage that an investor desires to participate relatively to the average trading volume.

Botha (2008) adopted the liquidity discount given by Jarrow and Subramanian (1997) as showed in equation (3.3)

$$c(\mathrm{s}_{i,t}) = p_{i,t} \cdot \gamma(\mathrm{s}_{i,t}) e^{\mu_{i,t} \cdot \Lambda \mathrm{s}_{i,t}} \qquad (3.3)$$

Where $p_{i,t}$ is the market price of securities i at day

$\gamma(\mathrm{S}_{i,t})$ is the price-drop function to determine the discounted price after immediately liquidate all i position

The price-drop function can be written as equation (3.4), given by Law and Kwok (2001)

$$\gamma(\mathrm{S}_{i,t}) = \frac{0.5}{1-0.5^{-\delta s_i}} \quad (3.4)$$

Where δ is the price-drop parameter[3]

s_i is the amount of i securities that desires to liquidate

The difference and performance tests

Difference test

In order to investigate the LVaR efficacy, the author proposed a Paired T-test. The author set up a preliminary assumption that VaR and LVaR , in high-liquid securities, should show no significant difference as the characteristics of high-liquid securities are in line with VaR assumptions. On the other hand, in low-liquid securities, liquidity adjustment should significantly raise LVaR over VaR. Nonetheless, since the calculations rely on rolling data for 250 days, to prevent the autocorrelation problem, the author will adjust the tested result by Newey-West (1987) approach.

Performance test

In order to prove the better performance of LVaR, the author will adopt the Traffic Light Test, a backtesting framework suggested by BIS (1996). BIS(1996) specified a testing framework of historical 250-day horizon at 99% confidence level. Under these given conditions, BIS (1996) defined Exceptions as the violations of the maximum losses anticipated by that model in the historical 250-day horizon at 99% confidence level. BIS (1996) zoned and defined the performance of that model at given Exceptions as showed in Table 2.

Table 2 : Traffic Light Test framework by BIS (1996)

Zone	Definition	Exceptions (times)
Green	Model is appropriate to use	0 – 4
Yellow	Model still needs to be improved	5 – 9
Red	Model is inappropriate to use	10 or more

Source : Bank for International Settlements (1996)

[3] Lau and Kwok (2001) assigned 0.02 to the price-drop parameter through an investigation of optimal liquidation strategy which provided the maximum utility to investors under Jarrow and Subramanian (1997) assumptions by Maximum Likelihood Estimation approach.

The author is aware that the Traffic Light Test may err on the side of conservatism. The more conservative the model is, the higher anticipated maximum losses. The number of Exceptions will consequently fall. The anticipated losses may unnecessarily be too high. Hence, to be cautious, the author suggested an additional test by Kupiec (1995) using Likelihood Ratio or LR, in which the calculation follows equation (4). Under the assumptions that the tested model is correct, the LR will be 1-degree of freedom Chi-square.

$$LR = -2\ln\{(1-\beta)^{N-n}\beta^{n}\} + 2\ln\left\{\left(1-\frac{n}{N}\right)^{N-n}\left(\frac{n}{N}\right)^{n}\right\} \sim \chi^2_{df=1} \qquad (4)$$

Where β is the Beta confidence level used to test the model
N is the range of the testing day
n is times of occurred Exceptions

To establish the test in the same standard with the Traffic Light Test, the author will test the model at 99% confidence level within an historical 250-day horizon. From equation (4), under these given assumptions, the model will be accepted as appropriate under 8 times of occurred Exceptions.

Revisiting regulators' haircuts

Regulators prescribed haircuts to make financial institutions realize the market risk to which they are exposed. According to the good corporate governance ideology, financial institutions should reserve adequate economic capital to bear the losses from the exposed risk. In theory, the prescribed haircuts are defined as the expected maximum losses at a given high confidence level and certain time horizon (BIS, 1996). Thus, the prescribed haircuts may be considered comparable to VaR. Although the prescribed haircuts must be adequate enough for financial institutions to tolerate the maximum losses, the extent to which haircuts anticipate must not higher than necessary. It will, otherwise, lead to higher cost of capital, and consequently lower the competitive advantages.

Most importantly, the haircuts have an effect on the stability, competitive advantages, and good corporate governance of financial institutions as well as Thai economy. The standardized supervisory haircuts, hence, must be revisited to empirically illustrate its appropriateness in Thai financial market. The author designed the revisiting processes, like VaR and LVaR model, through the performance test as described earlier: The Traffic Light and Likelihood Ratio approaches. Under the same data set and assumptions, the author will imply the safety factor added into the haircuts from each regulator. The author suggests a ratio of LVaR to each prescribed haircut value. Since regulators similarly use 10-day holding period at 99% confidence level assumptions, the author will rescale the haircuts values to the same scale, 1-day holding period at 99% confidence level, as VaR and LVaR before testing.

Data and Portfolio simulating process

Data

This study used daily data of securities listed in SET from Bloomberg database, from January 2, 2016 to December 29, 2016. Yet, the securities must have following market data in every trading day at the mentioned period: market price, trading volume, and stock turnover. The author will use the market prices to compute daily returns, standard deviations of returns, trading volume to represent securities' liquidity, and stock turnover to classify members in each simulated portfolio.

Simulating portfolios

The author will cluster securities into two groups: high and low liquidity, by using the liquidity threshold that formed SET Index as a criterion (SET, 2016). The securities selected to be in SET50 and SET100 are defined as high-liquid securities, and other securities (NON-SET100) are defined as low-liquid securities. Besides, regulators adopt the criterion in the similar manner. After clustering securities into two groups, as a proxy of their liquidity, the author ranked the securities by their stock turnover, and selected top 40[4] -liquid securities in each group to simulate two portfolios: high-liquid portfolio and low-liquid portfolio. In addition, the securities in SET50 and SET100 indices, and Non-SET100 group with high liquidity level generally lie in the stock universe of most investors, particularly mutual funds. This approach will not only help reduce the sample size and have same quantity, but also help distinguish the tested results from high and low -liquid portfolios. Finally, the author will re-simulate portfolios at every end of day to prevent cherry-picking.

Results

From table 4, in the high-liquid portfolio, tested at 99% confidence level, the VaR and LVaR statistically showed no significant differences. In contrast, in the low-liquid portfolio, the VaR and LVaR statistically showed significant differences. The results are in accordance with the author's preliminary assumptions.

Table 4 : Paired difference test between VaR and LVaR results

	Paired T-test	
	High-liquid portfolio	**Low-liquid portfolio**
T. Stat	0.406	7.051
P. Value	0.1574	0.000*

*Note *LVaR are statistically different from VaR*

From table 5.1, for the Traffic Light Test, the VaR in both high and low -liquid portfolios lied in the yellow zone. However, even though the yellow zone did not completely reject the model, the model still needs improvement.

[4]From author's preliminary research, 283 Thai equity mutual funds have the average asset under management of 2,500 million and hold 40 securities in average. Besides, according to Elton and Gruber (1977), a portfolio with more than 30 securities can significantly diversify idiosyncratic risk of securities.

According to BIS (1996), in implementing the model, the VaR needs rescaling accordingly with the number of occurred Exceptions, which, in this case, VaR must be multiplied by 1.13 and 1.13 respectively.

For Kupiec (1995) test, under 8 times of Exceptions, VaR in both portfolios is appropriate to use.

With an interest in whether Thai financial market needs to adopt LVaR rather than VaR, the author tested the performance of LVaR and found that, as in table 5.2, in both portfolios, the performance of LVaR by Traffic Light Test lied in the green zone, which is considered appropriate to use. Similary, the Kupiec (1995) test suggested the same conclusion.

Table 5 : Performance test results

	5.1. VaR performance results							
	High-liquidity portfolio				**Low-liquidity portfolio**			
Size (million THB)	2,500	BOT	SEC	OIC	2,500	BOT	SEC	OIC
Exceptions	5	1	0	0	5	0	0	3
Zone	Yellow	Green	Green	Green	Yellow	Green	Green	Green
LR. Stat	1.9568*	0.000*	0.000*	0.000*	1.9568*	0.000*	0.000*	0.001*
	5.2 LVaR performance results							
Exceptions	4	-	-	-	2	-	-	-
Zone	Green	-	-	-	Green	-	-	-
LR. Stat	0.7691*	-	-	-	0.1084*	-	-	-

*Note *model is appropriate to use*

Figure 4 : High-liquid portfolio backtesting result

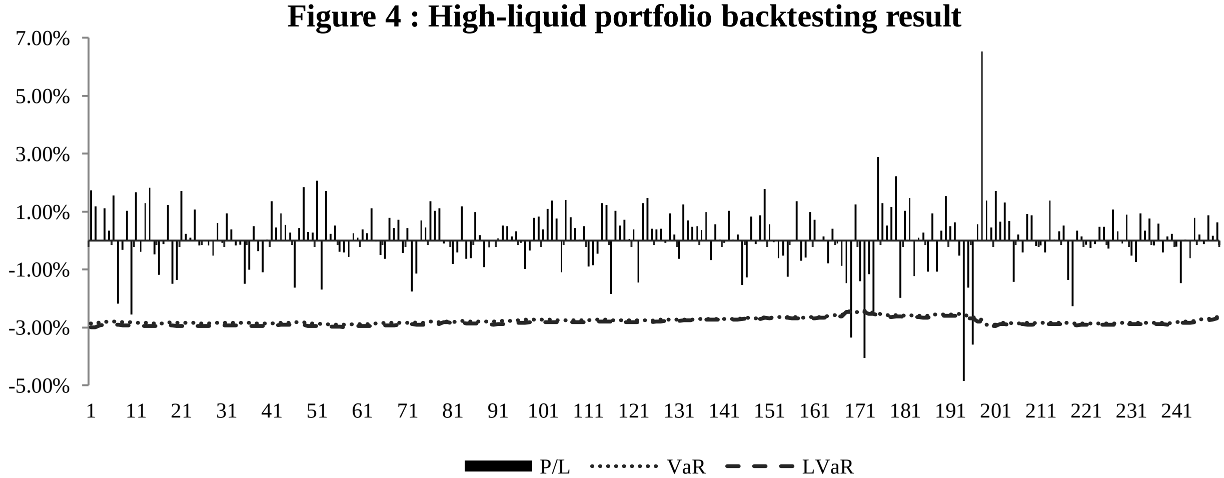


Figure 5 : Low-liquid portfolio backtesting result

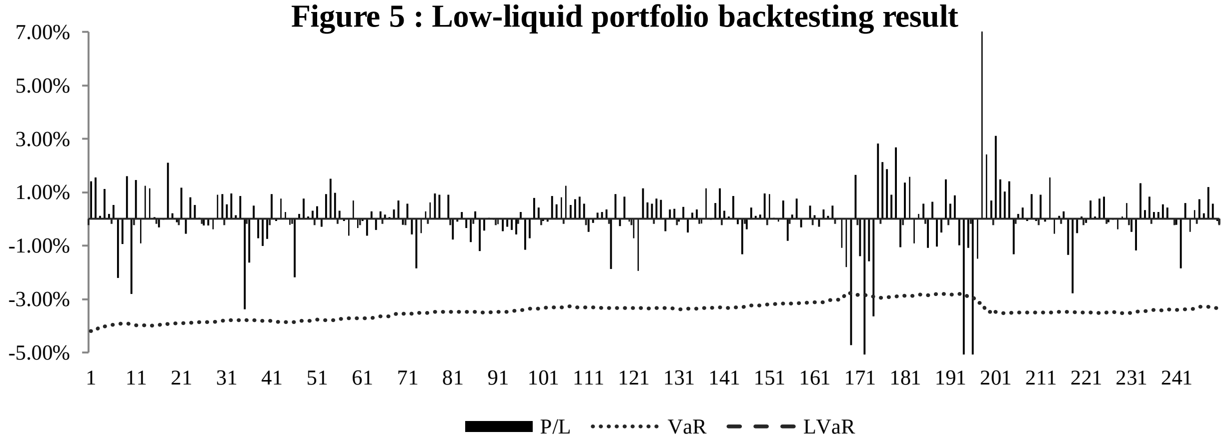


Figure 6 : High-liquid porfolio backtesting result in comparison with regulators' haircut

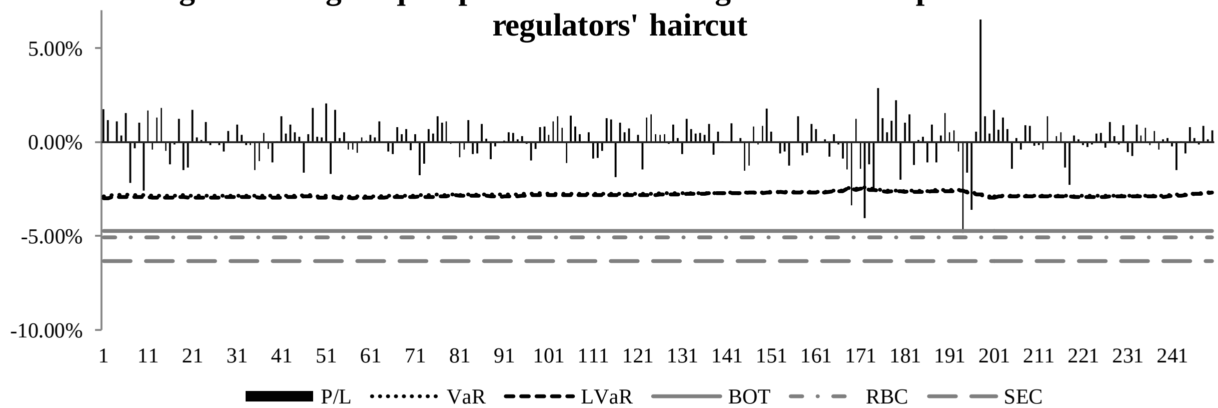
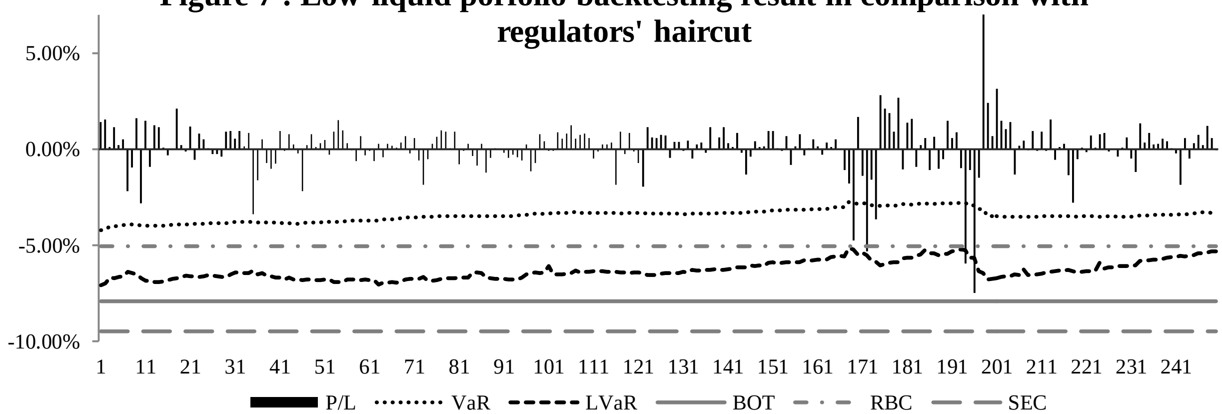


Figure 7 : Low-liquid porfolio backtesting result in comparison with regulators' haircut



From the standardized supervisory haircuts in table 1, the 1-day rescaled haircuts are as follows in table 6. The author used the rescaled haircuts to revisit the performance and appropriateness of Thai regulators' haircuts by using Traffic Light and Kupiec (1995) tests.

Table 6 : The rescaled standardized supervisory haircuts

Regulators	High-liquidity portfolio	Low-liquidity portfolio
BOT	4.74%	7.91%
SEC	6.32%	9.49%
OIC	5.06%	5.06%

For BOT haircuts, in both portfolios, the results lied the green zone. Kupiec (1995) test suggested the same result with only 1 Exception in the high-liquid portfolio, but no Exception occurred in low-liquid portfolio for 250 trading days.

For SEC haircuts, the traffic light test results, for both high and low -liquid portfolios, lied in the green zone, which considered appropriate to use. The Kupiec (1995) test also concluded the same way with no Exceptions in both portfolios.

For OIC haircuts, the traffic light test lied results in the green zone. The Kupiec (1995) test, like the traffic light test, indicated the haircuts are appropriate to use with no Exception in the high-liquid portfolio, but only 3 Exceptions in the low-liquid portfolio.

To empirically illustrate the liquidity adjustment by regulators, the author used a ratio of LVaR to prescribed haircuts. If regulators did not adjust safety factors into haircuts, theoretically, the ratio must equal 1.00. On the other hand, if regulators did adjust the safety factors, the ratio must be above 1.00. The conservatism may be described from the excess from 1.00 of the ratio, which the author depicted in figure 8 and 9.

Figure 8 : Safety factors of regulators comparing with LVaR in high-liquid portfolio

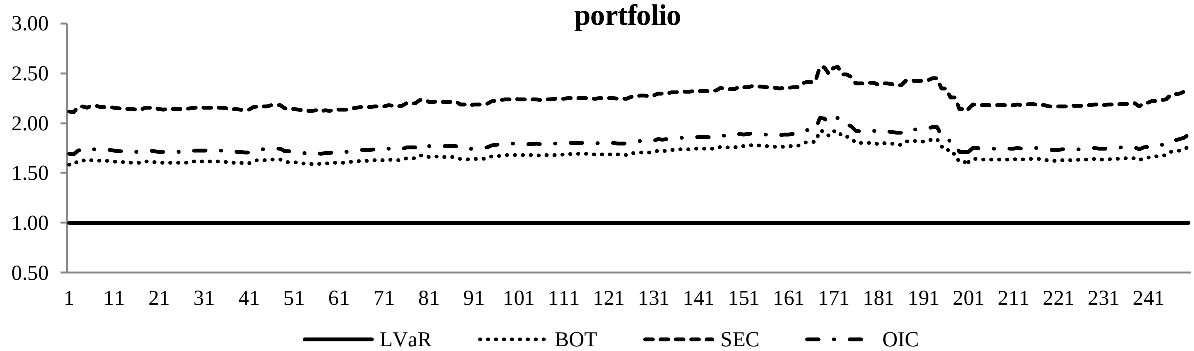
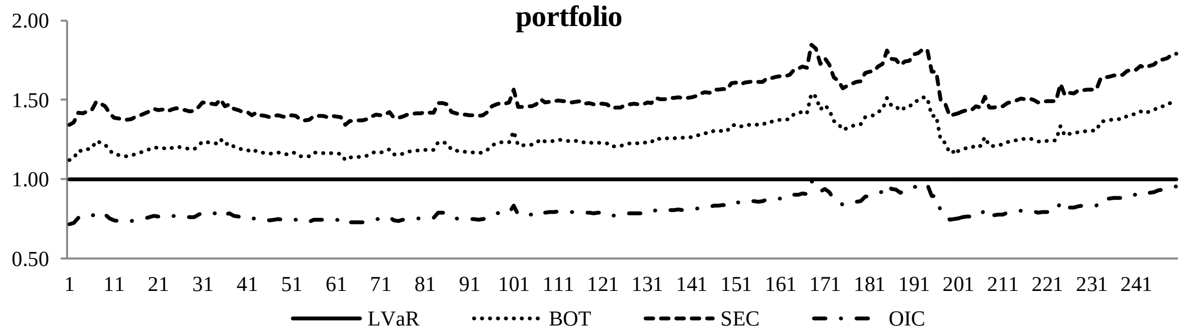


Figure 9 : Safety factors of regulators comparing with LVaR in low-liquid portfolio



From figure 8, in the high-liquid portfolio, all three regulators showed high conservatism. Implying from the safety factors, SEC has the highest degree of conservatism, while BOT and OIC apply almost the same safety level. On the other hand, from figure 9, in the low-liquid portfolio, SEC still showed the highest conservatism. Like in the high-liquid portfolio, BOT and OIC are also in the similar extent. OIC haircut, however, in the low-liquid portfolio, do not take trading liquidity risk into account like other regulators, making the haircut lower than 1.00

Conclusion

As a market risk measurement, trading liquidity affects VaR. In this study, the author revisited VaR performance comparing to LVaR, which raised the market risk level according to each securities' liquidity risk.

In the high-liquid portfolio, VaR statistically showed no significant difference from LVaR, whereas, in the low-liquid portfolio, the results are contrary. The significant differences in the low-liquid portfolio indicated that VaR underestimated the actual market risk, while LVaR could precisely anticipate the risk. Therefore, the author suggests LVaR to be used as a market risk measurement in every circumstance regardless liquidity level.

After concluding the better performance of LVaR over VaR, the author extended the study to revisit the appropriateness of standardized supervisory haircuts from Thai regulators: BOT, SEC, and OIC.

In both high and low -liquid portfolio, the results suggested, like in high-liquid portfolio, that the haircuts are appropriate. Yet, the author concluded the appropriateness simply resulted from the overly conservative haircuts. However, the only haircut that proposed lower risk level than LVaR is from OIC. The author concluded that it merely resulted from that OIC do not adjust the trading liquidity risk into haircuts, contrary to the conservatism of OIC as showed in the revisited result of high-liquid portfolio.

The prescribed haircuts provide practitioners with simplicity, yet at the expense of unnecessarily high economic capital. Consequently, this incremental cost may lead to higher charged fees. Not only may the competitive advantages of financial institutions deteriorate, but the higher charged fees also unnecessarily discourage opportunities to create such growth in Thai economy. From the study, the author supports LVaR to measure the market risk, which suggests lower yet adequate economic capital than that suggested by regulators' haircuts.

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WORKING PAPERS
FORUM 2018

REGULATING BY MARKET FORCES

Study of the Economic System of the Industrial Age: Financial Technology

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Study of the Economic System of the Industrial Age: Financial Technology

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This study has aimed to analyze the factors affecting GDP of Thailand in the context of Financial Technology. The development of technology systems, are developing rapidly so that E-payment is more likely to occur. This model is based on information regarding secondary money supply in the quarter between 2002 -2009 and 2010 – 2017. The estimated coefficients are derived using an Ordinary Least square paradigm. The analyzed test, was conducted for checking stationary data to verify by time series data.

The study found that the factors that explained the effect of E-money, could be preceded from the policy monetary and money market. The results of the analysis of factors affecting GDP can be explained by others factor; such as interest rate which the central bank controls inflation due to lower cash flow in the system. Meanwhile, the study uncovered that the important relation factors explaining money in the supply system are Money stock (M1); of which affects change of the GDP because people still used cash as much as E-money in the ecosystem. However, the important part of the variable affecting the other variables is the velocity of change significantly affects in the GDP even less affecting recently.

Keywords: **Demand and supply of money, E-payment, and GDP**

1. Introduction

This is a study about the social patterns of Thailand into a cashless society. In the hospitality industry, there is also a lack of understanding of the basics of accepting financial expenditure. There is business of financial transactions, without the cash for a long period of time. As technology starts to develop, it significantly influences consumer decision-making with more consumers. The research has aimed to reach the goal of implementing monetary policy through technology. It may affect the overall financial system of the country. It can now be called into play, as a role in targeting the bank and the entrepreneur through a targeted business. This focuses on the use of Fintech Ecosystem[1]. The concept is used in the competition and growth of the financial technology industry as a guideline for education. Determining the direction of the economy in the future without affecting the stability of the financial system, is of most importance. Conferring to a survey in Thailand, in the year 2020, a survey of PwC Thailand[2] there will be technological advances that will change the technology of the financial industry. The monetary policy was studied, and expanded in the form of cash and electronic forms. Currently, paper money plays a smaller role in consumer decision-making in many countries. Examples of countries entering the cashless society are China, Sweden, and India. For example, there is a drive for more technology[3]. Prosperous market changes start with the use of cards such as credit or debit cards. The new e-commerce market is paving the way. When looking at consumer behavior, there is a quick adjustment in the rate of change. Consumers quickly understand the price and convenience, of goods and services. Modern retail and market markets are emerging, by recognizing the changing economies around them. In turn, this helps them develop to an ever-changing market.

Currently, technology is rapidly emerging, and makes access to technology easier. From this point of view, it's the innovation that results in the financial shift from paper-based change to electronic money. At the same time, some countries are trying to find a way to end the payment of cash entirely. When looking at consumer behavior, there is a quick adjustment in the rate of change. The consumer quickly understands in terms of price, and convenience. Modern

[1] In Lee and Yong Jae Shin (2017) Fintech Ecosystem is a tool to support and economic stimulus Fintech Ecosystem that an individual has 5 elements by following 1.Fintech startups 2.Technology developers 3.Government 4.Financial customers 5.Traditional financial institutions

[2] *PricewaterhouseCoopers ABAS Ltd. (*PwC Thailand) ได้มีการคาดการณ์ผลสำรวจของ Financial Services Technology 2020 and Beyond: Embracing disruption

[3] India Is Likely to Become the First Digital, Cashless Society. Mauldin Economics. Retrieved June 29 ,2017

retail and modern markets are aware of the changing economies around them, making them more innovative, and refined.

Table 1.1: The amount of electronic payments (E-payment) in 2010 - 2017

Unit: Billion Baht

Year	2010	2011	2012	2013	2014	2015	2016	2017
Net Baht	144,319	182,256	191,753	201,701	212,421	226,484	259,926	270,983
E - Money	18	24	36	48	56	68	91	126
Online Retail Funds Transfer: ORFT	832	1,014	1,250	1,399	1,588	1,819	2,184	3,042
Bulk Payment	10,979	14,225	17,497	19,238	21,134	22,819	27,005	28,260
Payment card	796	970	1,233	1,364	1,474	1,565	1,676	1,804
Summary	156,944	198,489	211,769	223,750	236,673	252,755	290,882	304,215

Source: Bank of Thailand (PS_PT_003: Value of Payment Transactions processed)

Purpose of study

• To study the implementation of monetary policy that affects the economy; as well as more spending on consumer electronics technology.

• To study the relationship of factors. How does the change in the amount of money in the financial system (M) affect the growth of the GDP of countries entering the cashless society?

• Include the results of relationship studies to model.

2. Reviewing relevant literature and theories.

2.1 Relationship Theories

There was a study on the brunt of financial system; which was on the downward trend. Due to the emergence of quick-growing electronic payment systems ATM was born in the world in 1967, and after 16 years, Thailand had its first ATM. But the evolution of technology has made financial technology much more than withdrawals and transfers from ATMs. Economists have studied the impact of E-money, or electronic money that replaces currency. In the 1960s, many economists have cited economists (Friedman 1970), based on Fisher's ideas. Quantum of money is the study of the impact of e-payments on money supply. Price stability, is the velocity of money flow (Velocity) and controls the level of short-term interest rates; as well as financial institution stability. M1 Berentsen (1997) analyzed the effects of electronic money on three main factors**:**

2.1 System of expanding the amount of deposits of commercial banks.

2.2. Reserve amount of digital money (r_{EM}), and fixed deposit (r_D).

2.3 Specific definitions of M as well as the central bank's response being important to determine the changes taking place in M1.

In the analysis of total money supply, four independent variables were classified into four categories.

Monetary Base M0 have banknotes and coins that are circulated in the hands of the people; as well as in the hands of commercial banks. In addition, this includes deposits of financial institutions at the Bank of Thailand.

Money: M1 or Narrow Money refers to the amount of money circulating in the hands of people consisting of banknotes, and coins in the hands of the people and deposits of the public. (But not including money in other banks / financial institutions, and state money)

Monetary: M2 or Monetary Amount (Board Money) means the amount of money circulating in the public hands. It consists of banknotes and coins in public hands and deposits. Also, it includes fixed deposits and savings at the banking system.

Monetary: M3 or Broad Money M3 means the amount of money circulating in the hands of people in cash. Deposits of all types of financial institutions are deposited from the public. This includes deposits in the form of promissory notes of finance companies.

The information is based on the financial instruments used to classify the funds as shown in Table 2.1

Table 2.1: Classification of units

	Category: Physical	Category: Electronics
Financial Institutions: National Financial Standard Unit	Banknotes and coins	E-money (Central bank reserve, commercial banks) E-cash (RS coin concept)
Financial Institutions: Other Standard Units	Banknotes and coins (Ithaca HOURS)	Money in electronic form (Bitcoin, Ethereum)

The definition of E-payment broadly refers to Electronic money (E-Money), being the amount of money saved on a computer chip in a plastic card or electronic networks such as mobile phones. Zeinab (2010) provides the meaning of "E-money", as a value-added or "value-added" service. There are prepaid patterns saved in consumer applications on technology devices. This includes prepaid cards and prepaid software models that use electronic devices such as the internet or digital money, and the potential of electronic money to play a role is to pay attention to academics. Gabriele (2007) categorized the money and studied that some countries, most of the electronic money, were raised in the national currency. The value has been released by banks and private companies, such as commercial banks or E-money. The main form is that the deposits of commercial banks are held with the central bank and lent. E-money can generate revenue for electronic issuers. There is consistency in distributing returns between bond purchases, and debt issues while E-money represents liabilities for issuers.

Payment transactions through various payment systems (E-payment)[4] are a critical part of the education. They are divided into several categories together.

[4] 1) BAHTNET transfer to customers (BAHTNET 3rd party), is the transfer of money order of the customer who ordered the bank transfer money to the account; a beneficiary in another bank.

2) Bulk Payment, such as multiple transfers within the same bank (direct credit), direct debit and multi-bank transfer. (NITMX Bulk Payment)

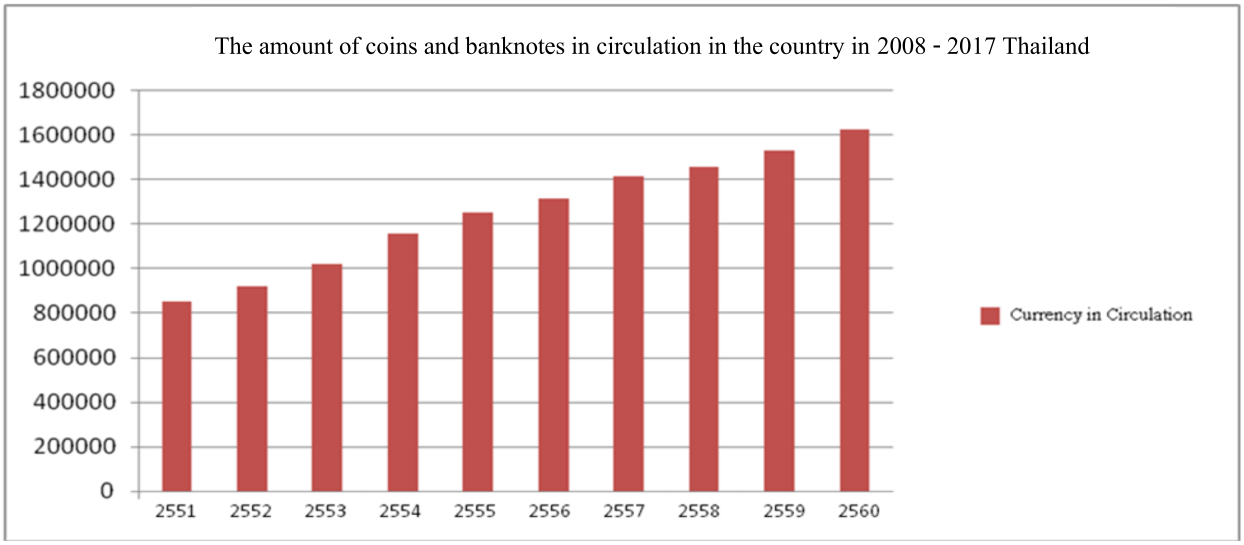
3) Online Retail Funds Transfer, such as ATMs, internet and branches.

4) Bank Transfer (Including payment for goods and services), such as by way of money transfer / payment via ATM, mobile internet

5) Electronic Card Payment (Excluding E-Money), such as payment at Point of Sale or Internet with debit and credit card.

6) Electronic money (E-Money) can be categorized into two types: Card based, where the value of money, card data and spending data are converted and stored in small chips embedded on things that do not include card types. Top-up card and Network / Server based cards or electronic money on computer networks. The value of money and information is converted and stored in the server's central server.

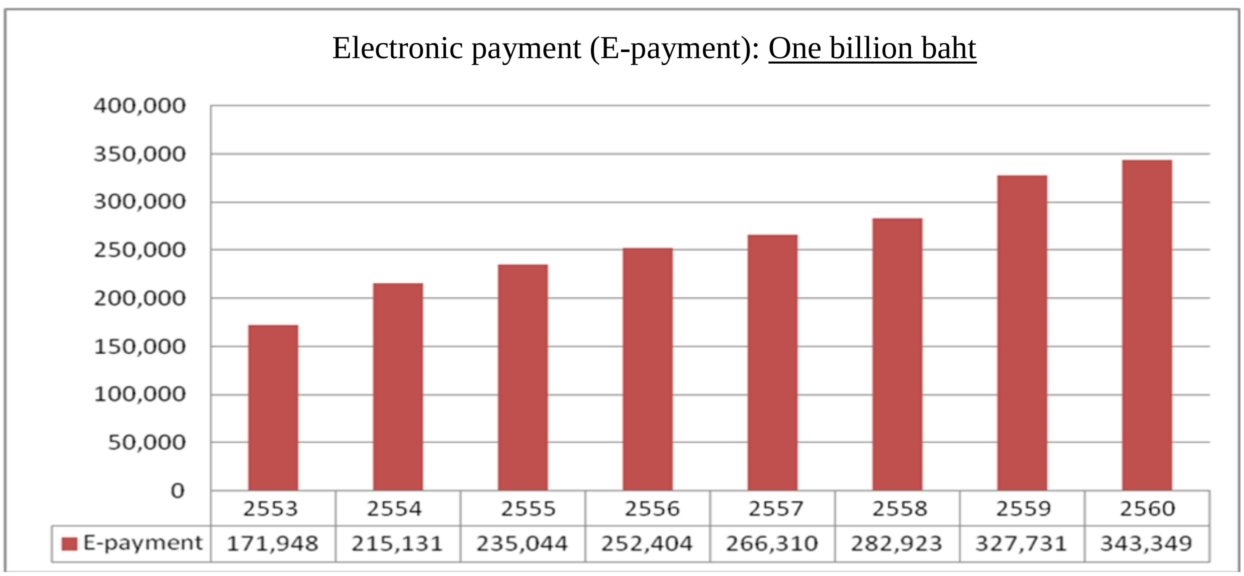
Figure 2: The amount of coins and notes in circulation in Thailand from 2008 to 2017.



Source: Bank of Thailand

The data can't be compared each year in a significant reduction, as Figure 2 illustrates the increased use of E-payment as the data collected by current flows. Figure 3 shows the amount of E-payment that shows that the amount of electronic money increased each year.

Figure 3: Electronic Payment (E-payment) from 2010 to 2017



Source: Bank of Thailand

Financial Policy Implementation

Financial transaction systems are controlled by monetary policy, by considering the impact of electronic money. This study has examined the amount of electronic money, that affects the rate of money circulation and the amount of money in a narrow sense, or M1. The study of money turnover is interesting, depending on the amount of money and the variables. The ultimate goal is an important part when the money flow rate is constant. Under the basic theory, there are important financial equations to be analyzed.

$$M * V = P * Y \tag{1}$$

A discussion of the monetary theory of the Bureau of Econometrics examines the equation of Irving Fisher, which describes the amount of electronic money in M1 financial terms, as follows: (1) Given the fixed rate of return for M in Fisher's equation is defined as the sum of money in the narrow sense M1 from equation (4) into equation (1).

$$(C + D + EM) * V = P * Y \tag{2}$$

The equation (1) is that Irving Fisher's equation shows the growth in financial volume leading to a change in P * Y, which is equivalent to the nominal GDP and Y is the real GDP. The velocity of money (V) is the variable that changes in correlation to the amount of money in the long run. Changes in the range of access to cashless societies to measure turnover may result in less stability. It is therefore more difficult to decide whether monetary policy is being used in a country dependent on monetary resources as a target or indicator (Jordan-Stevens 1996)[5]. The decline in revenue generated by the increase in money supply, with reduced reserve requirements (International Financial Controls Decline Zeinab Mohamed: 2010). The main objective of this study was to maintain the inflation rate at a low and constant level.

2.1.1 The analysis of the basic concepts of monetary multipliers is to be applied to electronic money in order to study the effect of monetary multipliers on equation (2).The monetary base (Monetary Base) as the equation.

$$M = m \times MB \tag{3}$$

[5] Jordan, J.L. and E.J. Stevens, 1996: *Money in the 21st Century*, Cato Institute's 14th Annual Monetary Conference

Equation (3) is further analyzed by means of the finite element (M1).

$$\text{Determined:} \quad M1 = C + D + (EM) \tag{4}$$

$$MB = R(Required\ reserves) + C(Currency) + E(Excess\ Reserves) \tag{5}$$

$$R(Required\ reserves) = r_D D + r_{EM} EM \tag{6}$$

Banks are willing to lend for a return that is greater than the cost of deposits. Analyzing assumptions by Berentsen (1997), in the case of commercial banks, returns on the amount of money borrowed. Therefore, the ratio of deposits depends on the ratio of demand for deposits (r_D) and the ratio of demand for electronic funds (r_{EM})[6]. The analysis is based on the following equation:

$$\partial M1 = \partial C + \partial D + \partial EM \tag{7}$$

People who bring cash back to electronic money from financial institutions. Cash flow to financial institutions (Vault cash), and financial institutions or commercial banks can take cash vault cash to release. (Which eventually increases the deposit again) and can also be used as an Excess Reserve (E).

$$\partial VC = r_D \partial D + r_{EM} \partial EM + \partial E(excess\ reserve) \tag{8}$$

The fact that people bring money to exchange electronic money, means that the amount of vault cash of financial institutions has increased in quantity equal to the amount of cash held in the hands of the people. $\partial VC = -\partial C$

$$\partial C = -r_D \partial D - r_{EM} \partial EM - \partial E(excess\ reserve) \tag{9}$$

From equation (9), we assume that the excess reserves are unchanged, when the exchange of currency to electronic money in the same amount determined. $\partial C = -\partial EM$

[6] There is no reserve of electronic data (r_{EM}) available due to the low volume of electronic money.

$$\frac{dM}{dEM} = \frac{1 - r_{EM}}{r_D} \tag{10}$$

It can be seen from Equation (10) that when increasing the use of electronic money, affects the change in money supply, M1, if financial institutions and commercial banks have demand for electronic money (r_{EM}) To reserve a deposit is not equal to one, and if $r_{EM} = 1$, the change of currency to electronic money will not change the amount of money clearly. However, when demand for deposit (r_D) increases, the amount of money M1 will decrease.

2.1.2 Modification of short-term interest rates according to Taylor's rules. When the monetary policy target is stopped, the money supply decreases. Declining cash requirements impact financial policy controls. Based on a sample study reference, the Swedish central bank, based on the real interest rate, controls short-term interest rates on interbank loans. In general, when inflation is higher. Central banks raise short-term interest rates with the goal of real interest rates (Romer 2000)[7]. The process is commonly known as Taylor Principle. The idea is based on the US economy in 1980 as a method used by central banks. It's related to economic productivity or unemployment; which is displayed by the equation below.

FFR = inflation + 0.5 * (output gap) + 0.5 * (inflation – 2%) + 2 (11)

Federal funds rate (FER) (Pier Francesco Asso 2010) The interest of the Federal Reserve (**Fed**) is used to indicate the direction of monetary policy. Output gap is the rate at which real GDP (GDP) deviates from the predicted GDP leads to the theory of financial quantity; of which is the basic theory of finance in which the central bank adopts a method of controlling monetary policy. Generally, the price level that is changing can be easily defined with the demand and supply of monetary conditions in the financial market equilibrium.

$$\frac{M}{P} = L(Y, r) \tag{12}$$

The equation (12) on the left side is the real supply of money. L is the real demand for money, which is the function of Y yield and interest rate.

[7] Romer, D, 2000. "Keynsian Macroeconomics without the LM Curve" Journal of Economic Perspectives,Volume 14 ,nr. 2. Web.

2.2 Literary review

From the previous study, the study group considered the effect of the money supply decreased in two forms: the central bank can carry out financial policy as a result of the decrease in the amount of currency and the case of monetary policy. This doesn’t work in the economy, and most researchers have defined a model of monetary policy relationships that affect the amount of money in the system. The variable X describes the relationship that affects the Y variable as a one-way relationship as described by Therése 2016. The researcher discusses the Riksbank central bank in Sweden. It can still control financial policy at a time that affects GDP, real GDP and CPI growth rate. The amount of money doesn’t affect the control of monetary policy. The Swedish central bank is interested in the short-term rate of interest that is regulated by the real interest rate of Taylor's approach to setting interest rates between commercial banks (Pier Francesco Asso 2010). This concept came from the behavior of the United States economy in the 1980s to the early 1990s. One of Taylor's principals was used by Thana. A new concept of financial policymakers has introduced the Federal funds rate (r) or short-term interest rate. It can reflect the productivity and unemployment rate. Odior et al (2012) also argues that, apart from the short-term interest rate controls, the demand for reserve assets Financial Market Operations. In the study of EMI (1994), it was analyzed that the increase in E-money was in the form of smart cards. There will be no impact on monetary policy. Due to the increase in electronic money press cards, only substitutes for sub-coins and coins.

In addition, the increase in E-money has led to research not only on short-term interest rate control, but also on the use of the Money Multiplier model to determine the required reserve requirement and is applied with monetary policy. Berentsen (1997) argues that the choice of a reserve currency when electronic money replaces a currency increases the amount of money held by a commercial bank. Nichols will notice that holding excess cash is appropriate and will deposit money with the central bank, which would increase the central bank's reserves. From the study, it was found that, when combining the study of electronic money in the system, the effect of E-money on the increase may be a consequence of the change in the amount of meaningful money, which is called M1. Defined as EM, which affects the money supply. M1 studies the liquidity factor when increasing the amount of electronic money. As a result, commercial banks will adjust their lending rates and deposit rates in proportion to the amount of reserves. The analysis is divided into two types: 1) Non-binding reserve requirements. 2) Binding reserve requirements. Electronic money reserve (rEM) is entered into the equation, but the change in M1 volume depends on the amount of deposit required (rD). The change in M1 financial volume is less. According to a study by African Development Bank (2011) research in Africa, mobile phones that use the transaction are increasingly used, resulting in a dramatic increase in cash flow. With the rise of price level, the analysis analyzed a number of studies that dealt with negative and positive financial policy implications. The operation depends on many factors from the operation of the central bank, and financial institutions. It’s possible that, in the full cash-free period, new technologies are emerging that lead to the payment system; as well as new ones.

From the article in many countries, the transition to the cashless era has concluded that most of them don’t affect the monetary policy when the amount of money in the system is reduced. There are ways to analyze the short-term interest rates. There are also other tools, that can be used to control inflation. This includes the need for reserves for cash and electronic money. Liquidity ratio, financial market is seen in most of the past studies. The equation model is used to study the relationship between the variables Y and the change that results from the change of the X model. The simulated equation is linear and positive with the term μ1.

3. Research

Based on relevant research, study changes in financial volume. In the model, the financial equation changes the form of cash into electronic money. According to the equation (1)

$$M * V = P * Y$$

Relevant research has investigated the change in the growth rate (Therése 2016) from Equation (13) and the change in velocity of money (V). Therefore, the rate of growth of the money turnover rate is set to constant, and the external variables have changed.

$$\frac{\partial MV}{\partial t} = \frac{\partial PY}{\partial t} \tag{13}$$

This study is in the form of time series data based on relationships at different time intervals. Estimation of Coefficients Based on M1, M2, and M3 Growth Equation Models Affecting Economic Growth. Nominal GDP When Electronic Money is Increased Using Secondary Data. Landscape is divided into two periods. The study was conducted during the first period from 2002 to 2009 and the second from 2010 to 2017. The results of the study on changes in electronic money were derived from the equation (13). The change in money (V) is not very high because it is a long-term change. The rate of change of money is calculated by subtracting M1 from M2 and subtracting M2 from M3. The equation consists of Nominal GDP as follows: Set variables to: and : $MoneyA = M_2 - M_1$ และ $MoneyB = M_2 - M_1$

$$\text{Function: } GDPgrowth = f\,[M1_{it}\,, MoneyA_{it}\,, MoneyB_{it}\,, \mu_{it}] \qquad (14)$$

Table 3.1: Description of active variables.

Endogenous Variables	**Explanation**
GDP growth	GDP growth rate
Exogenous variables or variables that are predefined.	**Explanation**
M_1gr (Narrow Money) *(1/)	The amount of money circulating in the hands of the people consists of notes and coins in the hands of the people and the deposits of the people.
Money Agr (Board Money) *(1/)	Broad money growth rate (M2) minus M1 (banknotes and coins in public hands and deposits of citizens)
Money Bgr (Broad Money M3)[8]	The widest range of money growth (M3) minus M2 (fixed deposit and savings at banking system)
μ_{1t}	Random variable

Source: Bank of Thailand (document EC_MB_004_S2: Money and Elements 1)

Note: * 1 / The BOT has revised the broad monetary definition of money by the new definition of bill of exchange issued by commercial banks. Deposits of savings cooperatives, and net asset value of money market funds.

3.1 Estimation of Coefficient

The instrument is used to estimate the coefficient of correlation between the growth rate of GDP, and the rate of change in money supply. The information is sorted by time, and time series. The relationship of variables is given set of relationships. The model was tested by unit root to calculate the coefficients of all equations. Afterwards, the calculation of variables occurs

8 From January 1999 to March 2001, a loan from the Government Savings Bank From April 2002 onwards, a loan from the Savings Bank And Krung Thai Bank. This is a short-term loan. Including promissory notes for debt restructuring. 2. Including promissory notes for debt restructuring. 3. short term 4. loan from financial institution to deposit 5. by issuing promissory note, and loans under the loan agreements borrowed from the BOT, Government Savings Bank and Krung Thai Bank.

within the Endogenous Variables. All variables are converted to logarithmic logs, so that they are linear.

Structural equation

$$Log(GDPgrowth) = Log[\beta_0 + \beta_1 M1gr_{it} + \beta_2\, MoneyAgr_{it} + \beta_3 MoneyBgr_{it} + \mu_{it}] \qquad (15)$$

The coefficients are calculated in the equation (15). Then calculate the parameters of the structural equation; by comparing the amount of money that can affect Nominal GDP.

3.2 Methods of study

3.2.1 Unit Root Test

In this study, the data is a time series data model using the Ordinary Least Square regression model, but the data for the test are not stationary (order and the value is small. Consideration should be given to stationary, mean, and variance data that do not change over time. If the time series data is not static. Non-stationary is the unrealistic regression equation. The unit root test needs to be tested with the Augmented Dickey-Fuller Test (ADF) under the assumption that the data is stable.

$H_0 = \rho = 0$ (X_t Features are not static. (Xt is not stationary. Non-stationary or Unit Root)

$H_1 = \rho \neq 0$ (X_t Still features (Xt is stationary or no unit root))

If the test results accept the main assumption (H0), the data is not static. If the null hypothesis test (H0) shows that the time series data, it’s stationary or there is no root unit.

<u>The data is not static. (non-stationary)</u>

- Selecting the appropriate lag in order to incorporate retrospective information into the appropriate relationships. There are white noise residuals.

- Long-term correlation test. The Cointegration Test is based on the principle that the least squares are stationary. Most often, the data is not static. (Non-stationary) using the common technique. Cointegration is a test of whether the variables are cointegrated. This variable is long term, in the equilibrium of the relationship.

4. Results

4.1. Stationary Condition

The study of the data was performed in a non-static manner. Non-stationary to analyze this study in the unit root test to test the stability of the variable. It's based on the Augmented Dickey-Fuller Test (ADF).

Table 4.1: Unit Root Test Results at Normal Levels 2002 - 2009

Variables	**ADF Statistic (McKinnon Critical Values at 5%)**	**McKinnon p-value**
	Random walk with drift and linear time trend	Random walk with drift and linear time trend
Log GDPgr	-4.9873 (-3.5629)	0.0018
Log M1gr	-5.8961 (-3.5629)	0.0002
Log MoneyAgr	-4.3979 (-3.5629)	0.0076
Log MoneyBgr	-5.5912 (-3.5629)	0.0002

Table 4.1 examines the value of the ADF compared to the critical value of 5%. The results from the McKinnon p-value, with a significance level of 0.05, can be seen. The p-value of the equation of random walk with drift and time trend is derived from the data that no value is greater than the significance level of 0.05. The data variables GDPgr, M1gr, MoneyAgr and MoneyBgr data are stationary at the data level. Normal (Level) means can reject the main assumption.

Table 4.2: Unit Root Test Results at Levels from 2010 to 2017

Variables	**ADF Statistic (McKinnon Critical Values at 5%)**	**McKinnon p-value**
	Random walk with drift and linear time trend	Random walk with drift and linear time trend
Log GDPgr	-7.8858 (-3.5629)	0.0000
Log M1gr	-5.7052 (-3.5629)	0.0003
Log MoneyAgr	-4.3366 (-3.5629)	0.0088
Log MoneyBgr	-4.5403 (-3.5629)	0.0054

Table 4.2 compares the critical value of the ADF with the Critical Value and the McKinnon p-value with a significance level of 0.05 at the level of I(0). Therefore, it is not necessary to test the variance at the First Difference level from Table 4.2 when considering the Critical Value at 0.05. The statistics from Random walk with drift and time trend ADF statistics variable values. The critical assumption is 95% confidence level can be negated. The p-value is less than the significance level of 0.05. The analysis is in the range where the null hypothesis can be rejected at the normal level.

4.2 Optimal Lag Considerations

Estimation of time series models requires analysis of appropriate hunting options. To know how to use the past data of several variables over time to participate in the description of the relationship appropriately. To test the long-run equilibrium equation using the Johansen and Juselius method, consider the appropriate delay. First, select the delayed variables in the model using the Akaike Information Criterion (AIC) that provides the lowest value for selecting the appropriate delay variables. The AIC1 value is derived from Equation (15) from Table 4.3. The predator variable was 4 at the confidence level of 95%. It will be used to find the appropriate delay.

Table 4.3: Results of the Lag length prediction test.

Lag	1	2	3	4
AIC1	-9.6939	-9.9369	-9.6468	-115237*

Table 4.4: Results of selection of Lag length hunting variables 2010 - 2017

Lag	1	2	3	4
AIC1	-17.7447	-17.9888	-18.0486	-19.4184*

From Table 4.4, the minimum AIC value is the predator value of 4 at the confidence level of 95%. It will be used to find the appropriate delay.

The test results are shown in Table 4.5. This test is based on the Schwarz Information Criterion (SC) criteria. The data for the 2002 - 2006 period are the most appropriate. Lag is in the normal order (At Level) at the 95% confidence level and 2010 - 2017. The optimal delay is Lag 1 (Order 1) at a confidence level of 95%, which is the appropriate delay. this It will be used to test the long-run equilibrium relationship of Johansen and Juselius.

Table 4.5: Test results for optimal lag (Optimal Lag)

Lag/ปี	SC/2545-2552	SC/2553-2560	AIC/2545-2552	AIC/2553-2560
0	-9.6008*	-16.6966	-9.7911	-16.8869
1	-8.5157	-16.7846*	-9.4673	-17.7362
2	-8.1054	-16.4252	-9.8182	-18.1379
3	-7.3786	-15.8010	-9.8527	-18.2751
4	-8.2884	-16.1830	-11.5237*	-19.4184*

4.3 Long-run equilibrium relationships (Cointegration Test)

Long-run equilibrium relationship test of variables. Based on the Stationary Data Stability Test, it was found that all variables of the two periods of time had an integrated level of I (0). Therefore, the longitudinal equilibrium relationship can be tested. The long-run equilibrium test is a time-series analysis that is not static (non-stationary).

Table 4.6: Cointegration Results by Trace Method, 2002 - 2009

Main assumptions	Secondary hypothesis	Eigenvalue	Trace Statistic	Critical Value (0.05)	Prob.
r = 0	**r > 1**	0.7861	90.3935*	47.8561	0.0000
r ≤ 1	**r > 2**	0.5559	44.1244*	29.7971	0.0006
r ≤ 2	**r > 3**	0.3772	19.7697*	15.4947	0.0106
r ≤ 3	**r > 4**	0.1692	5.5623*	3.8415	0.0183

Table 4.7: Cointegration Results by Max-Eigenvalue Method, 2002 - 2009

Main assumptions	Secondary hypothesis	Eigenvalue	Max-Eigen Stat.	Critical Value (0.05)	Prob.
r = 0	**r > 1**	0.7861	46.2691*	27.5843	0.0001
r ≤ 1	**r > 2**	0.5559	24.3546*	21.1316	0.0170
r ≤ 2	**r > 3**	0.3772	14.2074	14.2646	0.0510
r ≤ 3	**r > 4**	0.1692	5.5623	3.8415	0.0183

Note: r = 0 is a variable with no longitudinal equilibrium.

r = n is the Cointegration Number

Table 4.8: Cointegration Results by Trace Method 2010 - 2560

Main assumptions	Secondary hypothesis	Eigenvalue	Trace Statistic	Critical Value (0.05)	Prob.
r = 0	**r > 1**	0.7750	82.8958*	47.8561	0.0000
r ≤ 1	**r > 2**	0.5394	38.1359*	29.7971	0.0044
r ≤ 2	**r > 3**	0.3233	14.8817	15.4947	0.0617
r ≤ 3	**r > 4**	0.1002	3.1666	3.8415	0.0752

Table 4.9: Cointegration by Max-Eigenvalue 2010 - 2017

Main assumptions	Secondary hypothesis	Eigenvalue	Max-Eigen Stat.	Critical Value (0.05)	Prob.
r = 0	**r > 1**	0.7751	44.7598*	27.5843	0.0001
r ≤ 1	**r > 2**	0.5394	23.2542*	21.1316	0.0248
r ≤ 2	**r > 3**	0.3233	11.7151	14.2646	0.1218
r ≤ 3	**r > 4**	0.1002	3.1666	3.8415	0.0752

Note: r = 0 is a variable with no longitudinal equilibrium.

r = n is the Cointegration Number

Based on the Johansen and Juselius method, we can analyze the results by using the Trace method. Table 4.6. In the case of the main assumption r = 0, the Trace value is greater than the critical value. At 95% confidence level. The main assumption is that the variable doesn't have a long-term equilibrium relationship. The hypothesis is that the long-run equilibrium relationship occurs more than one pattern, and then tested in subsequent sequences to determine how long a long-term relationship exists between the Trace statistic and the null hypothesis. The accepted main assumptions are long-term equilibrium relationships occurring at 1, 2 and 3 patterns at 95% confidence level. Next came the test method. Max-Eigenvalue To confirm the results of the test from Table 4.7, in case of the main assumption that r = 0, the Max-Eigen statistic is greater than the critical value. The main assumption is that the variable doesn't have a long-term equilibrium relationship. The hypothesis is that the long-run equilibrium relationship occurs at least one pattern. The Max-Eigen statistic is greater than the critical value. It also rejected the main assumptions. In addition, the assumption that the long-run equilibrium is at least two and that the null hypothesis shouldn't be ignored. The Max-Eigen statistic is less than the critical value. It can be concluded that the equilibrium relationship There are two types of long-term tests. The result is that the growth rate of gross domestic product, and the independent variables in the model from 2010 to 2017, are moving together into a long-term equilibrium relationship.

Then, we can analyze the results by the Trace method. Table 4.8. In the case of the main assumption that r = 0, the trace value is greater than the critical value. At 95% confidence level, the main assumption is that the variable does not have a long-term equilibrium relationship. The hypothesis is that the long-run equilibrium relationship is more than one, and then tested in subsequent sequences. The subsequent trace is greater than the critical value, thus rejecting the assumption that there is less long-term equilibrium. This is a test of the sequence until the main hypothesis shouldn't be rejected. The trace value is less than the critical value. Accepted main assumptions are longitudinal equilibrium relationships occurring 1 and 2 patterns at 95% confidence level. Next came the test method. Max-Eigenvalue To confirm the results of the test from Table 4.9, in the case of the main assumption r = 0, the Max-Eigen statistic is greater than the critical value. The main assumption is that the variable does not have a long-term equilibrium relationship. The hypothesis is that the long-run equilibrium relationship occurs at least one pattern. The Max-Eigen statistic is greater than the critical value. It also rejected the main assumptions. Additionally, the assumption that the long-run equilibrium is at least two and that the null hypothesis can't be ignored. The Max-Eigen statistic is less than the critical value. It can be concluded that the equilibrium relationship There are two types of long-term tests. The result is that the growth rate of gross domestic product, and the independent variables in the model in 2010 – 2017 are moving together into a long-term equilibrium relationship.

4.4 Analysis of Factors Affecting the Relationship between Money Variables

From the correlation tests, it was found that the Gross Domestic Product (GDP) and the amount of money from the above equation Tests were performed using the least squares regression (Ordinary Least square: OLS). Estimates must have linear properties that are not biased. The Best Linear Unbiased Estimators (BLUE) have analysed the following problems:

1.The independent variable problem is linear. Multicollinearity tests with Simple Correlation Coefficients and Variance Inflation Factors (VIF) are based on the Pairwise Correlation Matrix. Simple Correlation Coefficients were used to determine whether a pair of values with correlation coefficient greater than 0.85 resulted in a multicollinearity problem. The correlation coefficients from 2002 to 2009 were 0.6259 and 0.4059, respectively. Multicollinearity If the value is greater than 0.85, the value of VIF can be considered. If the value is less than 10, then the problem of multicollinearity (Nitipong Songsirroj, 2010) can be considered multicollinearity.

From the relationship value Correlation between the amount of money in the system. And the Gross Domestic Product (GDP) when electronic money is used: an increase in the amount of electronic money and money. The continued increase in consumption in Thailand has a positive correlation coefficient to the Gross Domestic Product M1 has the most positive correlation coefficients for the two time periods analyzed.

2. Non-constant variance problems or Heteroskedasticity The White's Heteroskedasticity test was used to determine the problem. The P-value was 0.7778 and the P-value was 0.7778 during the period from 2002 to 2009. At the 95% confidence level, the null hypothesis (H0: Homoscedasticity) and the null hypothesis (Heteroskedasticity) were used. Heteroskedasticity

3. Correlation problem of discrepancies (Autocorrelation) is to test whether the error (Error term) of the variable is related to each other or not. Initially, it can be determined by the value. Durbin-Watson (D.W.), which approach Durbin-Watson Test is an easy way out of statistical values. Durbin-Watson in 2002-2002 was 2.1076 and during the year 2010-2060 it was 3.0508. Durbin-Watson, where n = 32 (number of samples) and k = 3 (independent variables), was obtained from Table dL = 1.177 and dU = 1.732, but the values were 2.1076 and 3.0508, respectively. dU <d <4- dU at the 95% confidence level. Accepted assumptions (H0: Non-Autocorrelation) and 3.0508 over the defined range are not conclusive. issue Autocorrelation, can't be put into total.

From the above investigation, it was found that the model used in the estimation was the unreliable standard error in the estimation of coefficients from the regression equation by the least squares method. Neway-West method was used to solve the standard error of the Ordinary Least square (OLS)[9] regression equation. The result of the solution is that the error is high. Increasing and decreasing the size of the t-statistic results in the least squares equation.

Equation of gross domestic product (GDP)

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[9] เฉลิมพงษ์ คงเจริญ (2547). การใช้โปรแกรม Eviews ร่วมกับ Gujarati, D. Basic Econometrics. 4th Edition. 2003.

Estimation of the GDP equation was estimated at the time of the year 2002 - 2009, the coefficient estimated from the regression equation by the least squares method.

$$GDPgrowth = [0.0109 + 0.6541M1gr_{it} - 0.5348\ MoneyAgr_{it} - 0.0003MoneyBgr_{it}] \quad (16)$$

(0.0041) (0.0749) (0.4239) (0.0004)

Estimation of the GDP equation for 2010 - 2017, the range of electronic money into the economy.

$$GDPgrowth = [0.0018 + 0.5427M1gr_{it} - 0.1077\ MoneyAgr_{it} - 0.0404MoneyBgr_{it}] \quad (17)$$

(0.0077) (0.1519) (0.4466) (0.1605)

***** The standard error reported in the brackets. And at the p <0.05 level.**

From the equation (16), when the coefficient R2 is 0.43, all these independent variables are considered. It can explain the amount of money at equilibrium by 43.39%. The remaining 56.61% is influenced by other variables which are not considered in equation (17). The coefficient R2 equals 0.16. 83.13 is influenced by other variables which are not taken into account in the equation. Can describe the directional pattern. And the relationship of factors is as follows.

Long-run relationships between variables were analyzed by equation Gross domestic product (GDP) correlates in the long run with 1 factor: the narrow money M1 in both time periods: Prob. Values 0.0000 and 0.0013, respectively. The confidence level is 95%, which is positive. Means that the change in the money supply in 2002 - 2009, the amount of money M1 increased by 1%, resulting in the increase in gross domestic product 65.41% and in 2010 - An increase of 1 per cent resulted in a 54.27 per cent increase in gross domestic product, indicating that, based on the situation analysis in 2010-2017, the amount of M1 contributed to the lower gross domestic product. This may be due to an increase in the amount of electronic money in Thailand. There has been a steady increase in the use of electronic money since 2014, and the amount of cash still circulating in the economy. And remains an important part of the economy.

MoneyA (M2 - M1) is a significant factor in the two periods of economic life: statistically significant at 95% confidence level. Means that the change in money supply in 2002 - 2009, MoneyA increased by 1%, resulting in a 53.48% decrease in gross domestic product and in 2010 - 2017 the amount of M2 an increase of 1 percent resulted in a 10.77 percent decrease in gross domestic product, in line with the assumption that MoneyA money could not reflect the stability of the financial system. The impact of the economic slowdown.

MoneyB (M3 - M2) in the two periods of time: statistically significant at the 95% confidence level, which resulted in a negative trend. Means that the change in money supply in 2002 - 2009, the amount of MoneyB increased by 1%, resulting in a decrease in gross domestic product of 0.03% and in 2010 - An increase of 1 percent resulted in a 4.04 percent decrease in gross domestic product, consistent with the assumption that MoneyB money does not reflect its financial stability. In the economy and contribute to the growth of the economy has declined. At present, the Bank of Thailand is able to control its monetary policy by controlling its cash flow. And control the interest rate to a low level. Consequently, the consumer price index has not increased due to the use of electronic money.

5. Summary

A study of research that affects gross domestic product in Thailand. An important part of the economy if it can replace the cash. Cash is being circulated and released electronically from financial institutions. The systematic analysis of equation systems was conducted using two data sets for the 2002-2006 and 2010-2020 periods. The unit tests were performed for stationary, because it is a time series data (Time Series data)

In the results of the study, the equation is the Gross Domestic Product (GDP). In the hypothesis, the factor of money M1 affects the change in variance over the two periods in 2010-2017. Start with electronic money information. Gross domestic product (GDP) decreased to 54.27%, which may be due to the fact that the amount of cash in the system began to affect the economy. And with the rapid increase in electronic spending from simple spending. And with a wide range of service providers, the Bank of Thailand has to cooperate with commercial banks and private companies to provide electronic funds to allow more regulated businesses to make more legitimate payments to stimulate the economy and protect those. Efficiently access to the public to stimulate the economy. The table below shows the list of 30 E-money providers[10] that can benefit the Thai economy as a whole. The total spending through E-Money has increased

[10] ข้อมูล ณ วันที่ 20 กุมภาพันธ์ พ.ศ. 2560 : https://www.isranews.org/thaireform-other-news/54298-emoney.html

each year, that is, the year 2017. The total value of the refill is 29,766.2 million baht and the total spending is 29,780.5 million.

Table 5.1: Information of electronic money providers including non-banks.

Account A: Service businesses that provide prior notice of service.	**Account B: Registered Service Business**	**Account C: Service business that requires authorization from the Electronic Transaction Committee.**
1. PTT ICT Solutions Company Limited	- GPM Group Co., Ltd. - Chevron (Thailand) Limited - Bangkok Expressway and Public Company Limited - Major Cineplex Group Plc. - Bangkok Mass Transit System Company Limited - Central Department Store Co., Ltd. - Robinson Department Store Co., Ltd.	- Including 8 commercial banks. - including 14 other companies

There are other factors. An external variable that can affect another variable is interest rate. The central bank controls the rate of inflation that can be increased because of the amount of cash in the system, according to the federal funds rate (FER). And people are still using more cash than electronic money. Use of cash flow data is based on financial theory. Increased electronic money may affect system price stability. The key part of the variable affecting the other variables is the rate of change in cash flow (V) will change with the decrease in cash flow. This may have an effect on the economy, which may result in more difficult monetary goals. On the other hand, the central bank needs to be more stringent in its monetary policy.

The advantages of using electronic money are many benefits. Including cost of production. Fast payout system, but there are risks involved in the use of electronic money, which Thailand must continue to improve. The Value of Online Payment Transactions National e-Payment is an electronic payment system that the government is trying to push. To provide a standard electronic payment system. It is compatible with the use of technology, especially the Internet and mobile phones are expanding. The technology is used for economic benefits as a whole. The government has initiated the National e-Payment concept since its inception in 2015.

Suggestions

Caution of the use of electronic money should keep the card, or a cell phone as well. Mostly when making E-Money card lost like a lost wallet. Can lose money in the card. And interfering with penetration into financial data. In this study, there is a limit to the amount of electronic money that is collected and disseminated from 2010 to 2017, so the data used in the study is quite limited (32 Observation). In the future there is more information. It may be possible to extend the study to other variables. This will affect the growth of the domestic economy. The amount of electronic money or E-payment is a flow of money is not included in the analysis of money.

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WORKING PAPERS
FORUM 2018

REGULATING BY MARKET FORCES

Synergistic effects of CSR practices on firm value: Evidence from Asia Pacific emerging markets

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Synergistic effects of CSR practices on firm value: Evidence from Asia Pacific emerging markets

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Abstract

Corporate social responsibility (CSR) has several attributes that are inherently unobservable or measured with errors. This study proposes an alternative methodology to account for measurement errors in CSR proxies. In this spirit, this study considers CSR to be a latent variable measured by environmental (E), social (S), and governance (G) pillars. To overcome limitations of a single-equation regression, this study employs structural equation modeling (SEM) to investigate the relationship between CSR engagement and firm value. Based on corporate data of nine emerging markets in Asia Pacific from 2010 to 2016, this study provides a number of interesting findings. First, Thailand shows the best performance in terms of the average score of ESG pillars whereas China exhibits the worst. Second, this study demonstrates that traditional regression analysis produces inconsistent relationships between CSR and firm value depending on which CSR proxy enters the regression. By contrast, SEM provides decisive evidence in support of the positive CSR effect on firm value irrespective of which proxy is used to identify CSR latent variable. Third, this study shows that CSR strategies based on a single pillar of ESG or the equally-weighted average of ESG pillars understate the benefits of CSR practices for firm value creation. This implies that CSR initiatives through ESG pillars should not be conducted in isolation since the effective solutions to CSR problems should contain all pillars in order to gain benefit from their synergistic effects. Finally, a main channel for CSR in driving firm value is social engagement rather than environmental and governance involvement, thus suggesting that social activities should be weighted more heavily than other CSR measures. These results have implications for capital market developments in minimizing environmental and social impacts and enhancing good corporate governance practices.

Keywords: CSR; firm value; latent variable; ESG; structural equation modeling

Acknowledgement: This research was supported by The University of the Thai Chamber of Commerce

1. Introduction

Corporate social responsibility (CSR) has received much attention among socially responsible investors and corporate managers who have focused on responsibility to other stakeholders rather than emphasized only shareholders. According to stakeholder theory, companies that diligently seek to meet the expectations of a wider group of stakeholders will create more value over time (Driver and Thompson, 2002; Harrison and Wicks, 2013). Stakeholder theory is closely related to CSR practices to the extent that it suggests how companies can develop long-term relationship with their stakeholders (Hillman and Keim, 2001; Jiao, 2010). Despite much research on CSR effects, the direction of the impact of CSR on firm value is ambiguous and no consensus exists in the empirical literature. There seems to be more support for the view that CSR is positively associated with firm value (e.g., Ammann *et al*., 2011; Fatemi *et al*., 2015; Ghoul *et al*., 2017; Harjoto and Laksmana, 2016; Servaes and Tamayo, 2013). This strand of research believes that companies investing in CSR programs are able to improve corporate image, attract more resources, and enhance operational performance. However, the other strand of thought argues that CSR is harmful to corporate value creation since companies investing in CSR activities incur unnecessary expenses and possibly weaken competitive advantage (e.g., Crisostomo *et al*., 2011; Tandry *et al*., 2014). As a consequence, CSR and firm value may have a negative relationship or no association at all.

The conflicting results in previous research raise important questions on whether CSR activities can be conducted not only to accomplish social goals but also to enhance firm value. The relationship between CSR practices and firm value is inconsistent possibly because model misspecifications and overlooking the channel through which CSR activities affect firm value (Margolis and Walsh, 2001; Ruf *et al*., 2001; Saeidi *et al*., 2015; Servaes and Tamayo, 2013). Some scholars cast doubt on assuming a direct link between

CSR measures and firm value since this relationship tends to be impacted by other intervening or immeasurable factors (e.g., Galbreath and Shum, 2012; Griffin and Mahon, 1997; Margolis and Walsh, 2003). Therefore, the investigation of relationship between CSR activities and firm value is still warrant further methodological development.

CSR is a multidimensional and complex concept that requires the use of multiple indicators (Griffin, 2000; Margolis and Walsh, 2003; Marom, 2006). The accurate measurement of CSR relies on various attributes that are inherently unobservable or measured with errors. As a result, the use of traditional regression analysis seems inappropriate for the examination of relationship between CSR and firm value because measurement errors in CSR measures may correlate with an error term in the regression model, which in turn leads to bias in the estimation of regression coefficients (Acock, 2013; Hair, *et al*., 2012; Loehlin and Beaujean, 2017). To overcome this situation, the current study treats CSR as a latent variable and employs latent variable analysis, namely structural equation modeling (SEM), to examine the effect of CSR on firm value. Different from single-equation regression analysis, SEM consists of a system of equations and explicitly takes into account measurement errors of CSR proxies by putting measurement errors and the error term into separate equations. Measurement errors are included in the measurement equations while the error term is located in the structural equation.

Extant studies usually employ Tobin's Q ratio as a measure of firm value. There is less attention on the relationship between CSR efforts and the price-earnings (PE) ratio. Although both ratios are market-based valuation measures, Tobin's Q ratio depicts the market's valuation of a company relative to its asset-in-place whereas the PE ratio measures company's market capitalization compared to its earnings. Because of its intuitive appeal and practical simplicity, the PE ratio is one of the most widely-used metrics for how investors value firms for equity investment (e.g. Kim and Ritter, 1999; Liu *et al*., 2002). As a benchmark comparison, the PE ratio enables investors to identify firms that have deviated from their normal valuation levels and firms that are overvalued or undervalued relative to their peers. A higher PE ratio reflects greater expected future gains due to perceived growth opportunities. According to Gordon's (1962) constant growth dividend discount model (DDM), the PE ratio is positively correlated with the expected growth rate but negatively correlated to the discount rate. In addition, a number of studies show that firms conducting better CSR practices have cheaper equity financing and higher earnings growth (e.g., Ghoul and Mishra, 2011; Harjoto and Jo, 2011; Mishra and Suar, 2010). Taken together, the current study hypothesizes that companies adopting effective CSR programs would see enhanced PE ratios given more stable earnings growth and lower discount rate valuations.

This study aims to fill the aforementioned gaps in the literature by proposing an alternative methodology to explore the influence of CSR on firm value. In doing so, CSR is considered to be a latent variable and SEM with firm-fixed effects is utilized to examine the relationship between CSR and firm value. Different from traditional regression analysis, SEM directly takes into account measurement errors of CSR proxies and firm-fixed effects control for time-invariant unobservable firm-specific characteristics that may drive both CSR and firm value. Three pillar scores of environmental, social, and corporate governance from ASSET4 are used as proxies for CSR activities. Based on companies in nine emerging markets in Asia Pacific over the period of 2010 to 2016, the findings of this study reveal that traditional regression analysis produces inconsistent effects of CSR on firm value depending on which CSR proxy enters the regression model. A main channel for CSR in driving firm value is social rather than environmental and governance activities, thus suggesting that social activities should be weighted more heavily than other CSR measures. In contrast to regression analysis, when all CSR proxies are simultaneously incorporated into SEM with firm-fixed effects, CSR is significantly positively related to firm value. These findings provide important implications for socially responsible investors and corporate managers. Investors who belittle CSR practices in valuing company may commit serious errors in making equity investment choices since CSR is a key determinant of firm value. Corporate managers should engage in all dimensions of CSR because conducting CSR programs based only on any single measure of CSR tends to understate the positive impact of CSR on firm value.

The remainder of this paper is organized as follows. Section 2 presents the literature review. Section 3 explains the analytical framework. Section 4 describes the dataset and variable construction. The empirical results are contained in Section 5. Finally, Section 6 provides concluding remarks.

2. Literature review

A number of studies use single-equation regression models to investigate the relationship between CSR efforts and firm value but their findings are rather mixed. In support of a positive effect of CSR on firm value, Jiao (2010) uses Kinder, Lydenberg, Domini (KLD) data to demonstrate that CSR has a positive relationship with company value, as measured by Tobin's Q, if companies meet the expectations of their non-shareholder stakeholders, such as employees, customers, communities, and environment. Harjoto and Jo (2011) find supporting evidence that CSR engagement positively impacts operating performance and firm value. In addition, CSR action is positively associated with governance characteristics and helps reduce conflict of interest between corporate managers and non-investing stakeholders. In a similar vein, Servaes and Tamayo (2013) illustrate that CSR programs enhance firm value but only under certain conditions. Specifically, CSR of firms with high customer awareness, as proxied by advertising expenses, is positively related to firm value.

However, the relation is either negative or insignificant for firms with low customer awareness. Hawn and Ioannou (2016) employ ASSET4 CSR data of 1,492 companies in 33 countries during the period of 2002 to 2008 and their results of panel regression analysis reveal that both internal and external CSR programs jointly contribute to the accumulation of intangible assets and positively affect company's market value. Using 1,718 US companies between 1998 and 2011, Harjoto and Laksmana (2016) utilize panel regression models and find that CSR activities are positively related to firm value since CSR helps reduce excessive risk taking and risk avoidance. Recently, Ghoul *et al*. (2017) use panel regression methods based on data of 2,445 companies in 53 countries from 2003 to 2010 and report that companies in weaker market institutions exhibit more positive relationship between CSR and firm value.

While the above empirical findings have significantly contributed to our knowledge of why a positive relationship between CSR and firm value may be expected, some studies find a negative relationship or no significant relationship. For instance, Soana (2011) uses the correlation methodology to examine the link between CSR measured by ethical rating and financial performance measured by market and accounting ratios in the banking sector. There is no statistically significant relationship between CSR and financial performance. Baird *et al*. (2012) investigate the relation between CSR and financial performance by estimating linear mixed models which allow for time-invariant industry and industry-interaction effects. Their findings confirm the presence of a negative relationship between CSR and financial performance. Crisostomo *et al*. (2011) utilize CSR data of 78 non-financial Brazilian firms over the period of 2001 to 2006 and their estimations of panel regression models show that CSR initiatives are detrimental to corporate value creation. Tandry *et al*. (2014) investigates the linkage between CSR and firm value for non-financial companies listed in Indonesia Stock Exchange and their results indicate that CSR activities have no significant influence on firm value.

Several studies point out that a possible reason for the lack of consensus among prior research on the relationship between CSR and firm value is model misspecification (e.g., Margolis and Walsh, 2001; Ruf *et al*., 2001; Servaes and Tamayo, 2013). The use of traditional regression analysis that directly associates CSR proxies with firm value might be inappropriate since many factors indirectly influence this relation (Li *et al.*, 2017; Mehralian *et al.*, 2016; Saeidi *et al*., 2015). Due to measurement errors of CSR proxies, traditional regression analysis seems inappropriate for investing the link between CSR and firm value because measurement errors may lead to bias in the estimation of regression coefficients (Hair, *et al*., 2012; Loehlin and Beaujean, 2017). To tackle this problem, CSR should be considered as a latent variable within SEM framework. Unlike regression analysis, SEM uses a system of equations and directly accounts for measurement errors of CSR proxies by putting measurement errors in the measurement equations and the error term in the structural equation (Acock, 2013).

Prior studies generally use Tobin's Q ratio as a measure of firm value in investigating CSR effects (e.g., Fatemi *et al*., 2015; Ghoul *et al*., 2017; Harjoto and Laksmana, 2016; Servaes and Tamayo, 2013). Nonetheless, there is less attention on the impact of CSR activities on the PE ratio. Pietrovito (2016) points out that while Tobin's Q ratio explains the expected future earnings related to those projected by the replacement cost of the company's assets, the PE ratio describes future growth of earnings relative to the projection of current earnings. To find the determinants of the PE ratio, several studies use Gordon's (1962) constant growth dividend discount model (DDM) as a starting point (e.g., Anderson and Brooks, 2006; Huang and Wirjanto, 2012; Wu, 2014). DDM suggests that the PE ratio has a negative relationship with the required rate of return but a positive association with the dividend payout ratio and the expected growth of dividend. In addition to these factors, the equity risk premium, the risk-free rate, the debt-to-asset ratio, the market capitalization, the market-to-book ratio, and the dividend yield are considered as determinants of the PE ratio in many studies (e.g., Chua *et al*., 2015; Jitmaneeroj, 2016b; Ramcharran, 2002; Wu, 2014). The rationales of these explanatory variables are summarized as follows.

The required rate of return can be computed as a combination of equity risk premium and risk-free rate, both of which should be negatively correlated to the PE ratio (Anderson and Brooks, 2006; Kane *et al*., 1996; Ramcharran, 2002; White, 2000). The growth rate of earnings is frequently used as a measure of company growth in stock valuation, thereby indicating that the PE ratio would be positively associated with earnings growth (Fama and French, 1998). When the dividend yield is higher, the expected return tends to be higher, which in turn could result in lower PE ratio (Fama and French, 1988; Kane *et al*., 1996). Investors require higher returns to compensate for companies with highly leveraged capital structures, thus implying a negative relationship between the debt-to-asset ratio and the PE ratio (Ramcharran, 2002). Larger companies generally have higher PE ratios than do smaller companies partly because mutual funds gravitate toward investing in larger companies (Anderson and Brooks, 2006; Huang and Wirjanto, 2012). Companies with high market-to-book ratios have low growth opportunities and hence low PE ratios (Huang and Wirjanto, 2012; Wu, 2014).

3. Analytical framework

The following panel regression model is first estimated to verify whether the relationship between CSR and firm value is consistent across different CSR measures.

$$PE_{it} = \alpha_i + \beta_1 DPR_{it} + \beta_2 GRO_{it} + \beta_3 RFR_{it} + \beta_4 ERP_{it} + \beta_5 MCA_{it} + \beta_6 DAR_{it} + \beta_7 MTB_{it} + \beta_8 DIY_{it} + \beta_9 CSR_{it} + \varepsilon_{it} \quad (1)$$

where i denotes the i^{th} firm, t denotes the t^{th} year, PE is the price-earnings ratio representing the value of the firm, DPR is the dividend payout ratio, GRO is the growth rate of earnings, RFR is the risk-free rate, ERP is the equity risk premium proxied by stock beta, MCA is the market capitalization, DAR is the debt-to-asset ratio, MTB is the market-to-book ratio, DIY is the dividend yield, CSR is the proxy for corporate social responsibility, α_i is the firm-fixed effects term, β_1 to β_9 are parameters representing regression relations between explanatory variables and firm value, and ε_{it} is the error term.

The inclusion of firm-fixed effects (α_i) in equation (1) is to control for time-invariant unobservable firm characteristics that possibly drive both CSR and firm value. The lack of such controls may result in spurious results and also may account for why traditional regression models with different CSR proxies have produced inconsistent results. This study follows prior research in specifying control variables shown to impact the PE ratio (e.g., Anderson and Brooks, 2006; Wirjanto, 2012; Wu, 2014). As outlined in the literature review, the predicted signs of these controls are as follows: DPR (+), GRO (+), RFR (-), ERP (-), MCA (+), DAR (-), MTB (+), and DIY (-). Based on ASSET4 dataset, CSR measures include three pillar scores: environmental (ENV), social (SOC), and corporate governance (GOV). When socially responsible investors and corporate managers are confronted by several CSR indicators, they tend to rely on an aggregate score as a whole measure of CSR performance. Following the equal weighting scheme of ASSET4, ESG aggregate score (ESG) computed as a simple average of three pillar scores is also used as proxies for CSR activities. In estimating equation (1), one of these four CSR proxies enters the model at a time.

Recent studies show that environmental, social, and governance practices should not be advanced in isolation (e.g., Hosseini and Kaneko, 2012; Jitmaneeroj, 2016a). The effective solutions to CSR problems should make these three activities sustainable. Since CSR is a multidimensional concept and inherently unobservable, CSR can be regarded as a latent variable and latent variable analysis enables to provide a unidimensional measure of CSR (e.g., Edwards and MacCallum, 2013; Madueno *et al*., 2016; Nicolosi *et al*., 2014). A latent variable is not directly observed but rather inferred from other proxies that can be measured. Given several sub-varieties of latent variable analysis, this study estimates the following structural equation modeling (SEM) which integrates the interrelation effects of environmental, social, and governance pillar scores into one latent variable.

$$PE_{it} = \alpha_i + \beta_1 DPR_{it} + \beta_2 GRO_{it} + \beta_3 RFR_{it} + \beta_4 ERP_{it} + \beta_5 MCA_{it} + \beta_6 DAR_{it} + \beta_7 MTB_{it} + \beta_8 DIY_{it} + \beta_9 CSR_{it} + \varepsilon_{it} \tag{2}$$

$$ENV_{it} = \theta_1 + \omega_1 CSR_{it} + \mu_{1it} \tag{3}$$

$$SOC_{it} = \theta_2 + \omega_2 CSR_{it} + \mu_{2it} \tag{4}$$

$$GOV_{it} = \theta_3 + \omega_3 CSR_{it} + \mu_{3it} \tag{5}$$

Similar to equation (1) of panel regression analysis, equation (2) of SEM is the structural equation that represents the relationship between firm value and its explanatory variables. Equations (3) to (5) are the measurement equations that associate a latent variable with its proxies. To elaborate, CSR is the latent variable measured by environmental, social, and governance pillar scores (ENV, SOC, and GOV). θ_1 to θ_3 are the constant terms, ω_1 to ω_3 are parameters (factor loadings) representing relations between observed proxies and the latent variable. μ_{1it} to μ_{3it} are measurement errors of CSR proxies. As designed by ASSET4, higher pillar scores are more favorable in terms of CSR performance. This implies that the expected signs of all factor loadings (ω_1 to ω_3) in the measurement equations should be positive.

The measurement models allow each proxy to have its own unique variance and do not reflect the shared variance of the three pillar scores. This is illustrated in equations (3) to

(5), where each pillar score has a corresponding measurement error term. Since all the pillar scores should tap CSR activities, the single-factor model is used in each of measurement equations. The CSR latent variable is what the three pillar scores share in common. The measurement models assume that the latent variable accounts for how companies engage in all pillars of CSR. By isolating the shared variance of the three pillar scores from their unique variances, the structural equation of SEM is likely to produce more reliable results than a panel regression because SEM separates measurement errors from the structural equation (Acock, 2013). The measurement error terms in equations (3) to (5) should not be confused with the structural error term in equation (2). The measurement error terms are associated with proxies of the latent variable but the structural error term reflects the unexplained variance in the dependent variable due to all unmeasured causes (Loehlin and Beaujean, 2017).

It is worth noting the advantages of SEM over traditional regression analysis. First, unlike a single-equation regression model, SEM treats CSR as a latent variable and simultaneously estimates a system of equations. Second, while a traditional regression model implicitly assumes zero measurement error, SEM explicitly separates measurement errors into the measurement equations. Isolating measurement errors from latent variable results in stronger predictive power since measurement errors are assumed to be random errors and as such have no explanatory power. As a consequence, the estimated coefficients in the structural equation (2) are unbiased by measurement errors whereas regression coefficients in equation (1) are not (Acock, 2013; Hair, *et al.*, 2012; Loehlin and Beaujean, 2017). Finally, different from ordinary least squares (OLS) regression estimates, SEM usually fits the model using maximum likelihood estimation (MLE) which does not assume uncorrelated error terms.

4. Data

In socially responsible investment, CSR performance is frequently referred to an integration of environmental, social, and corporate governance performance as these factors are important measures for corporate sustainability (e.g., Nicolosi *et al*., 2014; Crifo *et al*., 2015). Since 2002, ASSET4 has gathered CSR data as measured by environmental (ENV), social (SOC), and corporate governance (GOV) pillar scores. The definitions of these pillar scores can be referred to the Appendix. By using z-scores to benchmark company's score against the average score of all companies, the pillar scores are normalized in a range between 0 and 100. Higher scores are more favorable in terms of CSR performance. The equally-weighted average of ENV, SOC and GOV scores, namely ESG score, is calculated in order to provide the aggregate measure of CSR performance.

This study focuses on companies in nine emerging markets in Asia Pacific where there is a wide variety of CSR data available over the period of 2010 to 2016. Following the definitions of ASSET4, these nine emerging markets include China, Hong Kong, India, Indonesia, Malaysia, Phillipines, South Korea, Taiwan, and Thailand. Table 1 reports the number of companies in each country and the medians of pillar scores as well as the aggregate ESG score.[1] Compared to the mean score, the median score is less affected by outliers and more suitable for comparing data across countries. Among three pillar scores, corporate governance tends to get the lowest scores for most countries including India, Indonesia, Philippines, South Korea, Taiwan, and Thailand. In terms of the average ESG score, Thailand shows the best performance whereas China exhibits the worst performance of all the nine emerging markets in Asia Pacific.

[Table 1 around here]

[1] As Soana (2011) pointed out, banks generally have specifics in financial performance and different CSR practices from other industries. In this regard, this study also excludes banks from the analysis but the estimated results are qualitatively similar. Therefore, this study presents the results of companies in all industries including banks in the subsequent analysis.

In addition to CSR data, corporate financial data employed to compute the PE ratio and control variables are obtained from Thomson Reuters Eikon whose data definitions are briefly summarized in the Appendix. It is noted that, among several definitions of the PE ratio, this study uses the trailing PE ratio as a main measure of firm value throughout the subsequent analysis. The trailing PE ratio is derived by dividing the total market value of stock at the end of the year by the total earnings of the current year. Observations for which earnings are negative are deleted. The negative earnings post a difficult interpretation since traditional earnings capitalization models describe that investors are willing to pay a certain multiple for current earnings (Huang and Wirjanto, 2012). After data treatment, the unbalanced panel data are composed of 3,427 firm-year observations in total. Descriptive statistics of variables are reported in Table 2. All variables in the dataset are positive and most of them are rather skewed. In the following analysis, the natural logarithm is thus applied to each variable before estimating equations. The logarithmic transformation somewhat moderates the skewness problems and makes slope coefficients comparable across all independent variables.

[Table 2 around here]

5. Empirical results

5.1 Panel regression approach

Prior to estimating equation (1), it is necessary to examine whether each variable is stationary. The Augmented Dickey-Fuller (ADF) test is used in this study because it is able to test unit roots of the unbalanced panel data. As shown in Table 2, the inverse normal (Z) and modified inverse chi-squared (Pm) statistics of the panel ADF tests show that the null hypothesis of panels containing unit roots is rejected for any variable at a highly significance level. This implies that all variables are stationary and can be used in a panel regression analysis.

[Table 3 around here]

The estimations of equation (1) in various scenarios are reported in Table 3. The PE ratio in model 1 is first estimated as a function of all explanatory variables except CSR proxies. This baseline model will constitute a building framework for examining the impact of individual CSR measures on firm value. The results of model 1 show that the estimated coefficient of any control variable is significantly different from zero at the 1% level, except for equity risk premium (ERP) and debt-to-asset ratio (DAR) whose estimated coefficient is significant at 5% and 10%, respectively. In line with a number of previous empirical studies, the PE ratio is positively correlated to dividend payout ratio (DPR), growth rate (GRO), market capitalization (MCA), and market-to-book ratio (MTB) but negatively associated with risk-free rate (RFR), equity risk premium (ERP), debt-to-asset ratio (DAR), and dividend yield (DIY) (e.g., Anderson and Brooks, 2006; Huang and Wirjanto, 2012; Jitmaneeroj, 2017; Ramcharran, 2002; White, 2000).

The baseline model is then extended by including one CSR proxy as an additional explanatory variable at a time. Proxies for CSR in models 2 to 4 are ENV, SOC, and GOV pillar scores, respectively. The results of models 2 to 4 show that the estimated coefficients of all control variables display the correct signs and are broadly similar to those of the baseline model. The signs and significance levels of the estimated coefficients on CSR proxies are varied depending on which CSR proxy enters the regression model. The estimated coefficients of all CSR proxies are positive with the exception of ENV. In terms of significance level, only the estimated coefficient of SOC is positive and statistically significant at the 5% level. This result indicates that SOC is the main channel through which CSR activities affect firm value. To enhance firm value, the solutions to CSR strategies should make all of these three CSR proxies achievable (Jitmaneeroj, 2016a). The analysis is then taken a step further by simultaneously incorporating all pillar scores into estimations as shown in model 5. It can be seen that the estimated coefficients of ENV, SOC, and GOV are insignificant at any conventional level of significance. Given these mixed findings, it seems difficult to draw a clear-cut conclusion on whether CSR as a whole has a positive, negative, or neutral effect on firm value.

When socially responsible investors and corporate managers are confronted by several CSR indicators, they possibly have recourse to the aggregate score which is a single indicator that could serve as a whole measure of CSR engagement in environmental, social, and governance activities. In this respect, equation (1) is re-estimated by using the equally-weighted average score of ENV, SOC, and GOV pillar scores, namely ESG score. The estimated result of model 6 in Table 3 reveals that the link between the aggregate ESG score and firm value is positive but insignificant. This finding suggests that the important role of SOC in model 3 in driving firm value is overshadowed by the equally-weighted ESG score. In fact, social activities should be weighted more heavily than other CSR measures. A lack of explanatory power of simple average ESG score is in line with Marom (2006) who argues that the aggregate CSR score seems to provide confounded results in empirical analysis of the relationship between CSR and firm performance. The current study therefore suggests that the decision to adopt CSR orientated activities using the equally-weighted ESG score tends to understate the influence of CSR on firm value since a simple average of ENV, SOC, and GOV scores assumes each factor has an identical contribution to CSR. In other words, improving the performance of any CSR activity would equally contribute to the development of CSR as a whole. This seems untrue in real world applications since different companies may have their own strategies for improving certain CSR activities at a time.

[Table 4 around here]

5.2 Structural equation modeling approach

Depending on the selection of CSR proxies to enter the model, panel regression analysis in previous subsection produces diverse relationship between CSR and firm value. Since any proxy is almost absolutely an imperfect measure of CSR, this problem can be overcome by defining CSR to be a latent variable and employing SEM to examine the impact of CSR on firm value.

Allowing for interrelations among environmental, social, and governance activities of CSR, SEM is estimated by using equations (2) to (5) which contain one latent variable, CSR, to capture the combined effects of three pillar scores. Table 4 reports the estimations of SEM, with the results of the measurement equations in Panel A, the structural equations in Panel B, and the goodness-of-fit statistics in Panel C. The first focus is on the results of measurement equations in Panel A. To identify the variance of latent variable, the factor loading (ω) of one CSR proxy in equations (3) to (5) should be fixed at 1 (e.g., Acock, 2013; Bentler and Dudgeon, 1996; Posso and Tawadros, 2013). The proxy whose factor loading equals 1 is called the reference proxy. In this regard, ENV, SOC, and GOV are the reference proxies for models 7 to 9, respectively. Regardless of the reference proxies, all estimated factor loadings (ω_1 to ω_3) in each model are positive and statistically significant at the 1% level. The positive signs of all factor loadings imply that higher pillar scores are more favorable in terms of CSR performance.

For the results of structural equations in Panel B, it is evidently clear that the main findings across models 7 to 9 are fairly consistent. The estimated coefficients of all control variables display the expected signs and are statistically significant at the 1% level, with the exception of risk free rate (RFR), equity risk premium((ERP), and debt-to-asset ratio (DAR) whose estimated coefficients are statistically significant at 5%, 5%, and 10%, respectively. Independent of which proxy is chosen to identify CSR latent variable, the estimated coefficient of CSR in any model is positive and significant at the 1% level, with a larger magnitude than those of most control variables. The results from SEM strongly support the proposition that CSR activities positively affect firm value. Strikingly, the size of the CSR effect in models 7 to 9 (0.257, 0.269, and 0.240) is much larger than that of the estimated coefficient of social pillar score in model 3 (0.046). This indicates that although SOC is a main channel through which CSR affects firm value, the benefit of CSR in driving firm value is due to the integrated effect of ENV, SOC, and GOV activities, rather than any single CSR activity. In line with suggestions of Hosseini and Kaneko (2012) and Jitmaneeroj (2016a), environmental, social, and governance activities of CSR should not be advanced in isolation because enhancing firm value needs the integration of these activities.

The results for goodness-of-fit in Panel C assess how well SEM fits the data. The value of R-squared shows that 71.08% of the variance in the PE ratio is explained. The value of R-squared is higher in SEM approach than in regression analysis (R-squared ≈ 65.00% – 68.00%) possibly because pillar scores are specified as measurements of a latent variable and measurement errors in pillar scores are moved to their corresponding error term in equations (3) to (5); that is, a measurement portion of the model is included in addition to the structural equation. The comparative fit index (CFI) of 0.971 is better than the conventional target of 0.950 (Kim, 2005).[2] The root mean squared error of approximation (RMSEA) of 0.012 is well below the goal of being less than 0.050 (Browne and Cudeck, 1993).[3] Both CFI and RMSEA goodness-of-fit statistics indicate that SEM in models 7 to 9 fits the data quite well.

[2]CFI is in the range of 0 to 1. A higher value indicates a better goodness-of-fit. An acceptable fit is larger than 0.95 (Kim, 2005).
[3]RMSEA in the range of 0.00 to 0.05 indicates close fit, RMSEA between 0.05 and 0.08 indicates fair fit, and RMSEA between 0.08 and 0.10 indicates mediocre fit. RMSEA above 0.10 indicates unacceptable fit (Browne and Cudeck, 1993)

5.3 Robustness tests

As several studies suggested, CSR is a corporate strategy that works in the relatively long period (e.g. Campbell, 2007; Garriga and Mele, 2004; Servaes and Tamayo, 2013). A possible concern in the current study is that the results reported above do not allow for an enough time lag between CSR and firm value. To address this plausible problem, SEM in equations (2) to (5) is re-estimated by lagging CSR proxies by one year for model 10 in Table 5. This kind of robustness check reduces the number of observations that can be included in the estimations so the robustness test is limited to one-year lag effect between CSR and firm value. Qualitatively the estimation results of model 10 are very similar to those of models 7 to 9 in Table 4, with a slight reduction in the estimated coefficients of CSR (0.225) and the value of R-squared (69.17%).[4] This slight weakening of the results most likely reflects the small sample size.

[Table 5 around here]

Another concern is that the trailing PE ratio is employed as a main measure of firm value throughout this study. The trailing PE ratio is usually computed using the past 12-month earnings per share. Unlike the trailing PE ratio, the forward PE ratio (FPE) is calculated by dividing the year-end closing price of stock by the forecasted earnings per share for the next 12 months. Another robustness check is conducted by re-estimating equations (2) to (5) using the FPE ratio as an alternative measure of firm value. In this study, the FPE ratio is also obtained from Thomson Reuters Eikon. Descriptive statistics and unit root tests of the FPE ratio are summarized in Table 1. Compared to those of PE ratios, the mean and median of FPE ratios are relatively lower. This suggests that the earnings per share are expected to increase in the future. For the panel ADF unit root tests, the null hypothesis that the FPE ratio has unit roots is rejected at the 1% level. Hence, the

[4] To save space, robustness checks only report the estimations of SEM using ENV as a reference proxy. Employing SOC or GOV as the reference proxy leads to the same conclusion. The complete results are available upon request.

FPE ratios can be used in the estimation of SEM. As reported in model 11 in Table 5, the estimated coefficient of CSR (0.203) is slightly lower than the estimated coefficients of CSR (0.240 – 0.269) in models 7 to 9 in Table 4.

The PE ratio is generally used to compare the relative values of firms in the same industry. Several scholars point to industry differences as an important determinant of the PE ratio (e.g., Bodie *et al*., 2014; Kang *et al*., 2010). However, time-invariant unobservable industry characteristics that possibly affect both CSR and the PE ratio are not controlled in the estimations of SEM in models 7 to 9. As a robustness check, SEM in equations (2) to (5) is re-estimated with the inclusion of industry-fixed effects.[5] The estimation of model 12 in Table 5 shows that the estimated coefficient of CSR (0.219) is within the range of models 7 to 9 (0.240 – 0.269) and that R-squared (73.17%) is relatively higher than that of models 7 to 9 (71.08%).

In addition, the goodness-of-fit statistics of models 10 to 12 in Table 5 show that CFI is greater than 0.95 and RMSEA is lower than 0.05 for any model. These measures of fit are all acceptable, indicating that SEM is adequate. Taken altogether, even though there are some variations of the estimated results across several SEM specifications and CSR proxies, the results of robustness checks in models 10 to 12 in Table 5 are broadly consistent with the findings of models 7 to 9 in Tables 4. Therefore, it can be concluded that this study finds robust evidence of the positive CSR effect on firm value for companies in emerging markets in Asia Pacific.

[5] By the same token, the inclusion of country-fixed effects leads to the same conclusion despite some variations on the estimated coefficients.

6. Concluding remarks

6.1 Conclusions

To gain more nuanced understanding of the CSR effect on firm value, it is necessary to account for measurement errors in CSR indicators. However, many prior studies often assume a direct link between CSR proxies and firm value and employ traditional regression analysis. This may lead to unreliable results or even spurious relationships since measurement errors of CSR proxies may correlate with an error term of the regression model, which in turn causes bias in the estimation of regression coefficients. In an attempt to advance the literature in this important aspect, the current study treats CSR as a latent variable and uses structural equation modeling (SEM) to explicitly take into account measurement errors of CSR proxies. Different from a single-equation regression, SEM uses a system of equations consisting of measurement and structural equations. SEM separates measurement errors of CSR proxies from the error term of regression by putting measurement errors in measurement equations and the error term in structural equation.

In this study, CSR measures are derived from ASSET4 for companies in nine emerging markets in Asia Pacific over the period of 2010 to 2016. These CSR proxies include environmental, social, and governance pillar scores. This study empirically demonstrates that traditional regression analysis provides inconsistent relationship between CSR and firm value depending on which CSR proxy is selected to enter the model. To be more specific, only social pillar score significantly positively affects firm value. Environmental and governance have insignificant influence on firm value. When all pillar scores are simultaneously used as CSR proxies in regression analysis, CSR exhibits no relationship with firm value. Similarly, the equally-weighted aggregation of environmental, social, and governance pillar scores, namely ESG score, has insignificant association with firm value.

While regression analysis produces diverse and inconclusive results, SEM decisively shows that the combined effect of environmental, social, and governance pillar scores significantly positively impacts firm value. In other words, firms engaging in all CSR dimensions including environmental, social, and governance practices can significantly add to the value of the firm. This finding is robust to the inclusion of several control variables and a series of robustness checks. This study therefore recommends that a CSR decision-making process based only on a single measure of CSR or the equally-weighted average of CSR measures tends to understate the benefits of CSR practices for enhancing firm value

6.2 Policy implications

The analysis in this study has several implications for corporate managers in conducting CSR programs to enhance firm value, capital market regulators in promoting CSR campaigns, and socially responsible investors in screening stocks for investment. First, performing CSR assessment based on any single pillar score is likely to undervalue the CSR benefits for corporate value creation. Although social engagement is a main channel for corporate value creation, the ultimate influence of CSR on firm value is due to the combined effect of environmental, social, and governance activities, rather than any single CSR activity. Therefore, corporate managers should implement strategic CSR programs covering these activities in an integrated manner. However, if a company has limited resources for conducting all dimensions of CSR programs, corporate managers should give the first priority to social rather than environmental and governance activities since social engagement is a critical driver for corporate value creation. Second, to steer CSR concerns, capital market regulators may offer tax incentives to encourage companies for taking the initiatives to minimize environmental and social impact and enhance good governance practices. Finally, as investors increasingly look beyond the traditional financial statement analysis, they can use information regarding environmental, social and governance performance when screening for potential investments and assessing potential risks. Investors who downplay the importance of CSR factors in firm valuation can lead to considerable errors in making equity investment choices as CSR is one of the key determinants of firm value.

6.3 Limitations of the study

While the current study provides important insights into the positive effect of CSR on firm value, its limitations suggest several directions for future research. First, although ASSET4 has more than 278 key performance indicators (KPIs) of CSR, this study limits the analysis to aggregated pillar scores of CSR due to data availability. If these KPIs are accessible in the future, SEM specifications proposed in this study can be re-estimated to verify whether the current conclusions hold true for KPIs. Second, this study only focuses on CSR data obtained from ASSET4. An obvious extension of this research would be an examination of relationship between CSR and firm value by using other CSR datasets such as KLD Research & Analytics and Bloomberg Sustainability. Finally, the findings of positive CSR effects for companies in nine emerging markets in Asia Pacific should not be generalized to firms in other emerging or developed markets due to possible differences in CSR practices. As CSR gains importance for companies around the world, the re-estimations of SEM for companies in other countries, especially developed economies, may contribute to the understanding of different CSR effects between emerging and developed economies.

Appendix

The environmental pillar score (ENV): This pillar score measures corporate influences on living and non-living natural systems in order to avoid environmental risk.
The social pillar score (SOC): This pillar score measures corporate abilities to generate loyalty and trust among employees, customers, and society.
The governance pillar score (GOV): This pillar score measures corporate systems and processes to assure that the company's executives and board members perform in order to generate long-term shareholder value.
The price-earnings ratio (PE): the PE ratio of a company's current share price relative to its earnings per share (EPS). EPS is last twelve months (LTM) earnings per share from continuing operations. The PE ratio is not calculated when LTM EPS is less than or equal to zero.
The forward price-earnings ratio (FPE): The FPE ratio of a company's current share price relative to its estimated earnings per share (EPS) for the next year. The FPE ratio is not calculated when forward EPS is less than or equal to zero.
The dividend payout ratio (DPR): The dividend payout ratio is the ratio of gross dividends of common stocks for the trailing twelve months divided by income available to common stocks excluding extraordinary items for the same period and is expressed as percentage.
The growth rate of earnings (GRO): The long-term growth rate of earnings is the statistical average of all broker estimates. Long-term growth is an estimate of the compound average rate of EPS growth and analyst expects over a period of three to five years.
The risk-free rate (RFR): The risk-free rate is benchmarked by the three-month treasury bill rate.
The equity risk premium (ERP): The equity risk premium is proxies by 5-year monthly beta which is the measure of a company's common stock price volatility relative to market price volatility for a 5-year duration using a least square linear regression line. 5-year beta is calculated using monthly close price values with a minimum of 40 monthly price close points required within the 5 year trading period.
The market capitalization (MCA): Company market capitalization represents the sum of market value for all relevant issue level share types. The issue level market value is

calculated by multiplying the requested shares type by latest close price. This item supports default, free float, and outstanding shares types.
The debt-to-asset ratio (DAR): The debt to asset ratio is calculated as the net debt divided by total asset. Net debt represents the sum of total debt, minority interest, redeemable and non-redeemable preferred stock less cash, cash and equivalents, and short-term investments.
The market-to-book ratio (MTB): The price to book value per share is calculated by dividing the company's latest closing price by its book value per share. Book value per share is calculated by dividing total equity by current total shares outstanding.
The dividend yield (DIY): The ratio of the annualized dividends to the price of stock. Dividends are adjusted to account for any stock splits during the 12-month period. Gross dividends are used to calculate dividend yield. The price is the closing price on the prior trading day.

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Table 1: Sample sizes and medians of ESG scores by countries from 2010 to 2016

Country	No. of companies (%)	ENV	SOC	GOV	ESG
China	96 (14.93%)	28.22	22.95	24.21	27.06
Hong Kong	47 (7.31%)	18.30	18.23	39.91	29.15
India	103 (16.02%)	59.83	55.92	33.86	54.77
Indonesia	38 (5.91%)	46.26	66.39	22.40	52.51
Malaysia	52 (8.09%)	36.86	53.13	53.61	51.55
Philippines	26 (4.04%)	33.24	35.43	31.04	38.70
South Korea	115 (17.88%)	80.08	79.37	29.01	55.90
Taiwan	130 (20.22%)	45.99	32.44	27.64	35.75
Thailand	36 (5.60%)	52.37	68.56	47.06	59.62

Notes: This table classifies a total sample of 643 companies by countries. Three pillar scores of CSR include environmental (ENV), social (SOC), and corporate governance (GOV). Following ASSET4 methodology, ESG score is computed by using the equally-weighted average of ENV, SOC, and GOV. Compared to the mean score, the median score is less affected by outliers and more suitable for comparing data across countries.

Table 2: Descriptive statistics and unit root tests

Variable	Mean	Median	Standard deviation	Inverse normal (Z)	Modified inverse chi-squared (Pm)
PE	24.14	16.10	62.12	-14.57***	16.29***
DPR	0.33	0.29	0.26	-13.58***	15.12***
GRO	0.11	0.09	0.16	-14.62***	18.71***
RFR	0.03	0.02	0.02	-15.28***	20.56***
ERP	1.14	1.10	0.69	-26.47***	32.52***
MCA	8.60	3.62	20.34	-13.66***	14.59***
DAR	0.25	0.22	0.20	-12.13***	16.83***
MTB	3.43	1.73	18.45	-21.86***	25.14***
DIY	0.02	0.02	0.02	-17.71***	21.42***
ENV	47.38	42.02	30.42	-13.34***	17.82***
SOC	46.53	41.87	31.60	-17.89***	20.89***
GOV	26.78	20.00	23.03	-18.59***	17.93***
ESG	28.32	21.90	23.47	-17.46***	17.21***
FPE	18.13	13.23	46.08	-14.48***	18.16***

Notes: This table provides aggregated descriptive statistics and unit root tests of all firm-year variables: price-earnings ratio (PE), forward price-earnings ratio (FPE), dividend payout ratio (DPR), growth rate of earnings per share (GRO), risk-free interest rate (RFR), equity risk premium (ERP) as measured by stock beta, market capitalization (MCA: billion USD), debt-to-asset ratio (DAR), market-to-book ratio (MTB), dividend yield (DIY), environment score (ENV), social score (SOC), governance score (GOV), and the equally-weighted aggregation of environment, social, and governance scores (ESG). The Augmented Dickey-Fuller (ADF) test with drift and two lags is performed under the null hypothesis that the panel variables contain unit roots. The inverse normal (Z) and modified inverse chi-squared (Pm) statistics are reported for the ADF test. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

Table 3: The estimations of panel regression models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	PE	PE	PE	PE	PE	PE
Panel A: Control variables						
DPR	0.156*** [7.14]	0.182*** [7.37]	0.182*** [7.39]	0.183*** [7.41]	0.182*** [7.38]	0.184*** [7.44]
GRO	0.307*** [38.41]	0.310*** [33.77]	0.309*** [33.74]	0.309*** [33.68]	0.309*** [33.63]	0.309*** [33.73]
RFR	-0.127*** [-4.60]	-0.145*** [-4.74]	-0.140*** [-4.58]	-0.145*** [-4.73]	-0.140*** [-4.54]	-0.143** [-4.68]
ERP	-0.017** [-2.14]	-0.035** [-2.38]	-0.035** [-2.29]	-0.034** [-2.16]	-0.035** [-2.21]	-0.035** [-2.35]
MCA	0.186*** [6.45]	0.093*** [2.74]	0.087*** [2.68]	0.100*** [2.81]	0.087*** [2.78]	0.089*** [2.77]
DAR	-0.004* [-1.83]	-0.005* [-1.78]	-0.004* [-1.74]	-0.005* [-1.81]	-0.004* [-1.86]	-0.004* [-1.70]
MTB	0.141*** [4.11]	0.167*** [4.19]	0.174*** [4.39]	0.159*** [4.09]	0.173*** [4.33]	0.171*** [4.31]
DIY	-0.179*** [-9.57]	-0.206*** [-9.56]	-0.207*** [-9.62]	-0.206*** [-9.55]	-0.207*** [-9.61]	-0.207*** [-9.61]
Panel B: CSR proxies						
ENV	-	-0.023 [-0.95]	-	-	-0.007 [-0.24]	-
SOC	-	-	0.046** [2.01]	-	0.051 [1.60]	-
GOV	-	-	-	0.003 [0.37]	0.002 [0.27]	-
ESG	-	-	-	-	-	0.035 [1.49]
R^2	0.6540	0.6724	0.6733	0.6722	0.6734	0.6729

Notes: This table presents the estimations of panel regression models in equation (1). The variables in models are listed as follows: price-earnings ratio (PE), forward price-earnings ratio (FPE), dividend payout ratio (DPR), growth rate of earnings per share (GRO), risk-free interest rate (RFR), equity risk premium (ERP) as measured by stock beta, market capitalization (MCA), debt-to-asset ratio (DAR), market-to-book ratio (MTB), dividend yield (DIY), environment pillar score (ENV), social pillar score (SOC), corporate governance pillar score (GOV), and the equally-weighted aggregation of environment, social, and governance scores (ESG). The robust t-statistics are shown in brackets. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

Table 4: The estimations of structural equation modeling (SEM)

	Model 7 ω_1 = 1	Model 8 ω_2 = 1	Model 9 ω_3 = 1
Panel A: Measurement equations			
	CSR	CSR	CSR
ENV	1 -	0.709*** [23.33]	0.697*** [4.06]
SOC	0.410*** [23.33]	1 -	0.426*** [4.08]
GOV	0.193*** [4.05]	0.167*** [4.08]	1 -
Panel B: Structural equations			
	PE	PE	PE
DPR	0.445*** [23.75]	0.445*** [23.75]	0.445*** [23.75]
GRO	0.237*** [26.02]	0.237*** [26.02]	0.237*** [26.02]
RFR	-0.021** [-2.19]	-0.021** [-2.19]	-0.021** [-2.19]
ERP	-0.031** [-2.24]	-0.031** [-2.24]	-0.031** [-2.24]
MCA	0.030*** [3.24]	0.030*** [3.24]	0.030*** [3.24]
DAR	-0.007* [-1.72]	-0.007* [-1.72]	-0.007* [-1.72]
MTB	0.196*** [15.37]	0.196*** [15.37]	0.196*** [15.37]
DIY	-0.435*** [-26.89]	-0.435*** [-26.89]	-0.435*** [-26.89]
CSR	0.257*** [3.82]	0.269*** [3.95]	0.240*** [3.68]
Panel C: Goodness-of-fit tests			
R^2 CFI $RMSEA$	0.7108 0.971 0.012	0.7108 0.971 0.012	0.7108 0.971 0.012

Notes: This table presents the estimations of SEM using equations (2) to (5). Panel A reports the results for measurement equations. Panel B shows the results of structural equations. Panel C reports goodness-of-fit statistics. The variables in models are listed as follows: price-earnings ratio (PE), forward price-earnings ratio (FPE), dividend payout ratio (DPR), growth rate of earnings per share (GRO), risk-free interest rate (RFR), equity risk premium (ERP) as measured by stock beta, market capitalization (MCA), debt-to-asset ratio (DAR), market-to-book ratio (MTB), dividend yield (DIY), environment pillar score (ENV), social pillar score (SOC), and corporate governance pillar score (GOV). $ENV, SOC,$ and CGV are used to identify CSR of models 7 to 9, respectively. The robust z-statistics are shown in brackets. Goodness-of-fit statistics includes R-squared, comparative fit index (CFI), and root mean squared error of approximation (RMSEA). *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

Table 5: Robustness tests of structural equation modeling (SEM)

	Model 10 1-year lagged CSR proxies $\omega_1 = 1$	Model 11 The FPE ratio $\omega_1 = 1$	Model 12 Industry-fixed effects $\omega_1 = 1$
Panel A: Measurement equations			
	CSR	CSR	CSR
ENV	1 -	1 -	1 -
SOC	0.402*** [22.78]	0.414*** [21.98]	0.408*** [23.17]
GOV	0.187*** [3.95]	0.177*** [3.78]	0.187*** [4.01]
Panel B: Structural equations			
	PE	PE	PE
DPR	0.438*** [21.52]	0.419*** [19.82]	0.440*** [22.91]
GRO	0.241*** [24.87]	0.225*** [25.19]	0.239*** [25.28]
RFR	-0.020** [-2.07]	-0.019** [-2.11]	-0.020** [-2.16]
ERP	-0.030** [-2.19]	-0.031** [-2.22]	-0.031** [-2.25]
MCA	0.029*** [3.13]	0.030*** [3.06]	0.032*** [3.18]
DAR	-0.006* [-1.70]	-0.007* [-1.71]	-0.007* [-1.69]
MTB	0.193*** [13.82]	0.182*** [12.37]	0.189*** [14.92]
DIY	-0.419*** [-24.18]	-0.403*** [-23.32]	-0.431*** [-25.68]
CSR	0.225*** [3.26]	0.203*** [3.73]	0.219*** [3.59]
Panel C: Goodness-of-fit tests			
R^2	0.6917	0.6832	0.7317
CFI	0.961	0.958	0.969
$RMSEA$	0.028	0.034	0.021

Notes: This table reports the results of robustness checks using SEM in equations (2) to (5). Panel A reports the results for measurement equations. Panel B shows the results of structural equations. Panel C reports goodness-of-fit statistics. The variables in models are listed as follows: price-earnings ratio (PE), forward price-earnings ratio (FPE), dividend payout ratio (DPR), growth rate of earnings per share (GRO), risk-free interest rate (RFR), equity risk premium (ERP) as measured by stock beta, market capitalization (MCA), debt-to-asset ratio (DAR), market-to-book ratio (MTB), dividend yield (DIY), environment pillar score (ENV), social pillar score (SOC), and corporate governance pillar score (GOV). The robust z-statistics are shown in brackets. Goodness-of-fit statistics includes R-squared, comparative fit index (CFI), and root mean squared error of approximation (RMSEA). *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

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The Determinants of Mutual Fund Cash Holdings: Evidence of Thailand

Ratawan Bangkarm

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Special Project Submitted in Partial Fulfillment of

The Requirements for The Degree of Master of Science in Finance

Faculty of Commerce and Accountancy

Chulalongkorn University

Academic Year 2018

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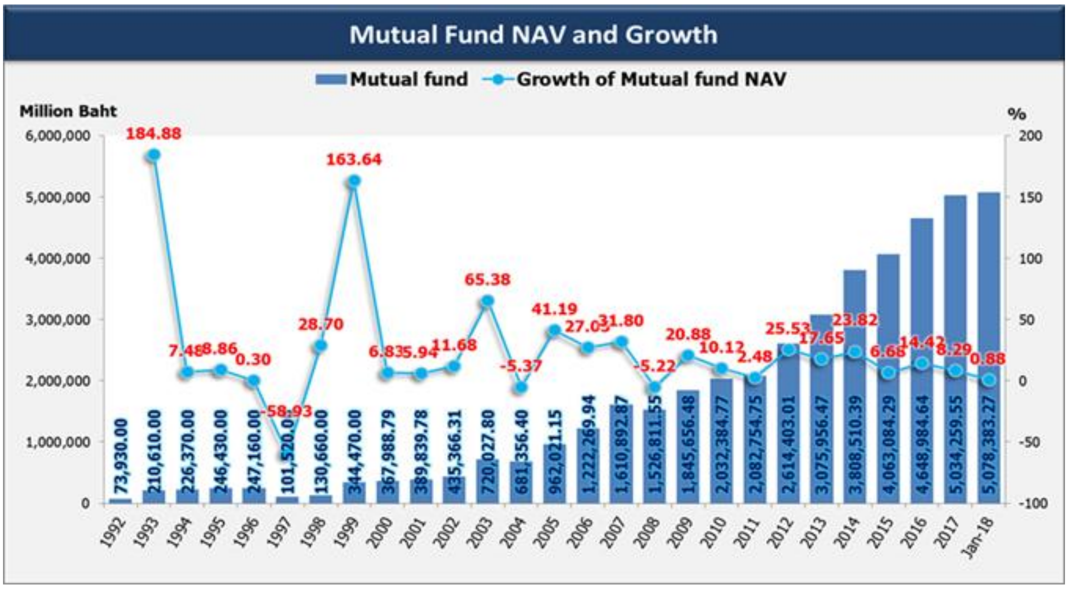
ABSTRACT

This paper examines the fund holdings of equity funds in Thailand using panel data of Thai mutual funds between 2000 and 2017, to investigate the determinants of cash holdings which are the most liquid asset class. I consider various fund characteristics that might affect to the level of the cash holdings. The results show that the exit fee, expense ratio, the past fund performance and fund size can explain the mutual fund cash holdings for equity fund in Thailand during 2000-2017. Next, I examine the stocks-picking and market timing skills using the approaches from Yan (2006) and Simutin (2013). Ranking the cash holdings into 5 quintiles. The empirical results show that no patterns for both determinants. For the optimal cash holding, I find that the patterns of expense ratio and alpha are consistent with the conditions from the previous literature. Interesting, empirical results highlight a policy implication for asset management industry. The asset managers are prone to achieve the minimum threshold for liquidity maintenance with irrational behavior on cash holding. Thus, the determinants have no effect on the behavior of holding cash. Setting the maximum amount of liquidity maintenance would be more effective for the policy and should find some variations with other determinants.

INTRODUCTION

Background and Significance of the Problem

With one simple purchase, I can invest in hundreds of different securities, hire a professional asset manager, and keep my investment cost low. That represents the power and importance of mutual funds thus they become an incredibly popular option for a wide variety of investors. The study of mutual funds has received considerable attention in the field of financial literature as well as in the study of investment due to their theoretical and empirical challenges. Mutual funds account for a large fraction of the overall asset management industry. According to Association of Investment Management Companies (AIMC), as of January 2018 the mutual funds had aggregate asset of 5.078 billion THB with 1,498 funds from 23 asset management companies.



Source: AIMC

Over the last decades, the determinants and implications of mutual fund cash holdings around the world were examined in several studies. The cash holdings component is crucial for any types of mutual fund to maintain liquidity management. Normally cash holdings are held for several purposes as a proportion of total assets under management that must be reserved within the mutual funds. In the previous literature, the cash holdings can create opportunity cost to the mutual fund by lowering the long-term fund performance. Despite how significant of the cash holdings are but the determinants of cash holdings have received little direct attention in Thailand mutual funds industry. Hence, it is worthwhile to examine and better understand the determinants of cash holdings in mutual fund asset compositions, especially the effects of a change in regulation. The regulatory bodies should strengthen the requirements on liquidity management concerning some determinants that have influence on cash holdings. The contributions will be useful implications for stakeholders who involve with the asset management industry.

Many literatures study about the relationship of cash holdings and mutual funds. For example, Constaninides (1986) suggests that cash holdings should be persistent and positively related to recent fund flows since in the presence of transaction costs, mutual fund needs to adjust its cash holdings to rebalance the portfolio continuously. Whereas in Yan (2006) illustrates that mutual funds face with the trade-off between the opportunity cost of cash and transaction costs associated with selling stocks to meet redemptions. Their findings show that cash holdings are significantly and positively related to past fund performance and fund expenses. Agarwal and Zhao (2016) investigates the effect of cash holdings on stock liquidity. Chernengo and Sunderam (2016) finds that cash holding is a good measurement of mutual fund' liquidity transformation activities, the fund manager can use as a tool to manage liquidity within fund. Furthermore, mutual funds have substantial cash holdings and use them to accommodate inflows and outflows of funds. There is also a related literature on the determinants of cash holdings in corporate that there is a target adjustment model for corporate cash holdings such as Opler et al. (1999).

Therefore, in this study, I apply the Yan (2006) and Simutin (2013) methodology, to observe the determinants of mutual funds cash holdings. Furthermore, I also focus on the responsiveness of the regulation on the cash holdings using the dummy variable. To represent the Thai equity funds, 176 funds are examined. My results highlight the important determinants of mutual funds cash holdings in Thai equity funds market and could provide early suggestion of the regulation on the liquidity requirement of the mutual funds.

The rest of this study is outlined as follows. The literature review and the data detail in Section 2 and 3. The methodology for determinants of mutual funds cash holdings and is provided in section 4. Section 5 outlines the empirical results. All determinants and the patterns of the optimal cash holdings used as empirical findings are presented in this section. Lastly, section 6 concludes and discusses the policy implication.

Objectives

This study examines the determinants of equity fund cash holdings in Thailand in 2000-2017 periods.

Research Hypothesis

Cash is the most liquid and least profitable asset. It plays an important role in asset management industry as one of the most essential issues and strategies of mutual funds liquidity management. The marginal benefit of cash holdings will decrease if the mutual funds have too much cash on hand. Whereas, all kinds of usual activities of mutual funds can be unsatisfied if the amount of cash holding is too low. Keynes (1936) defined the objectives of holding cash into three motives as the transactions motive, the precautionary motive, and the speculative motive which can be linked to the cash holdings in the mutual funds. The fund expenses and fees are viewed as the transactions motive for using cash to pay management fees and other expenses or make dividend and capital gain distributions. The fund performance, fund flows and fund volatility from redemption activities are the precautionary motive since the funds need to hold a certain amount of cash for unforeseeable events from investors and market. The speculative motive is more a result from extraordinary circumstances like market timing and stock picking skills of the asset managers for their expectations on market outlooks. In this section, I develop the following testable hypothesis by the three motives of holding cash along with the determinants of the cash holdings.

Hypothesis I-The transactions motive

a. *Cash holdings of mutual funds increase with fund expenses and entry fees, decrease with exit fees*

Yan (2006) found that on average, an increase in fund expense ratio would increase the cash holdings since fund expenses are paid with cash, funds with higher expenses need to hold more cash. As a result, this lead me to further find that, firstly, I expect to see the positive relation between the fund expenses and cash holdings. Secondly, the mutual funds with high expenses should hold more cash to reserve for paying all transactions which occur within the funds. The entry fees and exit fees of the mutual funds are typically large, salient, and one-time fee when the fund is purchased or sold. Furthermore, the cash holdings increase with entry fees as entry fees discourage new cash inflows from investors thus the fund needs to hold more cash to maintain the fund stability as no or low inflows is going into the fund. However, it is opposite for the exit fees as the exit fees deter the effects from redemptions, thus reducing the probability of a cash shortage.

b. *It is a negative relation between fund size and a fund's cash holding*

Normally, the mutual funds are constrained by the size of position they can take and hold. The large funds tend to have the economies of scale within the portfolios as the scale of the fund to hold in the position is large, thus the fund tends to hold more illiquid assets in the portfolio. Furthermore, the economies of scale leads to the cost advantage (lowering the cost of fund) for asset managers to manage the fund. The more the benefits from the economies of scale is the less cash to hold for the fund operation. Therefore, the greater the fund size, the less cash to hold in the portfolio

Hypothesis II-The precautionary motive

Cash held by mutual funds increase with uncertainty about investor redemptions.

The redemption or liquidity management of mutual funds generally creates the movement of cash flows within funds which is directly related to the underlying assets. The cash positions of mutual funds are built up when receiving inflows and draw down when suffering from outflows. Therefore, it is a precaution for asset managers to reserve enough liquidity to face with redemptions from investors in the future. The redemption activity is driven by the intersection of investor behaviors and asset under management illiquidity reflects in the relationship of fund flows and flow volatility. The mutual funds that generally invest in less liquid assets may be potentially prone to suspension of redemptions. The mutual funds with more volatile fund flows and more illiquid assets are effectively providing greater liquidity to investors. Chordia (1996) finds the evidence that mutual funds hold more cash when the volatility of redemptions increase. This is also supported by Yan (2006) that the mutual funds with more-volatile fund flows from redemptions tend to hold more cash.

Hypothesis III-The speculative motive

The asset managers with better market timing skills and stock-picking skills should hold less cash.

Normally, cash generates no growth potential return in the long term, holding too much cash could drag the fund performance. The market timing ability occurs when there is an expectation by asset managers to fund flows in market. The asset managers should actively and speculatively adjust cash holdings positions to take advantage of dynamic investment opportunities. The asset managers with better market timing ability should optimally carry less cash holdings to invest in other assets that generate higher return when there is an investment opportunity since cash normally has no growth potential in the long term. For the stock-picking skills which represented by the asset manager's alpha as the performance measure, the opportunity cost of holding cash is higher for more skilled managers since it is costly for them to hold more cash in funds as it is better to reflect their performance if they put more weights in other risky assets for their investment strategy so the asset managers who have better stock-picking skills tend to hold less cash.

Conceptual Framework

According to Thai Securities and Exchange Commission (SEC) laws, the asset management companies must invest professionally, on the other side they must achieve the liquidity maintenance within the funds at the same time. The definition of liquidity is classified into two tiers, both tiers are mainly composed of cash and cash equivalent, units in money market mutual funds, bill of exchange investment-grade fixed income instruments and derivatives. The difference between these two tiers is the length of investment time, tier I has a shorter investment period in some investment products. The minimum proportion of liquidity that the companies are required to maintain depends on the frequency of mutual fund redemptions. The more frequent of the redemption is, the less minimum proportion of liquidity maintenance is required.

Previous research documents were focusing on a relationship between cash holdings in mutual funds and a specific single factor such as fund performance, fund size, fund expenses, redemptions, asset manager skills, trading practices and investor behavior etc. Each factor responds to the amount of cash holdings differently. As mentioned the significance of cash holdings, it is beneficial to investigate the cash holdings in Thai mutual funds to observe empirically what factors determine the amount of cash holdings at fund level. The determinants of cash holding mostly find on relevant studies as there is a relationship between cash holdings and; i) Redemption or liquidity transformation ii) Marketing timing ability iii) Fund characteristics (fund size, expenses, fees, and fund past performance).

However, no research has been conducted on the determinants of mutual funds cash holdings specifically on these factors in Thailand where the mutual fund industry has been growing continuously in the increasing numbers of asset management companies, total assets under management, and numbers of mutual funds. In this paper, it will empirically analyze and test whether these factors are significant enough to explain the determinants of cash holdings in mutual funds specifically in equity funds.

Furthermore, there is a trade-off between the costs and benefits of the cash holdings. The optimal level of cash holdings should set at the level such that the marginal benefit of cash holdings equals the marginal cost. In practice, it is not optimal for mutual funds to maintain their cash holdings at a constant optimal level prior to the existing of the transaction costs. The optimal strategy is to keep the cash holdings within a certain range. The is an important implication for cash holdings to observe the persistence of mutual funds cash holdings. Another issue to investigate in this paper is the regulatory change effects on the amount of cash holdings. The SEC changed the requirements for liquidity maintenance in 2005 by indicating the minimum amount of liquidity that mutual funds must achieve. Prior 2005, there was no specific amount indicate for liquidity reserves. This may raise the question whether the mutual funds adjust themselves effectively to respond the regulatory change or not.

LITERATURE REVIEW

From the overall literatures related to the mutual fund industry, some research papers have been conducted to examine a relationship between cash holdings and some specific fund factors.

Mutual funds are engaging in substantial liquidity management especially when they need to accommodate inflows and outflows internally. Mutual fund investors are allowed to redeem any number of shares at the end-of-day net asset value or NAV. Chernenko and Sunderam (2016) illustrate that mutual funds accommodate a substantial fraction of fund flows through the changes in cash holdings indicate that redemption in asset management is highly dependent on liquidity provision. The redemptions from an open-end fund can force sales of illiquidity assets, depressing asset prices and stimulating further redemptions and fire sales.

Therefore, the asset managers are aware of the risks of fire sales and take steps to manage liquidity need.

Morris, Shim and Shin (2017) study the conditions under asset managers hoard cash as a buffer to meet redemptions without resorting to the sale of underlying assets. The cash holding may potentially reinforce the impact of investors redemptions. They have further found that the incidence of cash holdings is more severe for funds that hold more illiquid assets. Similarly, Hanouna, Novak, Riley, and Stahel (2015) find that the percentage of fund's portfolio held in cash and cash equivalents is greater when fund flow volatility is greater.

Particularly, the asset managers are perceived as more skillful and better-inform investors. The market timing skill of asset managers has been extensively discussed among various literatures. Simutin (2013) suggests that the asset managers with better market timing skill will hold more cash during the market downturn period and vice versa. These managers increase their market exposure to the market runner up and decrease it prior to downturn. Conversely, skill managers who do not find the available investment opportunity attractive or who avoid price pressure in the market may carry excessive amount of cash in the future. Yan (2006) illustrates that the opportunity cost of holding cash should higher for more skilled asset managers meaning that asset managers may hold cash when they expect future market returns to decrease. However, the result finds little evidence of systematic relation between fund cash holdings and market timing ability of managers.

Simutin (2013) recognizes the key factors impacting mutual fund cash holdings that cash holdings are affected by observable fund characteristics, such as fund expenses and fund performance. Funds with higher expenses tend to hold more cash. Further, fund size relates positively to the fraction of assets held in cash when controlled fund fee structure. Consistent with the findings of Yan (2006), presents that fund size, fund fees, and other characteristics relate to fund cash holdings. The transaction costs of funds are higher for small stocks, and consequently a shortage of cash is costly for small-cap funds. Therefore, a small-cap fund tends to hold more cash. The cash holdings are positively related to fund expenses, an increase in fund expense ratios would increase the cash holdings.

The mutual funds hold cash for many purposes such as redemption needs, transaction costs, distributions and market timing. Constantinides (1986) suggests that the cash holdings should be persistent and positively related to recent fund flows. In a frictionless world, a mutual fund rebalances its portfolio continuously to maintain the optimal level of cash holdings. However, in the presence of transaction costs, it is not optimal stage to rebalance portfolio continuously. The optimal strategy is to adjust cash holdings only they are above or below the threshold level. Yan (2006) finds that the optimal cash holding increase in transaction costs and fund flow volatility whereas decrease in asset manager's alpha. The greater the alpha, the higher the opportunity cost of holding cash as the asset managers hold less cash.

DATA

To study the determinants of Thai equity funds, there are several sources using in this analysis. The mutual funds cash holdings are hand-collected available online from SEC's the Mutual Report and Prospectus System (MRAP) database. This reporting system is required all asset management companies to submit semi-annually. The sample period is from 2000 to 2017.

Other data such as expense ratios, turnover ratios, entry fees, exit fees, beta, alpha, past fund performance, market return, risk-free rate (10-year government bond yield) and fund size can be collected from Morningstar Direct, and Bloomberg. I scope my study to all funds that originate until 2015 in Thai large-equity fund class as categorized by Morningstar. The final sample contains at least 4,109 observations representing 176 distinct funds. I do not select only funds that has data since 2000 to avoid the survivorship bias and too little sample funds. However, the survivorship bias still exits with the dead fund are excluded for this study.

Measure of fund flow and fund volatility

$$\text{Fund Flow}_{t^*} = \frac{(TNA_{t+1} - TNA_t(1+R_t))}{TNA_t}$$

Where

TNA_t represents the fund's total net asset at time t

TNA_{t+1} represents the fund's total net asset at time t+1

R_t represents the fund return in month t

*If there are the assets acquired from merger during month t, the numerator will be $TNA_{t+1} - TNA_t(1+R_t) - MGTNA$

Fund Volatility = the standard deviation of the past 12 month's fund flows

Measure of Morningstar beta and alpha (Morningstar Principia Plus for mutual funds, 1998)

To compute a beta of each fund, Morningstar performs a regression analysis comparing the monthly excess returns on a fund over the last 36 months with the excess returns on a standard index.

The regression equation is written as: $ER_{it} = a_i + msBeta_i * ER_{index,t} + e_{it}$

where

ER_{it} represents the excess return on fund i in month t

$ER_{index,t}$ represents the excess return on the index in month t

a_i represents the regression intercept

$msBeta_i$ represents the regression slope coefficient

e_{it} represents fund i's residual return in month i

As in any such regression analysis, the slope coefficient can be computed by dividing the covariance of the variables by the variance of the independent variable as follows:

$$msBeta_i = cov\,(ER_i\ ,\ ER_{index})\,/\,Var\,(ER_{index})$$

where

msBetai represrnts Morningstar's beta for fund i

For alpha computation, the intercept from the regression used to compute the Morningstar beta for each fund provides a measure of fund performance, since it represents the mean difference between the fund's excess return and that of a strategy using an index, levered up or down to have the same beta value relative to the underlying index. To produce its measure of alpha, Morningstar annualizes the regression intercept using compounding, as follows;

$$1 + msAlpha_i = (1 + a_i)\ 12$$

where

$msAlpha_i$ represents Morningstar's alpha for fund i

METHODOLOGY

To examine the determinants of cash holdings, the effects of regulation and the optimal level of cash holding, the methodology will begin as follows.

The Fund Characteristics and Cash Holdings

To study the relationship between fund- level cash holdings and various fund characteristics, this analysis will use two fixed-effects models to observe the determinants of fund cash holdings (Yan, 2006). Where cash holdings are dependent variables, control variables are Thai equity funds, and independent variables are fund fees, expense ratios, fund size, fund type, past fund performance, fund flow, and fund volatility.

$$Y_{it} = B_1X_{it} + B_2D + \alpha_i + \varepsilon_{it}$$

Where

Y_{it} represents a percentage of cash holdings

X_{it} represents fund characteristics that will affect cash holdings

D represents a dummy variable for regulatory change where D = 0 for the regulation before 2005 and D = 1 for the regulation after 2005

α_i represents unknown intercept for each entity

ε_{it} represents the error term

The rational use of the fixed effect model in Yan (2006) is the observation for the time-invariant effects variables. However, the Hausman test shows that the random effect is the appropriate model. This is because the model is added with the dummy variables for 2-time periods (prior 2005 and after 2005), thus using the fixed effect model has no effect for the observation as all variables are uncorrelated for each time and each fund. Using the fixed effect model for this regression will cause the multicollinearity problem with some variables, for example, the entry fees, the exit fees, the expense ratios, and the turnover ratios. Furthermore, the value of Y_{it} has a range from zero to infinity despite Y_{it} can be any value for the regression. Therefore, with this model, there still a bias problem with the normal regression.

The Portfolio Approach

As in hypothesis III, the asset managers with better stock-picking skills hold less cash because the opportunity cost of holding cash is higher for these managers. To test this hypothesis, I use the portfolio approach based on Yan (2006).

Step 1 Each year, forming five groups based on funds' cash holdings at the end of the previous year and rebalance these portfolios semi-annually (group 1 contains funds with the least cash holdings) and compute semi-annual TNA-weighted returns as portfolio returns for each group.

Step 2 Evaluating the performance of these portfolios by using the CAPM model by using alpha, the intercept term in the regression of fund returns on risk factors as the performance measure. The alpha should rank the highest at the group 1 to test this hypothesis.

$$\text{CAPM model: } E(R_p) = R_f + \beta_p * E(R_m - R_f)$$

Where

$E(R_p)$ represents expected return on portfolio

R_f represents risk-free rate

β_p represents beta of the portfolio

R_m represents the expected return on market

The Holdings-based Approach

To test hypothesis III, the asset managers with better market-timing ability optimally hold less cash when expecting bull market, I partly use the market timing model from Jiang, Yao, and Yu (2007) and Simutin (2013). The model proposes alternative market timing measures based on observed mutual fund portfolio holdings or holdings-based measures.

Step1 Similar to the previous model, each year, forming five groups based on funds' cash holdings at the end of each month t and rebalance these portfolios semi-annually (group 1 contains funds with the least cash holdings).

Step2 After that, find a change fund's beta for each fund using at the beginning of the period and the end of the period from t+1 to t+6. Then, calculate an average change in fund beta during the period t+1:t+6 of each quintile. The fund beta is collected from Morningstar for simplicity.

Step3 Regress the subsequent 6-month (t+7 to t+12) excess market return on the change in beta. If the managers of the fund in group i have market-timing ability, then the coefficient should be positive.

$$R_{M,t+7;t+12} = \gamma_{0i} + \gamma_{1i}\Delta\beta_{i,t+1;t+6} + \varepsilon_{it}$$

To see if there is a pattern in cash holdings, I sort the sample portfolios according to the alpha and the average change in beta into 5 quintiles and observe if there is a pattern and variation in cash holdings in each quintile.

A static model of optimal cash holdings

Yan (2006) has developed a simple model of optimal fund cash holdings by considering a two-period model. The objective of the fund is to maximize the expected TNA at t=1. At t=0, the fund allocates its money between a risky asset and a risk-free asset and assume TNA of the fund to be 1. At t=1, the return from the risky asset is realized as the net fund flow. The net fund flow can be positive or negative depends on the difference between the redemptions and new sales. Assuming a normal distribution for tractability. When the fund fails to meet the redemptions, the fund needs to liquidate a portion of its risky asset to increase cash assume that there is an expense associated with the risky asset liquidation. Therefore, the formula for the optimal cash holding is:

$$c^{*} = -\sigma\,\Phi^{-1}\frac{[[E(R)+\sigma]]}{g}$$

Where

c* represents the optimal cash holding

σ represents the level of flow volatility

E(R) represents the expected return

α represents the asset manager alpha

g represents the expense ratio

Φ^{-1} represents the inverse of the cumulative distribution function of the standard normal

Then the model obtains the closed-form solutions, the conditions as follows

$$\frac{dc*}{dg} > 0 \; \frac{dc*}{d\sigma} > 0 \; \frac{dc*}{d\alpha} < 0$$

According to the conditions, the optimal cash holding is increasing in expense g and cash flow volatility σ, and decreasing in the manager's stock-picking skill α. To study the comparative statics of the full model by using a numerical method, the baseline parameter values are given: μ = 0, E(R) = 6% per year, α = 0%, g = 1% and σ = 2%. The analysis can be plotted the comparative statics of optimal cash holdings with respect to g, σ, and α to get numerical method and observe some patterns in Thailand by using the given baseline parameter as a starting point of this stimulation. The given baseline parameter can be applicable for Thai equity funds market, with the zero mean fund flows which means that inflows and outflows are equal, the expected return of 6% is similar to the expected return of Thai equity fund market, and a zero alpha indicates the situation where the market is efficient. There will be 4 sets of data to be plotted the comparative statics of optimal cash holdings.

1) x=g y=σ z=c* given E(R)=6% α=0%
2) x=E(R) y=α z=c* given g=1% σ=2%
3) x=α y=g z=c* given E(R)=6% σ=2%
4) x=σ y=E(R) z=c* given α=0% g=1%

EMPIRICAL RESULTS

Table1 reports some descriptive statistics for the whole sample. The sample is unbalanced as each fund starts different inception year through time and there are missing data points in some variables. As a result, I have around 4,109 observations from 176 funds. The average cash holding is 6.3%, and the highest cash holding is 55.31%

Table 1: Descriptive Statistics

	Variables								
	Entry fee	Exit fee	Expense ratio	Turnover ratio	Cash holding	Return	Fund size	Fund flow	Fund volatility
Mean	0.011	0.007	0.017	210.112	0.063	0.013	1.54	-0.012	0.094
SD	0.012	0.007	0.005	273.778	0.065	0.057	4.00	0.131	0.081
Min.	0	0	0	0	0	-0.152	0	-1.126	0.017
Max.	0.08	0.032	0.03	2345.9	0.5531	0.295	6.32	1.699	1.525
Observation	4,526	4,526	4,526	4,526	4,246	4,526	4,516	4,512	4,109

Notes: Entry fee is a fee charged from an investor when purchasing the unit of mutual funds (unit: percentage). Exit fee is a fee charged from an investor when selling the unit of mutual funds (unit: percentage). Expense ratio is calculated as the total percentage of fund asset used for all expenses (unit: percentage). Turnover ratio is calculated as the percentage of mutual fund's holdings that have been replaced in a given year. Cash holding is the percentage of cash of the total holdings in mutual fund reported as semi-annually. Return is calculated as the sum of its capital appreciation and any income generated divided by the original amount of the investment (unit: percentage). The fund size is calculated as the net asset value of the mutual fund (unit: THB). Fund flow is calculated as the mentioned in the data section (unit: THB). Fund volatility is calculated as the standard deviation of the past 12 month's fund flows.

Table 2 presents the results on the determinants of fund cash holdings using the random-effect model. The sample period is 2000-2017 using semi-annual data. I include a dummy variable for period before and after 2005 as the regulatory change. *Cash holding* is the fund cash holding as a percentage of the total net asset. *Fund size* is the fund's total net assets or can be represented as the fund size. The dependent variable is *Cash holding* in the regression. The results show that the fund cash holdings are positively related to exit fee, expense ratio, turnover ratio, past fund performance, fund flow and negatively related to entry fee, fund size, and fund volatility. However, only the coefficients on the exit fee, expense ratio, past fund performance and fund size are statistically significant at the 5% level. The dummy variable is also positive and statistically significant. The results on the expense ratio, past fund performance and fund size are consistency with the previous studies. On the other hand, the exit fee is positively significant while negatively significant previously. The coefficient for dummy variable indicates that the regulatory change in 2005 affects the liquidity reserves by 2.77% increasing in the overall cash holdings.

Table2: The determinants of cash holdings table: January 2000-December 2017

	Cash holding
Entry fee	-0.332
	(0.096)
Exit fee	0.8202*
	(0.019)
Expense ratio	1.2183*
	(0.038)
Turnover ratio	0.0005
	(0.49)
Return	0.0394*
	(0.029)
Fund size	-6.88*
	(0.047)
Fund flow	1.972
	(0.098)
Fund Volatility	-0.1991
	(0.905)
Dummy	

	Cash holding
	2.7748*
R-squared	(0.00)
	0.0298

Notes: This table reports the estimation results for the determinants of cash holdings. The first line reports estimated coefficient while the second line in the parenthesis represents the t-statistics value of coefficient. The dependent variable is the cash holdings. The explanatory variables are as follows; entry fee, exit fee, expense ratio, turnover ratio, return, fund size, fund flow and fund volatility. *Dummy* denotes as the dummy variable for period before and after 2005. * represent significance at 5%. The sample period is from 2000-2017.

Table 3.1 presents the performance of fund portfolios sorted by the cash holdings. The sample period is 2005-2017. I rank all 176 funds according to cash holdings and forming five groups each year. The quintile 1 contains funds with the least cash holdings while quintile 5 contains funds with the most cash holdings. Alpha is the intercept term of this regression of the portfolio returns based on CAPM. The numbers in parentheses are t-stat value. The results show that if I see only the magnitude of coefficients, all quintiles have positive alphas indicate the outperforming the benchmark but statistically insignificant. The pattern of alpha is likely a decreasing trend from quintile1 to quintile 5 as quintile 1, the least holding group has the highest alpha as I predicted. Whereas, table 3.2 reports the reversal result as sorting the fund portfolios by alpha instead of cash holdings. The highest alpha group or quintile 5 does not has the lowest cash holdings, the highest cash holding group falls into quintile 4 where in the alpha does not at the lowest. Therefore, the lowest cash holdings quintile does not need to fall in the highest alpha opposite what I find in table 3.1.

Table 3: The cash holding and fund performance: January 2000-December 2017

Table 3.1

	Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Average cash holding (%)	0.7	2.54	4.66	7.81	16.54
Alpha-CAPM (basis point)	3.56 (0.243)	3.45 (0.201)	3.49 (0.214)	3.15 (0.236)	2.84 (0.258)

Notes: This table reports the estimation results for the cash holding and fund performance, sorted into five groups of average cash holding. The quintile 1 is the lowest average cash holdings group while quintile 5 is the highest average cash holdings group. The first line reports estimated coefficient while the second line in the parenthesis represents the t-statistics value of the coefficient. The sample period is from 2000-2017.

Table 3.2

	Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Average alpha (basis point)	-9.29	-2.69	-0.21	3.49	10.70
Average cash holding (%)	6.57	5.82	6.24	6.97	6.77

Notes: This table reports the estimation results for the cash holding and fund performance, sorted into five groups of average alpha. The quintile 1 is the lowest average alpha group while quintile 5 is the highest average alpha group. The sample period is from 2000-2017.

Table 4.1 represents the coefficients and the corresponding p-value of the market timing regressions. The sample period is 2006-2017. The fund portfolios are sorted is the exact method with the table 3. The results show that quintile 1 and 3 are negatively correlated with the average beta while other quintiles are positively correlated. The quintile 1 has the worst market timing and quintile 4 has the best market timing. All quintiles are statistically insignificant. Whereas, table 4.2 reports the reversal result as sorting the fund portfolios by the average change of beta instead of cash holdings. Quintile 1 and 2 have the negative average change of beta while quintile 3, 4 and 5 have the positive average change of beta. However, the average cash holdings fluctuate among all quintiles.

Table 4: The cash holding and market timing: January 2000-December 2017

Table 4.1

	Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Average beta	-3.59	0.8	-0.1	0.89	0.12
	(0.194)	(0.75)	(0.967)	(0.717)	(0.947)
Average cash holding (%)	6.57	5.82	6.24	6.97	6.77

Notes: This table reports the estimation results for the cash holding and fund performance, sorted into five groups of average cash holding. The quintile 1 is the lowest average cash holdings group while quintile 5 is the highest average cash holdings group. The first line reports estimated coefficient while the second line in the parenthesis represents the t-statistics value of coefficient. The sample period is from 2000-2017.

Table 4.2

	Quintile 1	*Quintile 2*	*Quintile 3*	*Quintile 4*	*Quintile 5*
Average beta	-0.1432	-0.0461	0.0031	0.0548	0.1798
Average cash holding (%)	16.879	15.9514	17.2906	16.2153	16.4583

Notes: This table reports the estimation results for the cash holding and market timing, sorted into five groups of average beta. The quintile 1 is the lowest beta group while quintile 5 is the highest beta group. The sample period is from 2000-2017.

Figure 1 presents the comparative statics of optimal cash holdings under 4 sets of Thai equity data based on the static model presented in previous section. The baseline parameter values are as follows: $\mu = 0$, $E(R) = 6\%$ per year, $\alpha = 0\%$, $g = 1\%$ and $\sigma = 2\%$

Figure 1: Comparative Statics of Optimal Cash Holdings

Figure 1.1 when x=g y=σ z=c* given E(R)=6% α=0%

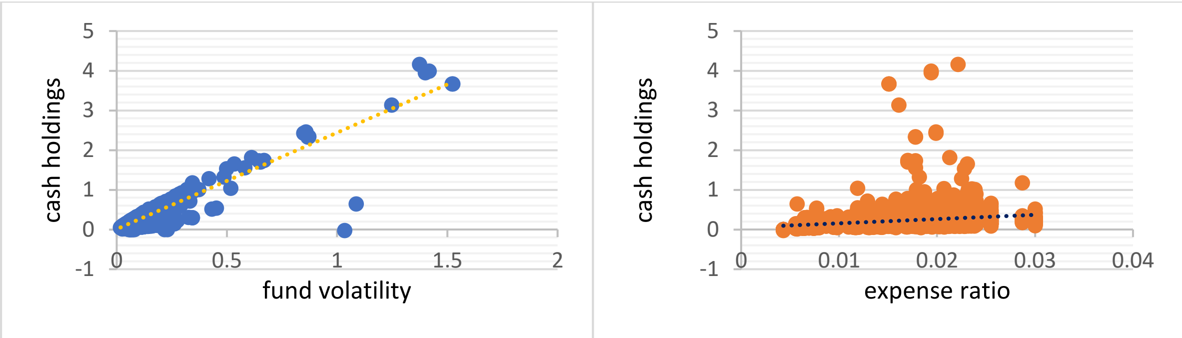


Figure 1.2 when x=E(R) y=α z=c* given g=1% σ=2%

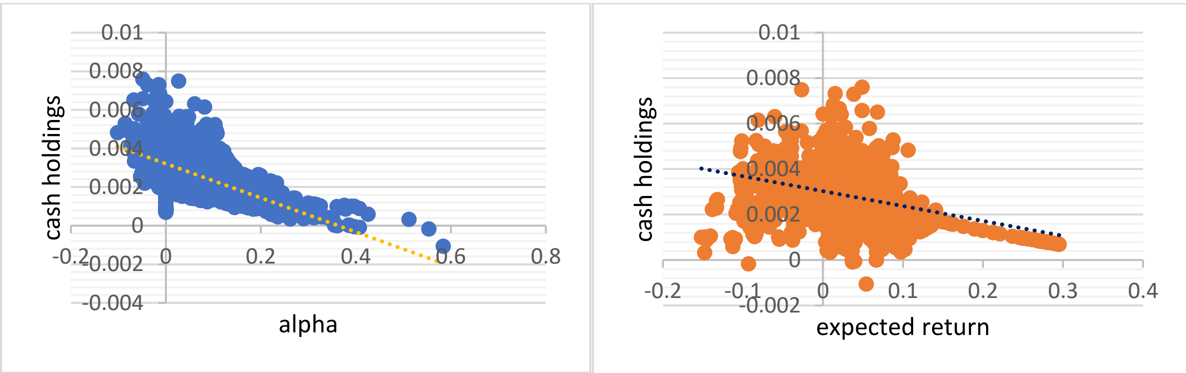


Figure 1.3 when x=α y=g z=c* given E(R)=6% σ=2%

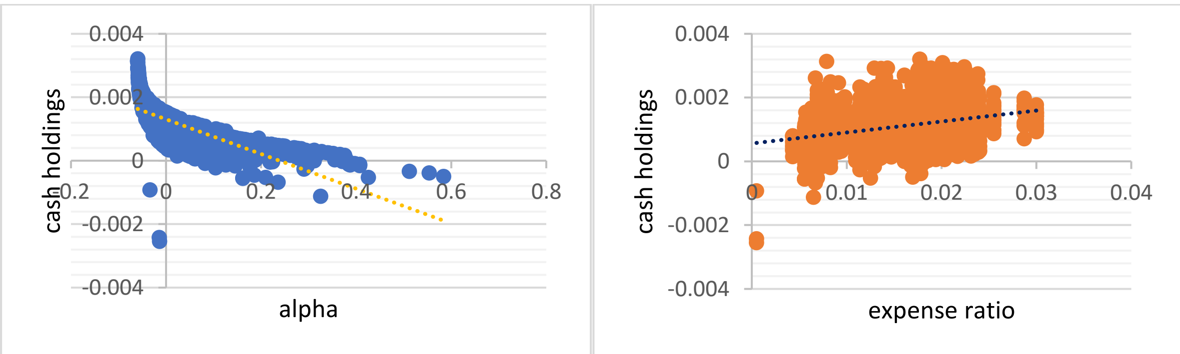
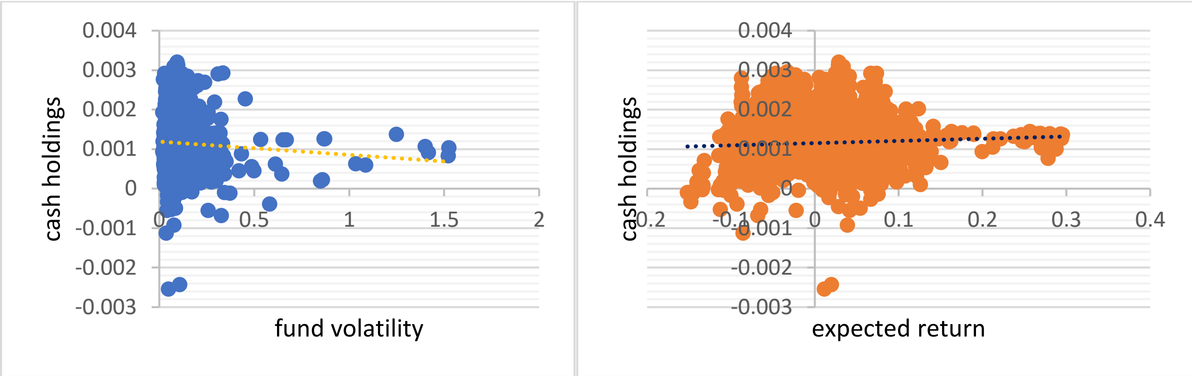


Figure 1.4 when x=σ y=E(R) z=c* given α=0% g=1%



The results indicate that the optimal cash holding increases in expense ratio decreases in asset manager's alpha. For fund volatility, it is inconsistent as in figure 1.1, the optimal cash holding increases in fund flow volatility whereas in figure 1.4, the optimal cash holding decreases in fund flow volatility. This inconsistency occurs with the expected ratio in figure 1.2 and 1.4 as well. For fund volatility, scenario 1.1, it satisfied with the condition as the higher the fund volatility is, the more cash to hold within the fund. However, the result in scenario 1.4 is opposite the condition, this might because under the situation that no alpha at all, with the greater the fund volatility fund pursues to hold less cash to bet for the higher return since low expected returns on cash can hinder fund performance.

Robustness check

Hausman Test

To check the selecting the correct model between the fixed effect model and random effect model, I run Hausman test to check whether my sample fit with fixed effect model or random effect model. According to the test, the null is random effect model is appropriate. In this case, the Chi-square is 6.55 and p-value is 0.0876 which is more than 1% significance level. As a result, the null hypothesis is accepted meaning that the random effect model is more appropriate.

Heteroskedasticity

It is necessary to check if our result exhibit Heteroskedasticity which could provide biased estimator from my sample. I run Breusch-Pagan test to confirm my result. I need to reject the null hypothesis which means there are heteroskedasticity. The result shows that the p-value is close to 0 which less than 1% of significance level.

Multicollinearity

To test the disturbance in data from a very high intercorrelations or inter-associations among the independent variable, I use variance inflation factor (VIF) test to check the multicollinearity problem. The VIF value is less than 2 meaning that there is no multicollinearity problem as the value of VIF must greater than 10 to indicates the problem of multicollinearity.

Robust standard error

I robust my result with robust command in Stata. The result shows that the exit fee, expense ratio, past fund performance, fund size, and timing dummy still have statistically significant. The t-test still have above significant level.

CONCLUSION

To examine the determinants of cash holdings of equity funds in Thailand, this study has considered all explainable variables that possibly cause the movement in fund cash holdings such as fund characteristics, fund performance and market timing. In this paper, I use the methodology based on Yan (2006) and Simutin (2013). The first empirical analysis explored the determinants of cash holdings with various fund characteristics, by using panel cross-sectional regression over the period of 2000-2017. The results show that the exit fee, expense ratio, the past fund performance and fund size can explain the mutual fund cash holdings for equity fund in Thailand during 2000-2017. I find that when the exit fee, expense ratio and past fund performance are increasing, the mutual fund cash holdings is also increasing whereas the fund size is in the opposite direction. The mutual funds with high expense ratio is needed to hold more cash holdings to preserve funding status after using cash to cover all transaction costs once occurred. However, the result from the exit fee contradicts with my prediction. In this case, I find that the more exit fees lead to the more cash holdings. The exit fees cannot deter the effects from the investors redemptions thus the probability of cash shortage still exist. I also find that the large fund size seems to hold less cash. Normally, the large mutual funds tend to benefit from the economies of scale from their size. The economies of scale leads to the cost advantage (lowering the cost of fund) for asset managers to manage the fund. The more the benefits from the economies of scale is the less cash to hold for the fund operation. Therefore, the greater the fund size, the less cash to hold in the portfolio. However, I cannot find significant relationship between the investors redemptions and the cash holdings. Furthermore, the result from testing dummy shows that the Thai equity funds adjust themselves effectively to respond the effects of regulatory changes in 2005 as increasing in level of cash holdings on average.

The second part of the study examines the relationship between the stock-picking skills of asset managers and cash holdings by using the portfolio approach. All quintiles of cash holdings outperform the benchmark but statistically insignificant. This might because the using of CAPM model gives the inappropriate explanation for my sample data. The lowest cash holdings quintile does not always generate the highest alpha. The result for the relationship between the market-timing ability and cash holdings shows that quintile 1 as the least cash holdings group has the worst market-timing ability which is consistent with the previous study. However, all quintiles are statistically insignificant. I find no pattern for the relationship between the cash holdings and the market timing. The cash holding ability of the market timing cannot explain systematically in this case. The way I construct these cash holdings portfolios might hinder the real effects from stock-picking and market timing skills. Each fund might have the effect individually. I reverse these two approaches and find that for the stock-picking skills, the high alpha quintiles do not need to fall in the low cash holdings quintile as predicted. For the market timing skills, I still find no pattern for the market timing with cash holdings.

Lastly, the optimal cash holding model represented by comparative statistics in figure 1. I find that only expense ratio (g) and asset manager's alpha are satisfied the conditions from previous study as the optimal cash holding increase in expense ratio as the higher expense ratio costs the fund to hold more cash. Another observation is the optimal cash holding decreases with the asset manager's alpha. The intuition for this pattern is that the greater asset manager's alpha, the higher the opportunity cost of holding cash. These results support the previous section of this analysis. The optimal strategy for a fund is to keep its cash holding within a certain range, and to trade only when the cash holding is either too high or too low. For fund volatility, scenario 1.1, it satisfied with the condition as the higher the fund volatility is, the more cash to hold within the fund. However, the result in scenario 1.4 is opposite the condition, this might because under the situation that no alpha at all, with the greater the fund volatility fund pursues to hold less cash to bet for the higher return since low expected returns on cash can hinder fund performance. However, the cash holdings can also be affected by other fund characteristics that excluded from this analysis and the different fund categories can affect in several directions either positive or negative, which could be extended for the further study.

Overall, this empirical analysis of mutual funds cash holdings shows evidence that partly consistent with the model predictions from previous study. My findings highlight an implication on asset management policy that the policy makers set the rule as the minimum amount of liquidity maintenance for each type of mutual funds to have the cautious investment strategies and appropriate with the type of funds and investors. The asset managers can invest with risk diversification and are able to maintain the liquidity for any circumstances. However, if any funds already achieve the minimum requirement threshold set by the policy, any determinants I test here should have no effects at all. In fact, the funds might hold cash with irrational behavior. They can hold any amount of cash as they pursue which might too high or too low. Furthermore, if the asset manager has high confidence over the minimum threshold that he reaches, he might consider abusing the investors by get paid from fees by do nothing since there are no variations to some fund variables. Setting the maximum amount of liquidity maintenance would be more effective for the policy and should find some variations with other determinants.

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APPENDIX

The Hausman test

```
Test:  Ho:  difference in coefficients not systematic

              chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =        6.55
            Prob>chi2 =      0.0876
            (V_b-V_B is not positive definite)
```

Heteroskedasticity test

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CashNet

         chi2(1)      =   212.13
         Prob > chi2  =   0.0000
```

Multicollinearity test

```
.
.  vif
```

Variable	VIF	1/VIF
Return	1.39	0.720959
Fundflow	1.37	0.732410
EntryFee	1.15	0.867765
ExitFee	1.13	0.881312
turnoverra~o	1.07	0.931000
NetExpense~o	1.06	0.947086
NetAssetss~s	1.05	0.952265
FundVolati~y	1.04	0.965556
Mean VIF	1.16	

WORKING PAPERS
FORUM 2018

REGULATING BY MARKET FORCES

The stochastic trading system through the ex-ante expectation of the maximum drawdown and the maximum drawup: Theory and empirical evidence in the Thailand stock market.

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Somporn Punpocha

The stochastic trading system through the ex-ante expectation of the maximum drawdown and the maximum drawup: Theory and empirical evidence in the Thailand stock market.

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Abstract

This article studies about the expected value of the maximum drawdown and the maximum drawup through the PDE approach. The pricing equations of these expectations based on the discount Feynmann-Kac theorem are exhibited. The comparison between the ex-ante values and the ex-post ones are accomplished through the closed-price daily data of SET50 index and of TFEX SET50 options during Jun 29, 2017 to Sep 26, 2018. Three kinds of the volatility were investigated. These are the 25% fixed volatility, the 30-day historical volatility and the implied volatility. The last one is recommended so that the ex-ante values are not only the path dependent process, but also reflect the market anticipation in the future via the prices of the options. The experiment found that the ex-ante values precisely and quickly converge to the ex-post values. Then, this article proposed a trading system based on *the stochastic analysis*. The ex-ante values of the maximum drawdown, the maximum drawup, the running maximum and the running minimum are considered together in order to foresee the market view. The numerical experiments were performed and found that the proposed trading system can generate the precise and quick trading signals before falling down or rising up.

1. Introduction

An Asset price movement involves with many financial activities such as risk management, portfolio performance evaluation and asset pricing. The first interests in the rising price. On the contrary; the latter interests in the falling down price. The last interests in the excess return respected to its risk. Therefore, the movement characteristic of an asset price affects to all activities in the financial market.

There are six parameters used to describe the path of asset price $S(t)$. These are 1. The running maximum, $M(t)$ 2. The running minimum, $m(t)$ 3. The drawdown, $DD(t)$ 4. The drawup, $DU(t)$ 5. The maximum drawdown, $MDD(t)$ and 6. The maximum drawup, $MDU(t)$. The running maximum is the path of maximum since the initial to time t while the running minimum is the path of minimum price in the same period of time. The drawdown is the distant from the running maximum to the asset price at time. The drawup is the distant from the running minimum to the asset price at time t. The maximum drawdown is the maximum value of drawdown since the initial to time t. Lastly, the maximum drawup is the maximum value of drawup since the initial to time t. These parameters that describe the price movement can be exhibited in Fig. 1

From Fig. 1, the running minimum of the presented asset path observed up to time t is similar to the support level. It is the decreasing function. The running maximum, contrarily, is the increasing function. It acts as the resistance level. The exhibited drawdown and drawup are the price falling down and price rising up at expiry date T respectively. The maximum drawup and maximum drawdown at time T are not necessarily occurred at the expiry date. They can appear at any time during the observation period. According to the given asset path, they successively turn up at time s_1 and s_2. The maximum drawdown and the maximum drawup are the increasing function. The example paths of the running maximum/minimum, drawdown/drawup and the maximum drawdown/drawup are shown in Fig. 2

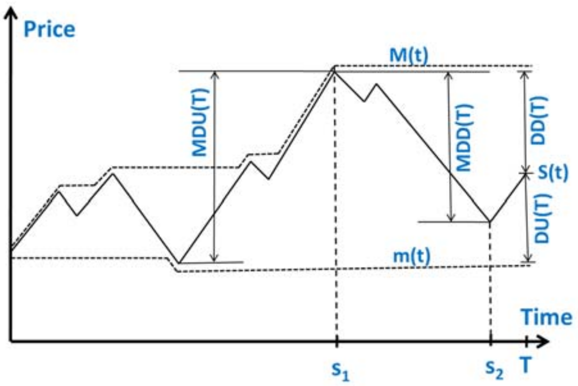

Fig. 1 The parameters of an asset price movement

Fig. 2 show the simulated asset price path generated by Geometric Brownian Motion (GBM). The initial price, the running maximum and the running minimum start at 1300. When the peak of price path increases, the running maximum increases. Conversely, when the bottom of price path decreases, the running minimum decreases. The drawdown, drawup and their maximum start at 0. Both distance of price falling down and rising up are the time varying, but the maximum drawdown (drawup) change if any only if the peak of drawdown (drawup) increases.

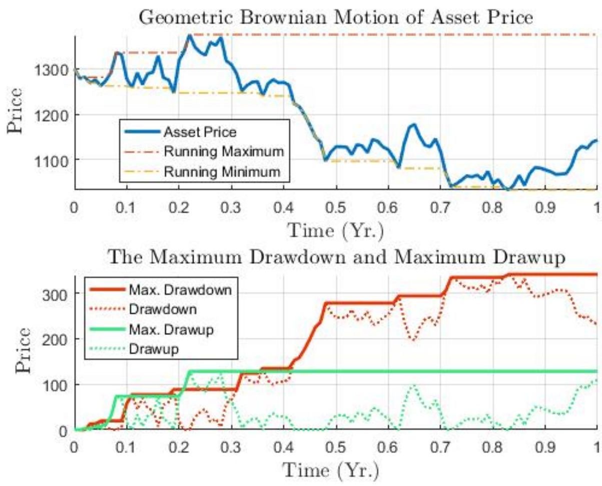

Fig. 2 The running minimum, the running maximum, the maximum drawdown and the maximum drawup of an asset path

The maximum drawdown and maximum drawup are the characteristic of asset path so that they are easy for the investors to understand. Moreover, they are directly involve with profit and loss that is the investors' first priority. Therefore, both of them are more suitable to exhibit the risk and the opportunity than the volatility or the standard deviation.

If the fund managers can calculate the expected value of the maximum drawdown in the next time frame, they can suitably allocate the risky asset or use the derivatives in order to make the drawdown range under control along the investment horizon. The portfolio's maximum drawdown is important to the long-term fund survival. The diminishing capital is easier to be perceived than the long-term expected return. The risk averse investors may close their accounts if the net asset value (NAV) of their funds decreases below their tolerated levels. The more number of the closed accounts, the more diminishing of asset under management (AUM). Funds have to been closed if their AUMs are less than some thresholds.

The hedge fund revenues come from the incentive fee, so the protection of its high-water mark is the first priority. The expected maximum drawdown of the next window frame is related to the expected high-water mark. Therefore, it has to make a decision whether to continue trading or to accept the incentive fee from the current level of its high-water mark.

The maximum drawdown is used to compute many risk ratios in the insurance industry. The normalized return by the maximum drawdown is easier to understand than by the standard deviation. The examples of the risk ratio normalized by the maximum drawdown are the Calmer ratio and the Burke ratio [6]. The first one is the return to the maximum drawdown. The latter is the excess return to the root of the sum of the maximum drawdown. If the expectation of maximum draw is known, then the expectation of these ratios are known.

The maximum drawup is referred to the investment opportunity. The difference between its expected value and the asset price implies the upside gain in the next window frame. Thus, the market trend can be foreseen through four parameters [6]. These parameters are drawdown, drawup, maximum drawdown and maximum drawup.

Fig. 3 shows the histogram of the maximum drawdown and the maximum drawup by Monte-Carlo simulation. The data used in the simulation are S&P500 index on Mar 26, 2008 which is 1,329.5. The risk free rate and the volatility is 4% and 19% successively. The simulation model is GBM with fixed both risk-free rate and volatility for the whole period (1 yr.) Two graphs on the right hand side implement the control variate variance reduction. The others are simulated without any variance reduction technique. The simulation results show that the distributions of the maximum drawdown and the maximum drawup have strong positive skewness and high variance. The variance reduction technique decrease only few degrees of variance.

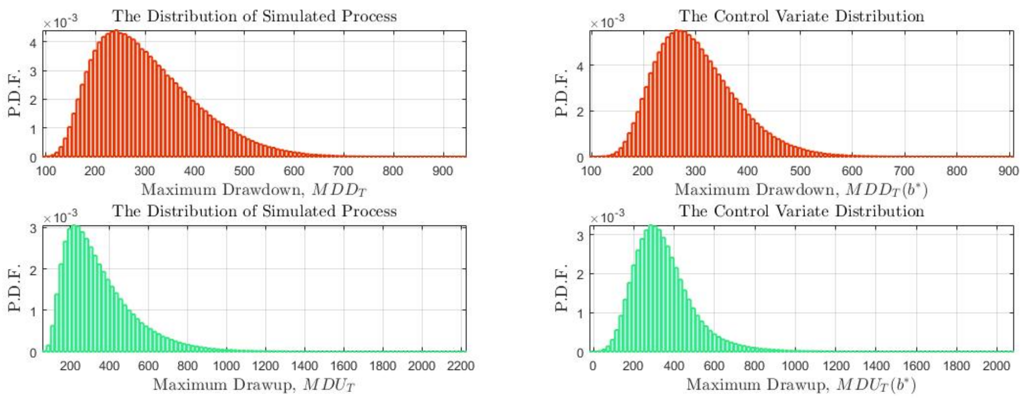

Fig. 3 The density distribution of the maximum drawdown and maximum drawup by Monte Carlo simulation

Since there do neither exist the density probability function of the maximum drawdown nor the maximum drawup, the importance and the satisfied sampling cannot be implemented. Moreover, the definition of both parameters is in the continuous function $\max(\ )$ [34]. The simulation has to use the miniature time step in order to observe the peaks and the bottoms of the continuous asset movement for the whole path. The more little in step of time, the more data have to simulate. The sorting of numerous data consumes an enormous time. This makes Monte-Carlo spend massive computational time. However, the estimated variances of the expected maximum drawdown and maximum drawup still high. Therefore, the Monte-Carlo simulation is ineffective to compute the expectation of both parameters. It is necessary to use another approach to calculate the expected maximum drawdown and expected maximum drawup.

Let T be the expiry date. From the definition of the drawdown and the drawup, they are equivalent to the payoff of the lookback call and lookback put options as shown in Fig. 4. These pay-offs have some relations with the characteristic parameters used to describe the movement of the asset price. Therefore, the price of financial derivative traded in the market can reflect the market view in the next window frame.

Suppose that there exists the derivative forward contract on the maximum drawdown maturity at time T traded in the market. The expected value of the maximum drawdown on the expiry date is the price agreement of this contract [26]. Therefore, the estimation of this parameter expectation is equivalent to the estimation of the contract price. The risk neutral formula and the Martingale representation theorem can be implemented if there exists the vector of parameters following on the Markov process. Then, the discount Feynmann-Kac theorem is used to derive the Partial Differential Equation (PDE) of the pricing equation [30]. The expected maximum drawdown, in consequence, is the solution of this PDE.

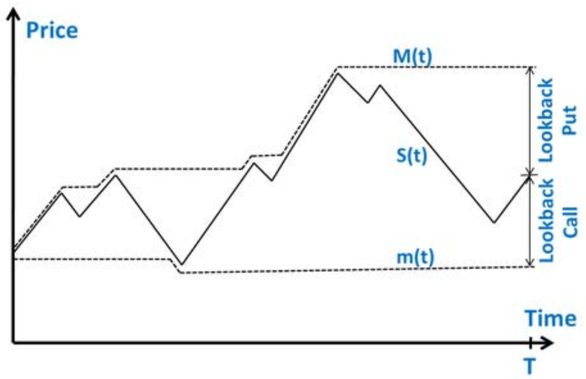

Fig. 4 Pay-off an expiry date of the lookback options

The discovery of PDE pricing equations of the derivative forward contracts on the maximum drawdown [26] and the maximum drawup [18] is contributed to the estimation of the expected value of the both parameters. However, the PDE pricing equation is in the form of 3D unsteady-state parabolic. The transfer functions have to be invented for the dimension reduction and domain reformation. Then, the numerical approach is used to solve this transformed pricing PDE on the 2D computational domain.

The derived pricing PDEs base on the assumptions of the Black-Scholes-Merton (BSM) model. The risk-free rate and the asset price volatility are treated as constant over the life of the contract. Accordingly, the derived pricing PDE is just 3D. The, The ADI (Alternating Direction Implicit) method based on Douglas-Rachford together with the created transfer function successfully lead to the solution of the pricing PDE [26].

However, the dimension reduction cannot be implemented if the derivative contracts are the options. The created transfer functions which reduced the dimension of the forward contract are not hold. These functions used as the technique of dimension reduction is effective to the linear pay-off such as the forward contracts' while is ineffective to the nonlinear pay-off. Many contracts like the options have the non-linear pay-off especially the option contracts on the maximum drawdown and the maximum drawup. Moreover, the dimension of the pricing PDE will be increased if some of the BSM assumptions are relaxed. The stochastic processes of the volatility and the risk-free rate make the dimension increase. Therefore, the alternative numerical methods which support the multi-dimension PDE are needed to advocate the further comprehensive models.

The modern schemes of the ADI method, called the operator splitting, are employed to compute the forward price of the contracts on the maximum drawdown and the maximum drawup [18]. Two schemes of the operator splitting, the Douglas scheme (ADI-Do) and the Hundsdorfer-Veiwer (ADI-HV), not only give the better accuracy than the Douglas-Rachford scheme, but the modern ones also support the multi-dimension PDE.

However, these modern schemes run into the problems of memory issues [40]. The concept of the operator splitting is to arrange the PDE in form of the system of Ordinary Differential Equations (ODEs). Then, these ODEs are arranged into the system of linear equations. The inverse matrix method is implemented to solve the root of linear equations. This root finding approach consumes many resources and leads to the memory issue.

Suppose the computational domain consists of [200x200] or 40,000 nodes. The operator splitting created a matrix to represent all the relations among these nodes. Each row of the matrix indicates the relations of the interested node to the other 39,999 nodes. As a result, the matrix dimension has to be so large as [40,000x40,000] in order to exhibit all the relations among the nodes of the computational domain [18]. Nevertheless, the inverse matrix approach gives the entire surface solution at once.

The Tri-Diagonal Matrix Algorithm (TDMA) or Thomas Algorithm is implemented to eliminate the issue of memory consumption in the traditional operator splitting scheme [40]. This algorithm is used to solve the system of linear equations which the elements of mass matrix are arranged in the tridiagonal line. The system of linear equations along each line of nodes are solved one by one. In order to accomplish the surface solution, the algorithm marches a node line from one edge to the opposite side. This sweep direction is called line-by-line method. Based on the supposed domain, [200x200] nodes, the size of matrix required by the TDMA algorithm is just [200x3]. The memory consumption required by the line-by-line method is diminutive compared with the traditional matrix inversion approach.

However, the implementation of this algorithm has some trade-offs. First, the low order of the central difference has to be applied to approximate the system of ODEs. The low order approximation affects the precision of the surface solution. The other is the sweep direction of the line marching. The more numbers of the dimension the domain has, the more complication of the sweep direction the solver has to elaborate. Anyway the exchange of the low order approximation and the sweep sophistication for the improvement of memory consumption is worthwhile [40].

Without the memory issue, not only the computational domain can be extended to include more possible events, but it can also be approximated by a larger number of nodes. The precision of the solution of PDE pricing equation of the forward contracts on the maximum drawdown/drawup depend on both the domain size and the node amount [40]. Moreover, the TDMA consumes less CPU time than the traditional one. These make the operator splitting with TDMA have an efficient resource-consumption. The necessity of the parallel computing, as a result, is faded away.

Even though the numerical technique to solve the expectation of the maximum drawdown and the maximum drawup has been recently developed, there do not exist the empirical study about the comparison between the expected value of these parameters and their realized value in the real financial market. The model assumptions of the expected value of these parameters, the BSM assumptions, do not always hold in the asset prices of the real market. The parameters describing the asset movement in the real market, especially the risk-free rate and the volatility, are not the constants like they were in the models. Therefore, it is necessary to inspect the difference between the calculated expectation from the model with some fixed parameter and the realized value from the real financial market.

In this article, the difference between the ex-ante and the ex-post value of the maximum drawdown/drawup on the expiry date is explored. Accoring to the estimated ex-ante value, the novel trading system based on the stochastic analysis can be invented and proposed for the first time. The secondary daily data from the Thailand Futures Exchange (TFEX), the Stock Exchange of Thailand (SET) and the Bank of Thailand (BOT) since Jun 26, 2017 to Sep 27, 2018 are employed. The underlying asset used in this research is the SET50 index. Four series of the call and put options on that index are employed as the supplementary data used to extract the parameters of the stochastic movement. Those options, traded in TFEX market of Thailand, are the Z17 H18 M18 and U18 series.

The prices of the forward contract on the maximum drawdown and the maximum drawup are used as the proxies of the expected value. The operator splitting with TDMA algorithm is the numerical method used to solve the PDE pricing equation which is derived based on the BSM assumptions. The interest rate policy from the Bank of Thailand is utilized as the risk-free interest rate fixed at 1.5% per annum. The price volatilities used in the numerical experiment are divided into three cases. The first case fixes the volatility as constant at 25% per annum. The second case uses the historical volatility based on the past 30 business-day stock return. The last case applies the implied volatility received from the options expired at the same date as the proxy of the price volatility. It is important to realize the differences between the ex-ante and the ex-post value appeared from the selection of the volatility parameters. These results show the precision of the PDE-approach approximation. The proper approach of the volatility can be chosen in order to foresee the market view based on the ex-ante value of the maximum drawdown and the maximum drawup.

As the best of my knowledge, this article is not only the first research which studies the empirical results of the expected maximum drawdown approximation on the Thailand SET50 index, but this research, especially, is also the first one which shows the empirical evidences of the precision of the ex-ante maximum drawup evaluation in the real financial market.

This article is divided into 5 sections. The first one is the introduction. The motivation and the research methodology as well as the data collection are exhibited here. Next is the literature review. The brief reviews of some literatures are presented. The third section is the financial model. Not only the PDE pricing equations of the forward contract on the maximum drawdown and the maximum drawup, but also the solving numerical schemes are given. The next one is the empirical results. The empirical evidences of the ex-ante expectation of the maximum drawdown and the maximum drawup are introduced here for the first time. The evidences of convergence lead to the invention of a new trading system, called *the stochastic anlaysis*, based on the expected value of the maximum drawdown and the maximum drawup. Then, the last section is the conclusion and policy suggestion.

2. Literature review

The research of the maximum drawdown has been initiated in 2004 by Malik Magdon and Amir Atiya. They proposed the mathematical formula of the maximum drawdown based on the Arithmetic Brownian Motion (ABM). However, this article needs to model the asset-price movement by the Geometric Brownian Motion (GBM). Therefore, the proposed functions are not hold.

In 2006, Vecer J. proposed the concept of the approximation of the maximum drawdown through the risk neutral pricing formula. The derivative contracts whose pay-offs are equivalent to this parameter at the expiry date can be the proxies of the expected maximum drawdown based on the market agreement. Therefore, the market price of the forward contract on the maximum drawdown is the expected value of this parameter at the maturity. Moreover, this contract has to follow the risk neutral formulation. Then, the Monte-Carlo simulation is implemented to find the price of the forward contract, the ex-ante expectation. Two years latter, Pospisil L. and Vecer J. proposed the numerical approximation based on the PDE approach to estimate the expected maximum drawdown. They found that even though the asset price is the path dependence, the vector of the asset price, the drawdown and the maximum drawdown is independent from the historical path. Namely, the vector of these three parameters, $\left\{S(t), M(t), MDD(t)\right\}$, follows the Markov process. According to the Discount Feynmann-Kac theorem, the contract price is a Martingale. Hence, they successfully derived the PDE pricing equation and the boundary conditions (BC) of the forward contract on the maximum drawdown.

Their proposed pricing PDE is resemble to the BSM PDE, but it is in 3D. The independent variables of this equation are the asset price, drawdown and its maximum value. These variables are the members of the vector $\left\{S(t), M(t), MDD(t)\right\}$. In order to reduce the dimension of the problem, the transfer functions are defined. After the implementation of these functions, the PDE and its boundary conditions are transformed into 2D rectangular domain which is suitable for the numerical approach to solve the root of equation.

Their transformed PDE is similar to the well-known equation in the problem of 2D diffusion equation with mix derivative. The Douglas Rachford scheme, one scheme of the classical ADI method, is applied to solve this PDE. Unfortunately, the analytical solution of the ex-ante expectation is under research. It is necessary to use the solutions of some specific problems to verify the precision of the numerical solution.

Pospisil and Vecer indicate that the prices of the lookback options can be referred to the expected drawdown. According to the transformed PDE, if the pay-off at the expiry date is changed from the maximum drawdown to the drawdown at that time, the root of the surface solution located at the origin point is the price of the lookback put option. Thus the price of the forward contract on the maximum drawdown, the proxy of the expected maximum drawdown, is compared to the analytical solution of the lookback put option. Due to the concept combination of the forward contract representation, the Markov process, the risk neutral pricing formula, the defined transfer function and the numerical approach, they can calculate the expected maximum drawdown for the first time.

Nine years later, the researches of Vecer and Pospisil have been extended by A. Kijkarncharoensin and A. Chiarawongse. Two researchers would like to foresee the market movement by using 4 characteristic parameters of the asset price movement. These parameters are the drawdown, the drawup and their maximum value. They notice that the prices of the lookback option cannot solely forecast the market trend. The prices of lookback options are just the representations of the expected drawdown and the expected drawup at the expiry. The expected maximum drawdown and the expected maximum drawup cannot be implied by these prices. Therefore, they have extended the numerical methodology proposed by Pospisil and Vecer in 2008 to derive the PDE pricing equation for the maximum drawup.

A. Kijkarncharoensin has found that although the asset price is path-dependent, the vector of the running minimum, the drawup and the maximum drawup follows the Markov process. In other words, the vector of $\left\{S(t), m(t), MDU(t)\right\}$ follows the Markov process even if $MDU(t)$ is a path-dependent process.

When the vector related to the maximum drawup follows the Markov process, the risk neutral pricing formula, the Martingale representation theorem and the Discount Feynmann-Kac can be implemented. The price of the forward contract on the maximum drawup used as the underlying is a representation of the ex-ante maximum drawup. The basic research concept is that if there exists this contract traded in the market, then its price is the market agreement on the expected maximum drawup appeared at the expiry date.

A. Kijkarncharoensin and A. Chiarawongse proposed the derived PDE pricing equation of the expectation of the maximum drawup for the first time ever. This equation looked like to the BSM pricing equation, but it is the 3D equation. The independent parameters of the equation are the asset price, the running minimum and the maximum drawup. According to the proposed equation, its boundary condition is derived from the Martingale representation theorem. The initial condition of the PDE is the contract's pay-off which equals to the magnitude of the maximum drawup appeared at the maturity.

Since the pricing PDE is in the 3D computational domain, they have to invent the transfer functions to transform the PDE into 2D-rectangular domain. The most important research accomplishment is these created transfer functions of the maximum drawup pricing PDE. They do not only transform the domain, but also convert the pricing PDE to the one Pospisil proposed in 2008.

Even though the transformed PDE of the maximum drawdown is identical to that of the maximum drawup, the quadrant of the computational domain and the definition of the variables are different. The variable x of the 2D transformed PDE of the maximum drawdown is the relative value of the asset price to its running maximum whereas the variable x of the maximum drawup PDE is defined as the relative value of the asset price to its running minimum. The variable y of the former PDE is referred to the asset price proportional to the one at which the maximum drawdown appeared. The variable y of the latter PDE, conversely, is the proportion of the asset price to the one at the arrival of the maximum drawup. The computational domain of the former is in the first quadrant while the latter is in the third quadrant.

Similar to the case of the maximum drawdown, there exists neither the analytical formula nor the probability function of the maximum drawup. The researchers have to use the numerical approach to solve the root of pricing equation. Although the derivation of the pricing PDE is according to the BSM assumptions, they would like to implement the alternative numerical scheme which can support the more sophisticated model used in the further researches. The new numerical schemes, called the operator splitting, are applied to the root-finding procedures instead of the ones Pospisil and Vecer used in 2008

The two selected schemes of the operator splitting are ADI-Do (Douglas-Rachford) and ADI-HV (Hundsdorfer-Veiwer). The ADI-Do scheme is the first procedure implemented in many schemes of the operator splitting. The ADI-HV makes some adjustments based on the ADI-Do results for the superior precision. The researchers found that even though the results of ADI-HV have higher precision than those of ADI-Do, the precision of the latter is enough for the minimum tick size of the quote price traded in the current market.

The operator splitting approximate the PDE by the system of ODEs and then discretized the ODEs by the finite-difference approximation. Therefore, the root-finding of the PDE proposition is converted to that of the linear simultaneous equations. The discretized equations required the matrices to represent the relations among the nodes located in the computational domain. Hence, the matrices represents the domain impacts from the domain nodes on to the interested one. The concept of the domain impact make the root-finding procedure be easy to adjust the order of finite difference approximation. In this research, the researchers implemented the lower order central difference into the operator splitting to solve the pricing PDE.

A. Kijkarncharoensin showed that, for the procedure of the result verifications, the lookback call options are the special case of the forward contracts on the maximum drawup. Therefore, the program computer used for solving the proposed transformed PDE can compute the expectation of 4 parameters at once. This can be done because those parameters which are the drawdown, the drawup and the maximum drawdown and the maximum drawup have the identical pricing PDE. The differences of their estimations are just the boundary conditions and the initial conditions.

After the achievement of the ex-ante estimation, the researchers presented the market trend forecast through the expected values of the drawdown, the drawup and their maximum value. The prices of the lookback call, the lookback put, the forward contract on the maximum drawdown and the forward contract on the maximum drawup are use as the proxies of these parameters.

Although, the operator splitting used in the research implemented the low order central different to estimate the partial derivative, the results, according to the analytical formula, are more accurate than the ones proposed in 2008. Anyway, the researchers got into a difficult situation with the memory issues. The literature in 2008 evaluated the numerical solutions based on the [0.6x0.6] squared domain with three levels of the node density. These density degrees are [100x100], [200x200] and [300x300]. But the researchers were able to evaluate just to the [200x200] level before running out of memory.

In the next year, A. Kijkarncharoensin and S. Punpocha extended the numerical methodology based on the operator splitting approach done in 2017. The results published by A. Kijkarncharoensin and A. Chiarawongse implied that it might not necessary to implement the higher order approximation to the partial derivatives. The concept of the domain impact, represented the relationships among the domain nodes, consumes much memory. The memory is wasted to represent the extravagant relationships such as the bonds of the distant nodes which weakly affect to the considered node. The memory issue also weaken the strength of the operator splitting. Despite of the capability of the multidimensional solving, the operators splitting can not be utilized if the resources of the computational system are not adequate.

A. Kijkarncharoensin implement the Tri-Diagonal Matrix Algorithm (TDMA), well known as the Thomas Algorithm, to the traditional operator splitting scheme to eliminate that memory issue. He derived the discretized equation used in the operator splitting schemes, ADI-Do and ADI-HV, in an alternative approach. The members of the stiffness matrices in the system of linear simultaneous equations are arranged for the tri-diagonal alignment. In order to accomplish the implementation, the lower order of the central difference approximation has to be used for the discretization. The simultaneous equations are solved for each line of nodes. The root-finding procedure through the TDMA algorithm is kept going line by line from the one edge to the opposite side. Then, the direction of the line sweep is rotated to the other intermediate direction. The characteristics of direction sweep and line-by-line are called the line-by-line method. A. Kijkarncharoensin integrated the TDMA and the line-by-line method to the operator splitting he used in 2017 to fade away the issue of memory consumption. The operator splitting scheme with TDMA algorithm was compared with the traditional approach. The result comparisons exhibited that the interchange of the lower order approximation and the elimination of the memory issue is worthwhile. The researchers found that not only the memory but the time consumption is also much more significantly efficient.

A. Kijkarncharoensin (2018) introduced, based on the numerical experiments, that the precisions the numerical solution depend on the size of the computational domains and the density of the nodes as well. He suggested the [0.9x0.9] domain instead of the [0.6x0.6] one Pospisil and Vecer used in 2008. The recommended node density should be [301x301] through the ADI-Do scheme.

However, all of the pricing model proposed by Pospisil (2008) and A. Kijkarncharoensin (2017) are based on the BSM assumptions. One of the crucial assumption in the models is the constant volatility in the asset price process. This assumption is quite unrealistic most of the time asset traded in the actual financial markets. It is essential to examine the effects of this assumption on the estimation of the maximum drawdown and the maximum drawup. Due to the non discovery of the PDF of these parameters, it looks likely difficult to inspect the precision of the calculated expected value. In addition to this inconvenience, the expectation could not be computed from the historical data of the path of the asset price. Both of the maximum drawdown and the maximum drawup are path-dependent. The historical data are a string of data of only one asset path. A realized path can not be represented the whole population of all the possible events. However, the expected value should equal to the value of the almost surely event at the expiry date.

Therefore, it is expected that the calculated ex-ante expectation should converge to the actual value at the maturity. Vecer (2006) has ever exhibited the convergence of the ex-ante maximum drawdown, based on the Monte-Carlo simulation, to the realized value at the contract maturity in 2005. The experimental data based on S&P 500 from Jan 2005 to Jan 2006. The index opening value is at 1,211.92, fixed interest rate $r = 0.03$, fixed volatility $\sigma = 11\%$. The convergence of the ex-ante expectation based on the PDE approach of the maximum drawdown have never been examined. Moreover, there are not no researches on the evidences of the convergence especially in the case of the maximum drawup.

This article studies the empirical evidences of the maximum drawdown and the maximum drawup based on the PDE approach on the Thailand SET50 index. This research investigates not only the case of the fixed volatility, but also the cases of historical volatility and the implied volatility received from the SET50 option traded in the Thailand TFEX. This article expects that all of the three cases should converge to the ex-post value at the contract expiry. But, the convergence rate, the accuracy and the precision of the ex-ante value might be different. Hence, from the empirical evidences, even though the constant-volatility assumption does not follow the behaviors of the real financial market, the most appropriate approach of the volatility parameter can be chosen in order to estimate the expectation of the maximum drawdown and the maximum drawup. Finally, a new trading system based on the stochastic analsys of the ex-ante expectation can be created and examined.

3. Theorem

This section involves about the theorem used to compute the ex-ante expectation of the maximum drawdown and the maximum drawup. The derivation of the pricing equation was presented by A. Kijkarncharoensin (2017) in details. The operator splitting scheme, the numerical method, used in this article follows the approach of A. Kijkarncharoensin (2018). The last topic under this section is about the coefficients of the discretized equation at each region entire the whole domain.

3.1 The pricing PDE

Since the forward contract is used as the proxy of the expected maximum drawdown and the expected maximum drawup, take Ito lemma to the contract value. Because the vector of the independent variables satisfies the Markov process, the Martingale representation theorem is applied and lead to constrains of the pricing PDE used as the boundary conditions. Based on the no-arbitrage assumption, the risk neutral world exits. Hence, the contract price under risk neutral measure is a Martingale. According to the Martingale property, the pricing PDE is derived by the driftless property. The transformed pricing PDE of the forward contact is

$$\frac{\partial u(\tau,x,y)}{\partial \tau} = c_x u_x + c_y u_y + c_{xx} u_{xx} + c_{yy} u_{yy} + c_{xy} u_{xy} \tag{1}$$

where

$$\begin{aligned} c_x &= -\left(r + \tfrac{1}{2}\sigma^2\right) \\ c_y &= \left(r + \tfrac{1}{2}\sigma^2\right) \\ c_{xx} &= \tfrac{1}{2} \\ c_{yy} &= \tfrac{1}{2} \\ c_{xy} &= -\sigma^2 \end{aligned} \tag{2}$$

$u(\tau,x,y)$ is the contract price relative to the stock price. τ is time in backward direction from maturity T back to zero. The coefficients in (2) are the multiple functions to the derivative terms in the pricing equation. However, based on the assumptions of the constant value of r and σ, these coefficients are constants. x and y are relative stock price depending on the underlying of the forward contract on whether the maximum drawdown or the maximum drawup. As the master of fact, the variable x and y is the Cartesian coordinate on the transformed domain. The definitions of x and y are determined by the transfer functions of the forward contracts. In the case of the maximum drawdown, the transfer function are (3)-(4) and the boundary conditions are (5)-(8). In the other case, the maximum drawup, the transfer function are (9)-(10) and the boundary conditions are *(*11*)*-(14), successively.

For, the forward contract on the maximum drawdown

The transfer function

$$x = \ln\left(\tfrac{M}{S}\right) \tag{3}$$

$$y = \ln\left(\tfrac{S}{M - MDD}\right) \tag{4}$$

The boundary conditions

At $x=0$ $$u_x\left(\tau,0,y\right)=e^y u_y\left(\tau,0,y\right) \tag{5}$$

At $x=x_{\max}$ $$u_x\left(\tau,x_{\max},y\right)=e^{-r\tau}e^{x_{\max}} \tag{6}$$

At $y=0$ $$u_y\left(\tau,x,0\right)=0 \tag{7}$$

At $y=y_{\max}$ $$u\left(\tau,x,y_{\max}\right)=e^{-r\tau}\left(e^x-e^{-y_{\max}}\right) \tag{8}$$

For, the forward contract on the maximum drawup

The transfer function

$$x=\ln\left(\tfrac{m}{S}\right) \tag{9}$$

$$y=\ln\left(\tfrac{S}{MUD+m}\right) \tag{10}$$

The boundary conditions

At $x=0$ $$u_x\left(\tau,0,y\right)=e^y u_y\left(\tau,0,y\right) \tag{11}$$

At $x=x_{\min}$ $$u_x\left(\tau,x_{\min},y\right)=-e^{-r\tau}e^{x_{\min}} \tag{12}$$

At $y=0$ $$u_y\left(\tau,x,0\right)=0 \tag{13}$$

At $y=y_{\min}$ $$u\left(\tau,x,y_{\min}\right)=e^{-r\tau}\left(-e^x+e^{-y_{\min}}\right) \tag{14}$$

The variable x in (3) is referred to the asset price relative to the running maximum. The variable y in (4) is referred to the asset price relative to the price in the past once the maximum drawdown appear. The domain range of this contract is (15). On the other hand, x of the maximum drawup contract is the relative asset price between the current one and its running minimum. y is the relative value of the current asset price and the one at the appearance of the maximum drawup. The domain is opposite to the case of the maximum drawdown. The domain of the maximum drawup is (16)

The maximum drawdown: $$\left(x,y\right)\in\left\{0\le x\le x_{\max},0\le y\le y_{\max} \mid x_{\max}\to\infty\wedge y_{\max}\to\infty\right\} \tag{15}$$

The maximum drawup: $$\left(x,y\right)\in\left\{0\ge x\ge x_{\min},0\ge y\ge y_{\min} \mid x_{\min}\to-\infty\wedge y_{\min}\to-\infty\right\} \tag{16}$$

Since the pricing PDE of the two contracts is identical and their boundary conditions are quite similar, the computational domain can be numerically merged into one region, shown in Fig. 5

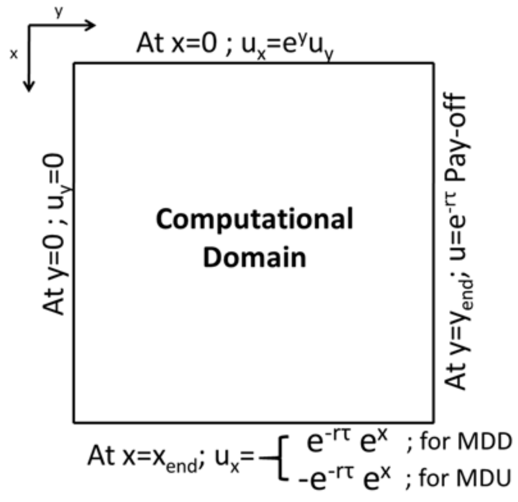

Fig. 5 The computational domain of the forward contract on the maximum drawdown and the maximum drawup

x_{end} and y_{end} are referred to either $x_{\max}$ and $y_{\max}$ or $x_{\min}$ and $y_{\min}$ depending on type of the forward contract. The boundary condition along y_{end} is the Dirichlet condition. The value at this edge is fixed to a function which equal to the discount pay-off at the expiry date. According to the model, the discount pay-off function for the maximum drawdown and the maximum drawup are (8) and (14). The boundary conditions along $y=0$ and $x=x_{end}$ are the Neumann condition. The former required that there do not have any vector gradients perpendicular to this edge. In other word, it is not allow the relative price of the forward contract to change its value respect to y. In contrast, the latter assign the vector gradients along the boundary. The vector gradient which is referred to the relative price respect to x is (6) or (12) ,respectively, for the maximum drawdown and the maximum drawup. The boundary conditions at the edge where $x=0$ are unclassified. They are neither the Dirichlet nor the Neumann type. These boundary condition, (5) and (11), imposed the relation between two directional gradient vectors.

In addition to the boundary conditions, the contract pay-off at maturity distinguishes the one from another. These pay-offs of the four forward contracts which have the identical pricing PDE depend on their underlying. For example, the contract on the maximum drawdown has to pay the value of the maximum drawdown and vice versa. Therefore, the contract pay-offs are used to be the initial condition based on the backward directional time τ. The contract pay-offs at maturity of the forward on the maximum drawdown, the maximum drawup, the drawdown and the drawup are (17).

$$u(0,x,y)=\begin{cases} e^{x}-e^{-y} & for\ \ MDD \\ -e^{x}+e^{-y} & for\ \ MDU \\ e^{x}-1 & for\ \ DD \\ 1-e^{x} & for\ \ DU \end{cases} \tag{17}$$

In fact, equation (17) is the actual $MDD(T)$, $MDU(T)$, $DD(T)$ and $DU(T)$ paid at the expiry date, but they are transformed to the computational domain as shown in Fig. 5 through the transfer functions (3),(4),(9) and (10). The pricing PDE, the boundary conditions and the initial condition are used altogether in order to estimate the ex-ante expectation of the 4 four parameters that describe the characteristic of the asset path appeared in the next window frame. The operator splitting schemes, the numerical approach, presented in the next section, are implemented to solve the pricing PDE. Therefore, the surface solution entire the computational domain, the surface forward price, are the value of those expectations.

3.2 The operator splitting

The operator splitting schemes usually used in the literatures are ADI-Do (Douglas scheme), ADI-CS (Craig-Sneyd scheme), ADI-MCS (Modified Craig-Sneyd scheme) and ADI-HV (Hundsdorfer-Veiwer scheme). The operator splitting approximates the PDE through the system of ODEs. These utilized ODEs, each of which is in the same direction, are discretized through the low order central difference. Therefore, the root-finding procedures, based on the operator splitting, of the PDE are transformed to that of the system of linear equations. The operator splitting start from solving the PDE through the explicit scheme finite difference in order to get the based case of solution surface. Then, this surface is gradually adjusted through the system of ODEs in the whole dimensions. The surface after the adjustment is the solution of the pricing PDE. The details of the ADI-DO and ADI-HV schemes used in this article are presented here.

Let operator L be the linear combination of the derivative approximation through the low order central difference.

$$\begin{aligned} L_x\, U &= u_x \\ L_y\, U &= u_y \\ L_{xx} U &= u_{xx} \\ L_{yy} U &= u_{yy} \\ L_{xy} U &= u_{xy} \end{aligned} \tag{18}$$

Let U be the column vector stored the solution of the PDE of the entire domain. u_x is the partial derivative approximated by the central difference, i.e. $L_x U = \frac{U(i+1,j)-U(i-1,j)}{2\Delta x}$ and vice versa. Let A be the group of the operator L based on the independent variables.

$$\begin{aligned} A_0 &= c_{xy} L_{xy} \\ A_1 &= c_x L_x + c_{xx} L_{xx} \\ A_2 &= c_y L_y + c_{yy} L_{yy} \end{aligned} \tag{19}$$

Let $U'(\tau) = \frac{\partial u(\tau,x,y)}{\partial \tau}$ be the partial derivative respect to time τ. Let R be the column vector of the residual due to the central difference approximation. Therefore, the pricing PDE can be arranged to (20)

$$U'(\tau) = A_0 U + A_1 U + A_2 U + R \tag{20}$$

The ADI-Do is the based case of the other schemes. This scheme starts from the explicit finite difference. Then, some adjustments will be done. The adjusted solution surface are stacked up and passed to the other layers. The surface solution of the pricing PDE is that of the ODE on the top layer.

The root-find process of ADI-Do in order to solve the pricing PDE consists of 4 procedures.

1. Determine the solution of the layer Y_0 at the n^{th} step in time by the explicit finite difference

$$Y_0 = \left[I + \Delta\tau\left(A_0 + A_1 + A_2\right)\right]U^n + \Delta\tau R^n \tag{21}$$

2. Determine the solution of the layer Y_1 through the correction of the layer Y_0

$$\left[I - \theta\Delta\tau A_1\right]Y_1 = Y_0 - \theta\Delta\tau A_1 U^n \tag{22}$$

3. Determine the solution of the layer Y_2 through the correction of the layer Y_1

$$\left[I-\theta\Delta\tau A_2\right]Y_2 = Y_1 - \theta\Delta\tau A_2 U^n \tag{23}$$

4. The surface solution of the $(n+1)^{th}$ step in time

$$U^{n+1} = Y_2 \tag{24}$$

Suppose N is the amount of nodes in a line of the $[N\times N]$ square domain in 2D. I is the $[N\times N]$ identity matrix. $\Delta\tau$ is the scalar quantity of the time step width. The matrices A_0, A_1 and A_2 are the $[N\times N]$ tri-diagonal matrix. U^n, Y_0, Y_1 and Y_2 are the column vector sized $[N\times 1]$ to store the solutions of each layer. θ is the parameter of the Weight-θ method used to alter the root-finding scheme of the linear simultaneous equations. $\theta=0$ is referred to the explicit scheme while $\theta=1$ and $\theta=0.5$ are the parameters for the implicit method and the Crank-Nicolson method, respectively.

ADI-HV scheme includes more steps of adjustment to results of the ADI-Do. These more additional steps are interchanged with the more superior precision. This scheme consists of 7 steps of computation shown in the following procedure.

1. Determine the solution of the layer Y_0 at the n^{th} step in time by the explicit finite difference

$$Y_0 = \left[I+\Delta\tau\left(A_0+A_1+A_2\right)\right]U^n + \Delta\tau R^n \tag{25}$$

2. Determine the solution of the layer Y_1 through the correction of the layer Y_0

$$\left[I-\theta\Delta\tau A_1\right]Y_1 = Y_0 - \theta\Delta\tau A_1 U^n \tag{26}$$

3. Determine the solution of the layer Y_2 through the correction of the layer Y_1

$$\left[I-\theta\Delta\tau A_2\right]Y_2 = Y_1 - \theta\Delta\tau A_2 U^n \tag{27}$$

4. Determine the solution of the layer $\tilde{Y}_0$ by correction the solution of the layer Y_0 with that of the layer Y_2

$$\tilde{Y}_0 = Y_0 + \tfrac{1}{2}\Delta\tau\left[\left(A_0+A_1+A_2\right)Y_2 - \left(A_0+A_1+A_2\right)U^n + \left(R^{Y_2}-R^n\right)\right] \tag{28}$$

5. Determine the solution of the layer $\tilde{Y}_1$ by correction the solution of the layer $\tilde{Y}_0$ with that of the layer Y_2

$$\left[I-\theta\Delta\tau A_1\right]\tilde{Y}_1 = \tilde{Y}_0 - \theta\Delta\tau A_1 Y_2 \tag{29}$$

6. Determine the solution of the layer $\tilde{Y}_2$ by correction the solution of the layer $\tilde{Y}_1$ with that of the layer Y_2

$$\left[I-\theta\Delta\tau A_2\right]\tilde{Y}_2 = \tilde{Y}_1 - \theta\Delta\tau A_2 Y_2 \tag{30}$$

7. The surface solution of the $(n+1)^{th}$ step in time

$$U^{n+1} = \tilde{Y}_2 \tag{31}$$

ADI-HV starts with the root-finding procedure based on ADI-Do, (25) to (27). The solutions of layer Y_2 are compared to the relative price at time n, U^n. The differences are brought back to adjust the solutions of the ADI-Do in order to get the layer $\tilde{Y}_0$, (28). The results of the adjustment are the solutions of the layer $\tilde{Y}_0$. Then, the solutions of this layer are adjusted twice, (29) to (30). The solution surface at time $n+1$ based on the ADI-HV is the layer $\tilde{Y}_2$ as a result.

Equation (22) (26) and (29) are the ordinary differential equation in x-direction. On the contrary, equation (23) (27) and (30) are in the y-direction. The ODEs is not only much easier to solve than the PDE, but, due to the unidirectional characteristic, the discretization is also uncomplicated. The number of linear terms related to the seconder order partial derivative through the central difference is three per one dimension. Therefore, the implementation of the low order central difference make the operator splitting involve with only three nodes per equation through each step of the correction. On the other hand, the number of nodes involved with the 2D PDE is six even though the low order approximation is implemented. Hence, the transformation of PDE to the system of the ODEs is one of the strength provided by the operator splitting.

3.3 The discretized equation

In order to solve the system of ODEs received from the operator splitting, implement the low order central difference to these equations. The ODEs, as a result, are approximated by linear combinations of the algebraic operations between the interested node and its neighborhoods. Then, group the discretized equation based on the intermediate directions of the neighbor nodes. The discretized equations of the ADI-Do schemes are exhibited in the following equations.

The discretized equation of the pricing equation at the layer Y_0

$$Y_{i,j}^0 = a_W U_{i-1,j}^n + a_C U_{i,j}^n + a_E U_{i+1,j}^n + a_S U_{i,j-1}^n + a_N U_{i,j+1}^n + R_{Cross} + \Delta\tau R^n \tag{32}$$

where $$a_W = \Delta\tau\left(c_x L_x\left(i-1,j\right) + c_{xx} L_{xx}\left(i-1,j\right)\right) \tag{33}$$

$$a_E = \Delta\tau\left(c_x L_x\left(i+1,j\right) + c_{xx} L_{xx}\left(i+1,j\right)\right) \tag{34}$$

$$a_S = \Delta\tau\left(c_y L_y\left(i,j-1\right) + c_{yy} L_{yy}\left(i,j-1\right)\right) \tag{35}$$

$$a_N = \Delta\tau\left(c_y L_y\left(i,j+1\right) + c_{yy} L_{yy}\left(i,j+1\right)\right) \tag{36}$$

$$a_C = 1 + \Delta\tau\left(c_{xx} L_{xx}\left(i,j\right) + c_{yy} L_{yy}\left(i,j\right)\right) \tag{37}$$

$$R_{Cross} = \Delta\tau c_{xy} \begin{pmatrix} L_{xy}(i+1,j+1)U_{i+1,j+1}^n + L_{xy}(i+1,j-1)U_{i+1,j-1}^n \\ +L_{xy}(i-1,j+1)U_{i-1,j+1}^n + L_{xy}(i-1,j-1)U_{i-1,j-1}^n \end{pmatrix} \tag{38}$$

The discretized equation of the pricing equation at the layer Y_1

$$a_W Y_{i-1,j}^1 + a_C Y_{i,j}^1 + a_E Y_{i+1,j}^1 = a_W U_{i-1,j}^n + \alpha_C U_{i,j}^n + a_E U_{i+1,j}^n + Y_{i,j}^0 \tag{39}$$

where $$\alpha_C = -\theta\Delta\tau c_{xx} L_{xx}\left(i,j\right) \tag{40}$$

$$a_W = -\theta\Delta\tau\left(c_x L_x\left(i-1,j\right) + c_{xx} L_{xx}\left(i-1,j\right)\right) \tag{41}$$

$$a_E = -\theta\Delta\tau\left(c_x L_x\left(i+1, j\right) + c_{xx} L_{xx}\left(i+1, j\right)\right) \tag{42}$$

$$a_C = 1 + \alpha_C \tag{43}$$

The discretized equation of the pricing equation at the layer Y_2

$$a_S Y_{i,j-1}^2 + a_C Y_{i,j}^2 + a_N Y_{i,j+1}^2 = a_S U_{i,j-1}^n + \alpha_C U_{i,j}^n + a_N U_{i,j+1}^n + Y_{i,j}^1 \tag{44}$$

where
$$\alpha_C = -\theta\Delta\tau c_{yy} L_{yy}\left(i, j\right) \tag{45}$$

$$a_S = -\theta\Delta\tau\left(c_y L_y\left(i, j-1\right) + c_{yy} L_{yy}\left(i, j-1\right)\right) \tag{46}$$

$$a_N = -\theta\Delta\tau\left(c_y L_y\left(i, j+1\right) + c_{yy} L_{yy}\left(i, j+1\right)\right) \tag{47}$$

$$a_C = 1 + \alpha_C \tag{48}$$

The coefficient a_W a_E a_S a_N and a_C are the weights of interested node $\left(i, j\right)$ through the neighbor nodes in all the intermediate directions. R_{Cross} is the value of the cross-derivative at the node $\left(i, j\right)$. R^n is the residual from the substitutions of the boundary conditions, i.e. the known value received from the Dirichlet boundary condition. $L_x\left(i, j\right)$ $L_{xx}\left(i, j\right)$ $L_y\left(i, j\right)$ and $L_{yy}\left(i, j\right)$ are the constants at the node $\left(i, j\right)$. These constants are received from the approximation of the partial derivatives, i.e. $L_x U$ or $\frac{\partial U}{\partial x}$, through the low order central difference. Therefore, they are the scalar values. The coordinates such as $\left(i+1, j\right)$ $\left(i, j\right)$ and $\left(i-1, j\right)$ are referred to the neighbor nodes directionally relative to the considered node $\left(i, j\right)$.

The discretized equations for the ADI-HV can be derived in the same way as the ADI-Do

The discretized equation of the pricing equation at the layer $\tilde{Y}_0$

$$\tilde{Y}_{i,j}^0 = a_W V_{i-1,j}^n + a_C V_{i,j}^n + a_E V_{i+1,j}^n + a_S V_{i,j-1}^n + a_N V_{i,j+1}^n + R_{Cross} + Y_{i,j}^0 \tag{49}$$

where
$$V_{i,j}^n = Y_{i,j}^2 - U_{i,j}^n \tag{50}$$

$$a_W = \tfrac{1}{2}\Delta\tau\left(c_x L_x\left(i-1, j\right) + c_{xx} L_{xx}\left(i-1, j\right)\right) \tag{51}$$

$$a_E = \tfrac{1}{2}\Delta\tau\left(c_x L_x\left(i+1, j\right) + c_{xx} L_{xx}\left(i+1, j\right)\right) \tag{52}$$

$$a_S = \tfrac{1}{2}\Delta\tau\left(c_y L_y\left(i, j-1\right) + c_{yy} L_{yy}\left(i, j-1\right)\right) \tag{53}$$

$$a_N = \tfrac{1}{2}\Delta\tau\left(c_y L_y\left(i, j+1\right) + c_{yy} L_{yy}\left(i, j+1\right)\right) \tag{54}$$

$$a_C = \tfrac{1}{2}\Delta\tau\left(c_{xx} L_{xx}\left(i, j\right) + c_{yy} L_{yy}\left(i, j\right)\right) \tag{55}$$

$$R_{Cross} = \tfrac{1}{2}\Delta\tau c_{xy}\begin{pmatrix} L_{xy}(i+1,\, j+1)V^{n}_{i+1,\, j+1} + L_{xy}(i+1,\, j-1)V^{n}_{i+1,\, j-1} \\ +L_{xy}(i-1,\, j+1)V^{n}_{i-1,\, j+1} + L_{xy}(i-1,\, j-1)V^{n}_{i-1,\, j-1} \end{pmatrix} \tag{56}$$

The discretized equation of the pricing equation at the layer $\tilde{Y}_1$

$$a_W\tilde{Y}^1_{i-1,j} + a_C\tilde{Y}^1_{i,j} + a_E\tilde{Y}^1_{i+1,j} = a_W Y^2_{i-1,j} + \alpha_C Y^2_{i,j} + a_E Y^2_{i+1,j} + \tilde{Y}^0_{i,j} \tag{57}$$

where $$\alpha_C = -\theta\Delta\tau c_{xx}L_{xx}\left(i,\, j\right) \tag{58}$$

$$a_W = -\theta\Delta\tau\left(c_x L_x\left(i-1,\, j\right) + c_{xx}L_{xx}\left(i-1,\, j\right)\right) \tag{59}$$

$$a_E = -\theta\Delta\tau\left(c_x L_x\left(i+1,\, j\right) + c_{xx}L_{xx}\left(i+1,\, j\right)\right) \tag{60}$$

$$a_C = 1 + \alpha_C \tag{61}$$

The discretized equation of the pricing equation at the layer $\tilde{Y}_2$

$$a_S\tilde{Y}^2_{i,j-1} + a_C\tilde{Y}^2_{i,j} + a_N\tilde{Y}^2_{i,j+1} = a_S Y^2_{i,j-1} + \alpha_C Y^2_{i,j} + a_N Y^2_{i,j+1} + \tilde{Y}^1_{i,j} \tag{62}$$

where $$\alpha_C = -\theta\Delta\tau c_{yy}L_{yy}\left(i,\, j\right) \tag{63}$$

$$a_S = -\theta\Delta\tau\left(c_y L_y\left(i,\, j-1\right) + c_{yy}L_{yy}\left(i,\, j-1\right)\right) \tag{64}$$

$$a_N = -\theta\Delta\tau\left(c_y L_y\left(i,\, j+1\right) + c_{yy}L_{yy}\left(i,\, j+1\right)\right) \tag{65}$$

$$a_C = 1 + \alpha_C \tag{66}$$

According to (32) and (49), the solutions of the layer Y_0 and $\tilde{Y}_0$ can be solved by the explicit finite difference scheme. The computational nodes, related to both equations, or the node $\left(i,\, j\right)$ are shown in the Fig. 6. The × point is the unknown node. The ○ points are the known-value neighbor nodes. The ● points are the nodes involved with the cross derivative. The explicit scheme solves the root of pricing PDE on each node once at a time. The root-finding procedure will repeated to all of the nodes entire the whole domain. The sweep direction starts in the y_{end} edge and ends at the y_0 in the opposite side in the W-E direction. Then, the direction of sweep is rotated to the other in the S-N. The solutions of the layer Y_0 will be adjusted through layer Y_1 and Y_2 . The solutions of the other will be adjusted through the layer $\tilde{Y}_1$ and $\tilde{Y}_2$. The solution after adjustment, based on the ADI-Do and ADI-HV, is the solutions that are passed through the layer Y_1 , Y_2 , $\tilde{Y}_1$ and $\tilde{Y}_2$.

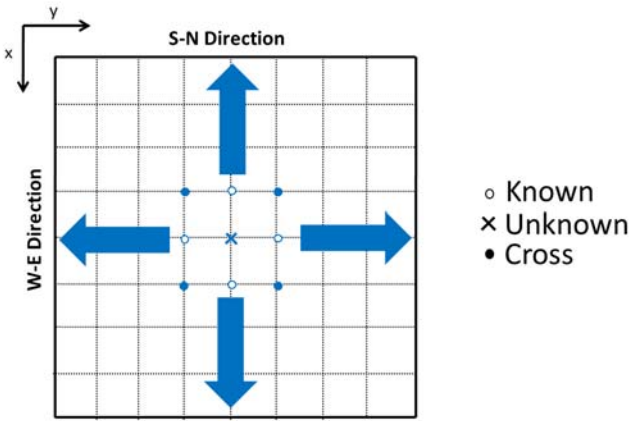

Fig. 6 the discrete nodes of the explicit finite difference scheme.

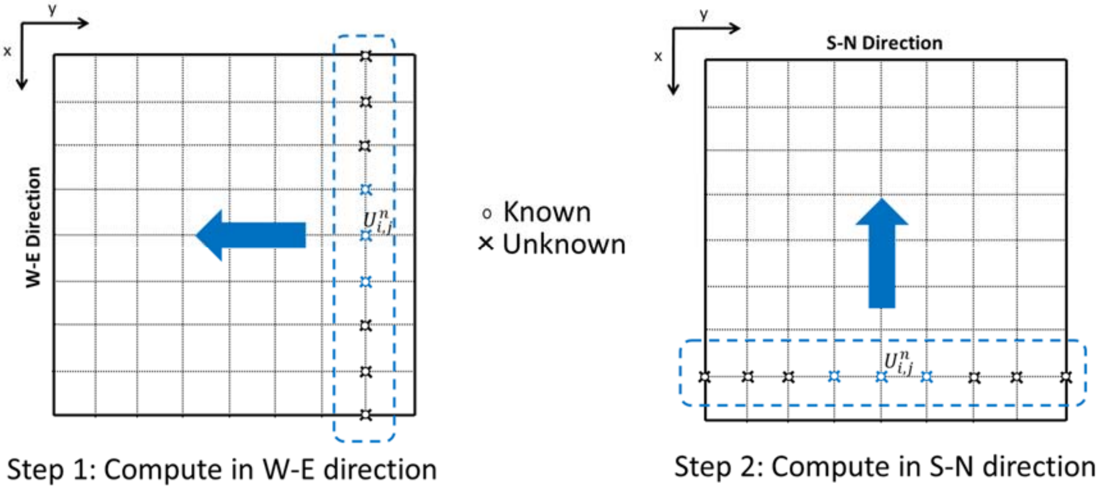

Fig. 7 the discrete nodes of the weight- θ *finite difference.*

The left hand side of the Fig. 7 illustrates the line of nodes involved with the root-finding procedure of the layer Y_1 and $\tilde{Y}_1$. The solutions have to be solved for the entire nodes on the line. The line of nodes marches on the W-E direction from y_{end} back to the opposite side, y_0. Then, the root-finding procedure will be proceeded on the layer Y_2 and $\tilde{Y}_2$ as exhibited in the right hand side of the same figure. The direction of sweep is performed in the S-N direction from x_{end} back to x_0.

The discretized equations presented in this section, (32) to (66) are derived from the principle of the low order central difference. The benefits of the low order approximation is the capability of TDMA implementation. The improvement of the memory consumption, as a result, is achieved. The values of the operator L, i.e. $L_x(i,j)\,L_{xx}(i,j)\,L_y(i,j)$ and $L_{yy}(i,j)$, are depending on the region on which the nodes locate. The computational domain are divided into 7 areas. These areas are the domain interior, the 4 territories, the origin and the last point located at $(x_{end},0)$ opposite to the origin. These 7 areas influence by the different boundary conditions. The values of operator L based on the low order approximation are reported in the chapter 3 of reference [40] in details. If the high order approximation is crucial, the concept of the domain impact presented in [18] might be implemented.

4. The empirical evidences

According to the characteristics of the forward contracts, we first expect that the computed forward prices will almost surely converge to the underlying at maturity. The convergence means that the ex-ante value of those 4 parameters is converge to the realized value. Therefore, we can further develop a novel trading system that is neither the technical nor fundamental analysis. The novel trading system relies on only the statistical parameters and the stochastic approach, called "*the stochastic analysis"*. The ex-ante value of the maximum drawup and the running maximum inform about the investment opportunity. On the other hand, the ex-ante value of the maximum drawdown and the running minimum imply about the investment risk. In order to archive this objective, the proof of convergence is very crucial to confirm about the methodology precision.

The section exhibits the expected value of the drawdown, the drawup, and their maximum values based on the daily closed price of Thailand SET50 index. The presentations start at the solution surfaces of these 4 parameters. The actual data of S50U18 series on Jun 21, 2108 when the implied volatility during the study period is maximum are selected to illustrate. Then, the expected value of those parameters are studied and compared to the daily realized values based on three types of volatility. These volatilities are the constant annual volatility, the 30-day historical volatility and the implied volatility. The comparison will be examined through the put options of the H18 M18 and U18 series. The most suitable kind of volatility will be chosen in order to estimate the ex-ante expectation of our parameters. Then, the concept of the trading system based on theses ex-ante expectation is presented. This section ends at the market movement forecast of the SET50 index through the ex-ante value of the maximum drawdown and the maximum drawup and their related parameters. The frame of the study is a 5-quarter period during June 29, 2017 to Sep 26, 2018 in order to foresee the market view on Dec 28, the last business day of the year 2018.

4.1 The solution surface

The solution of the pricing equation (1) require the parameters of the asset movement. The most crucial parameter is the asset volatility. Three cases of this parameter are studied. The first one is a constant volatility fixed at 25% per annum. This number is an approximate value per annual of Thailand SET index. The second one is the 30-day historical volatility computed by the daily returns of the underlying asset. The 30-day window frame is the business trading day, exclude holidays and weekends. The last one is the implied volatility. This kind of volatility is the market quoted price based on the BSM formula of the call and put options. The examples of the implied volatilities are illustrated in Fig. 8

Fig. 8 exhibits the implied volatilities of S50U18 put options at all strike prices and all tenors. These option series are traded during Mar 29, 2018 to Sep 27, 2018. The values at the bottom of the volatility smiles at each time maturity are used as the parameters to compute the ex-ante value of the maximum drawdown and the others. The blue-colored surface underneath the smiles is the value of the 30-day historical volatility. The surface solutions of the pricing PDE (1) based on the illustrated implied volatilities and SET50 index on Mar 29, 2018 are presented in Fig. 9 to Fig. 12.

These illustrated solution surfaces are the ex-ante values of those 4 parameters at the end of contracts of S50U18 put options on Sep 27 in the same year,. Fig. 9 exhibits the 3D surface solution of the forward price on the lookback put options. The value of surface is the proxy of the ex-ante drawdown at the expiry. The SET50 index is 1,158.54 , the interest rate $r = 0.15$, the implied volatility $\sigma_{imp} = 0.1893$, time to maturity $T = 0.5$ .The z-axis is the ex-ante expectation relative to the underlying asset. The x-axis is the asset price respected to its running maximum. The y-axis is the proportion of the asset price to the price which the maximum drawdown appeared. The blue-colored points along the edge $y = 0$ is the price of the lookback put options. Fig. 10 to Fig. 12 illustrate the ex-ante expectation of the maximum drawdown, the lookback call and the maximum drawup in order based on the identical parameters. The ex-ante value on the expiry given on the condition of the specific day is a value at the coordinate (x, y) on the solution surface. x and y are the transform coordinate based on the transfer function (3),(4),(9) and (10) depending on the kind of the contracts.

These solution surfaces have to be computed at every step of the time in order to inspect the convergence of the ex-ante value to the ex-post one on the expiry. The most suitable kind of volatility will be selected to develop the new trading system based on our "*stochastic analysis"*.

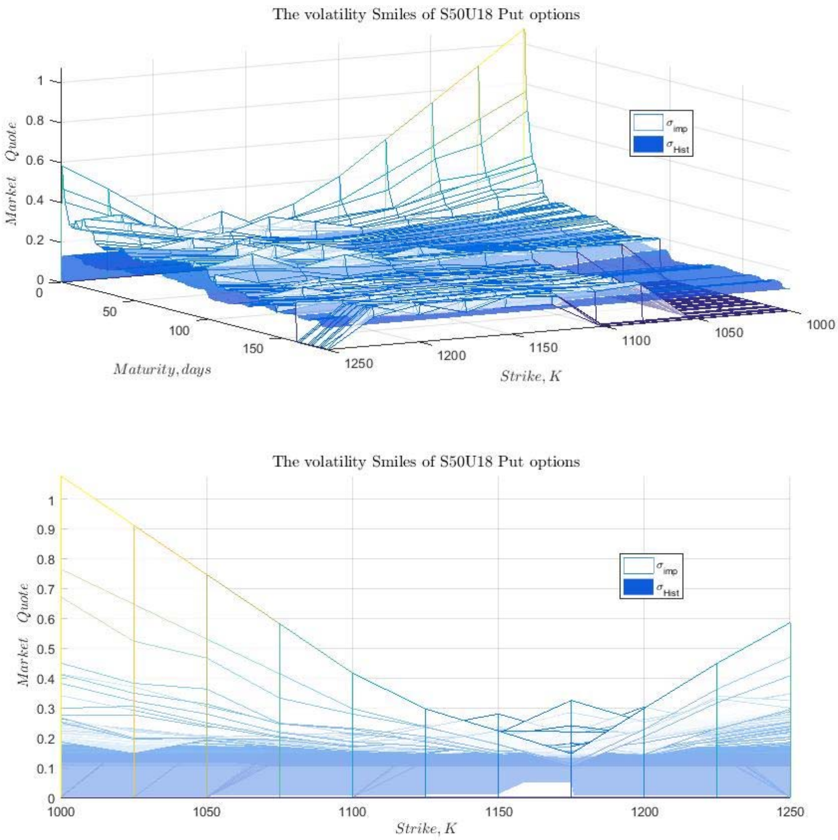

Fig. 8 The implied volatility of the S50U18 put options during Mar 29, 2018 to Sep 27, 2018

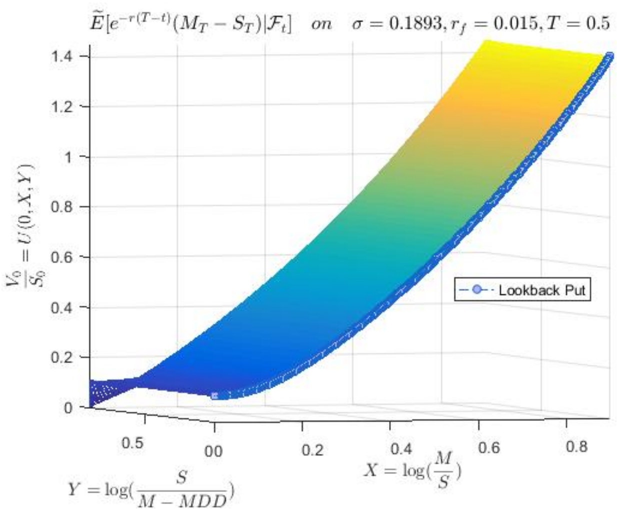

Fig. 9 The ex-ante drawdown of SET50 on the expiry date of S50U18 series based on the data on Mar 29, 2018

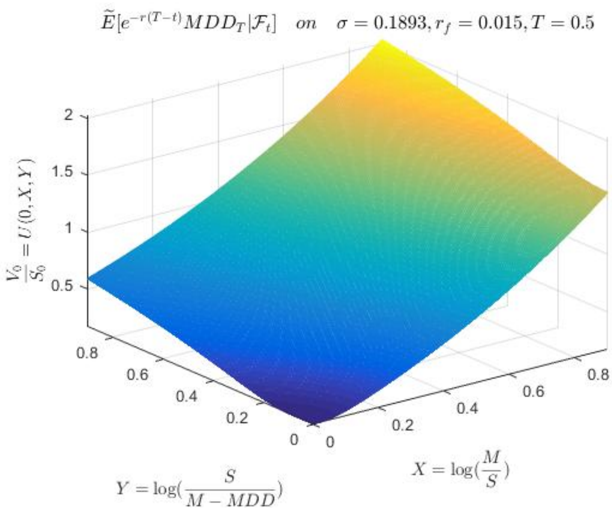

Fig. 10 The ex-ante maximum drawdown of SET50 on the expiry date of S50U18 series based on the data on Mar 29, 2018

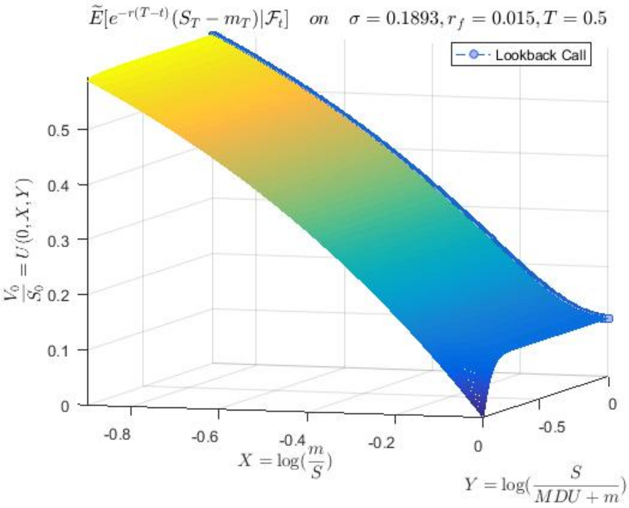

Fig. 11 The ex-ante drawup of SET50 on the expiry date of S50U18 series based on the data on Mar 29, 2018

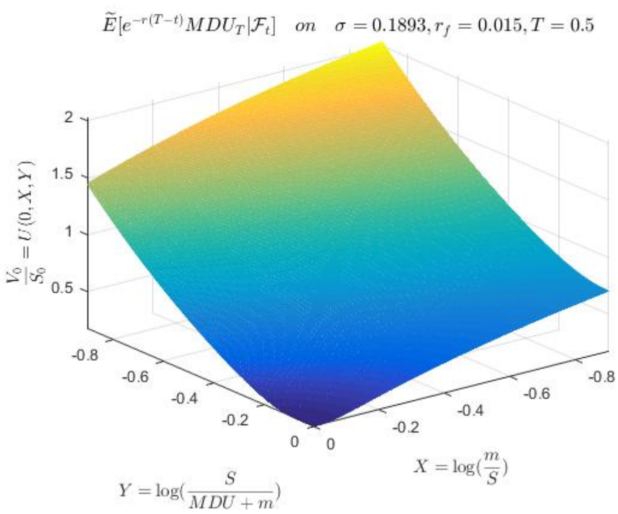

Fig. 12 The ex-ante maximum drawup of SET50 on the expiry date of S50U18 series based on the data on Mar 29, 2018

4.2 The evidence of the convergence.

The actual volatility in the financial market is the crucial parameter that violate the model assumption. Therefore, it is necessary to examine the effects of this assumption on the precision of the estimated ex-ante expectation. The characteristic of the convergence of the ex-ante value is studied through 3 kinds of the volatility. This article expect that, due to the characteristic of the forward contract, the ex-ante value should almost surely converge to the underlying asset on the expiry. The first one is the constant volatility. This parameter is fixed at 25% per annum. This value is approximate about the Thai SET market annual volatility. The next examination is the case of 30-day historical volatility. The historical daily returns of the SET50 index are used to calculate the standard deviation, the volatility, per annum. The 30-day window frame is selected to implement based on the Central Limit Theorem (CLT). The last case is the implied volatility extract from the SET50 options at all strike prices.

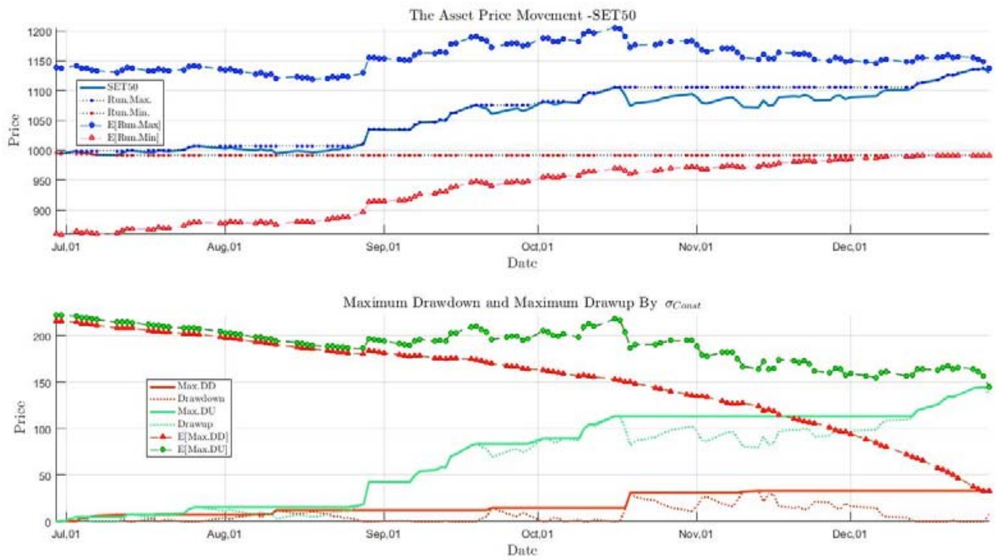

Fig. 13 The convergence of the ex-ante expectation to the realized value in case of constant volatility 25%.

Fig. 13 illustrates the convergence of the ex-ante value based on the 25% fixed volatility. The upper figure is the path of SET50 index during the life of the S50Z17 options. The blue-colored line is the SET50 movement. The small red-colored dot line under the asset path is the path of the realized running minimum, called the support line. The small blued-colored dot line above the asset path is the path of the realized running maximum, called the resistance line. The large red-colored dot line under at the ground is the path of the ex-ante running minimum. The path is the movement of the expectation of the running minimum appeared at the end of S50Z17 series given on the information up to the present time at each time step. Quite the contrary, the large blue-colored dot line at the top is the path of the ex-ante running maximum. It is the movement of the expectation of the running maximum at the expiry date of S50Z17 series. The path at the ground and at the top are the processes of the expected value at contract maturity given on the information up to time t. Therefore, they are not the expected value at t , but they are they are the expected value at T given on the current information.

Even though the model used a fixed volatility at 25% per annum, all of the ex-ante expectations, the maximum drawdown and the others, converge to the ex-post values at the end. This convergence exhibits that the ex-ante value converge to the ex-post value at the almost surely event. Moreover, the convergence is the characteristic of the forward contracts. The convergence of the expected forward price and the precision of lookback prices, the special cases shown in 4.1, can be used as the evidences to advocate our PDE approach estimations.

Unfortunately, the convergence rate based on the constant volatility shown in the figure is not good. Both of the ex-ante maximum drawdown and the ex-ante maximum drawup slowly converge to the ex-post value. The inferior rate of convergences appear from the improperly parameter. The volatility used in Fig. 13 is an average value per annum. It is not the parameter of the considered date. The more proper parameters used as the proxy of the volatility at any specific dates is needed. These parameters are the historical and implied volatility presented serially in Fig. 14 and Fig. 15.

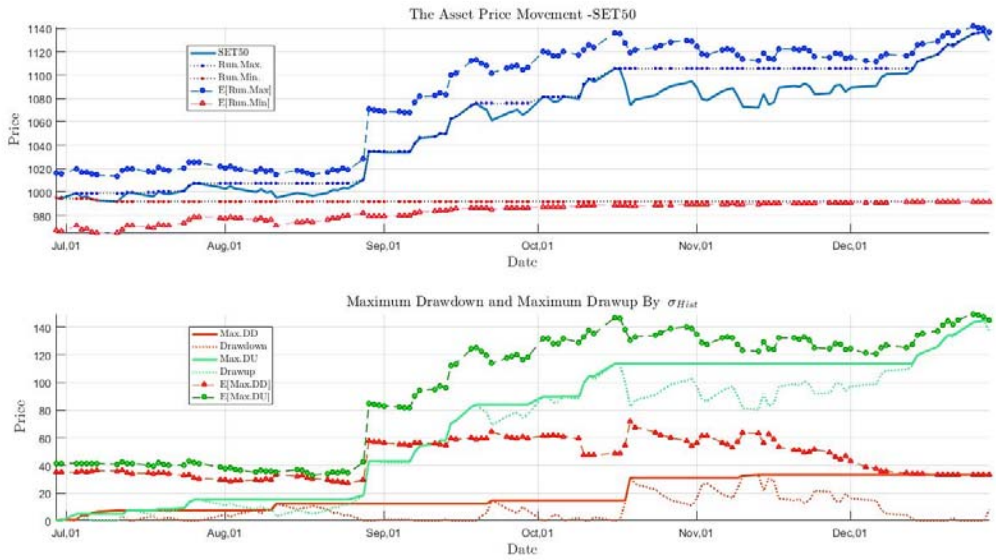

Fig. 14 The convergence of the ex-ante expectation to the realized value in the case of 30-day historical volatility.

Fig. 15 The convergence of the ex-ante expectation in case of the implied volatility based on the S50Z17 series put options

Fig. 14 illustrates the ex-ante expectation of the maximum drawdown and others based on the 30-day historical data. The time series data are the same ones of the previous figure. The 30-day window frame considers only for the market trading days. According to this kind of parameter, the stochastic processes of the ex-ante maximum drawdown and the others are more proper reflect the market agreement at the expiry than the case of constant volatility. The convergence of processes based on the 30-day historical parameter is much faster than the fixed one. Not only give the superior rate of convergence, but the former parameter also outstandingly reflect the market trend. Based on the time series data, the underlying process is in the market bullish. The 30-day historical volatility can reflect the market up-trend since the last week of Aug 2018. The 25% fixed volatility has to wait until the mid of Sep 2018 to reflect to the market bullish.

Fig. 15 exhibits the stochastic processes of the ex-ante values based on the implied volatility. The minimum values of the volatility smile are implemented to compute the expectation of the maximum drawdown and the others. These implied volatilities generate the better rate of convergence than the constant volatility do. Moreover, based on the same time series data, they can reflect the market view at the expiry date since the first trading day of S50Z17 options. On the contrary, the 30-day historical volatility has to wait until almost 2 months.

4.3 The trading system

According to Fig. 13 to Fig. 15, the ex-ante values based on the case of implied volatility provides the superior rate of convergence and the distinct market-trend forecast. Therefore, this article recommends the implied volatility to compute the ex-ante expectation of the drawdown, the drawup and their maximum value. The predominant characteristics generated by this kind of parameter receive from 2 distinguish qualities. The first one is the path dependent characteristic of the maximum drawdown and the related parameters. The path-dependent characteristic means that the ex-ante values have included all the information generated by the Brownian motion up to the present. The other one is the investor’s market views in the future. These views are reflected by the implied volatility through the prices of the options traded in the market. The aggregation of the information in the past and in the future imply that the market-trend forecast based on the ex-ante values has included all the market information available at the present time. As a result, the implementation of the implied volatility in order to estimate the ex-ante expectation and to eliminate the model drawback from the BSM assumptions is the most suitable among three kinds of the parameter.

Fig. 16 to Fig. 18 successively present the ex-ante value estimation through the implied volatility based on the prices of S50H18, S50M18 and S50U18 options. These options are traded in the different market trends. The first series were in the market uptrend. The next series were traded in the market downtrend. The last ones active during the market reversion. The numerical experiment show that there is a great potential to forecast the market trend through the ex-ante values of the maximum drawdown and the related parameters. The concept of the new trading system based on these expected value is call “*the stochastic analysis”.*

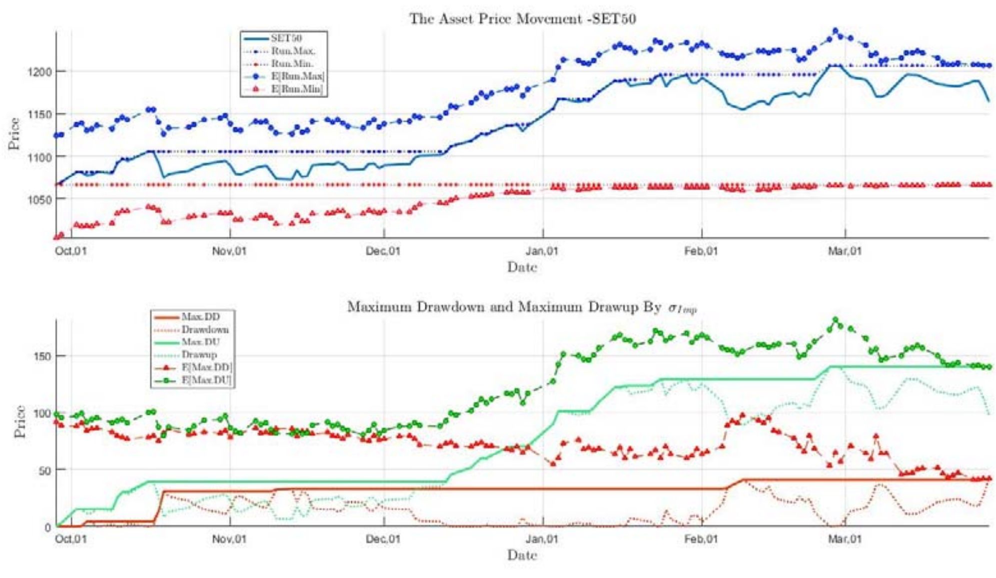

Fig. 16 The convergence of the ex-ante expectation in case of the implied volatility based on the S50H18 series put options

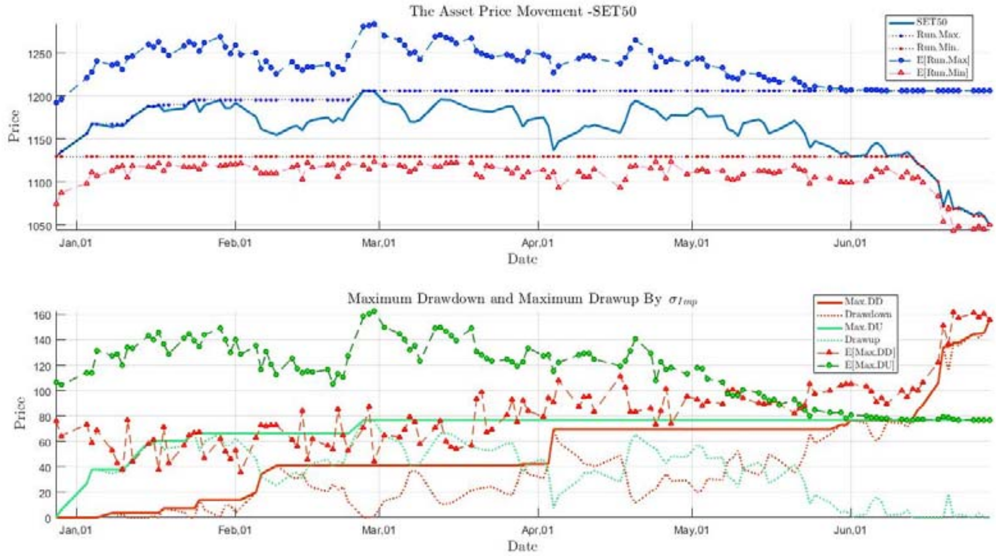

Fig. 17 The convergence of the ex-ante expectation in case of the implied volatility based on the S50M18 series put options

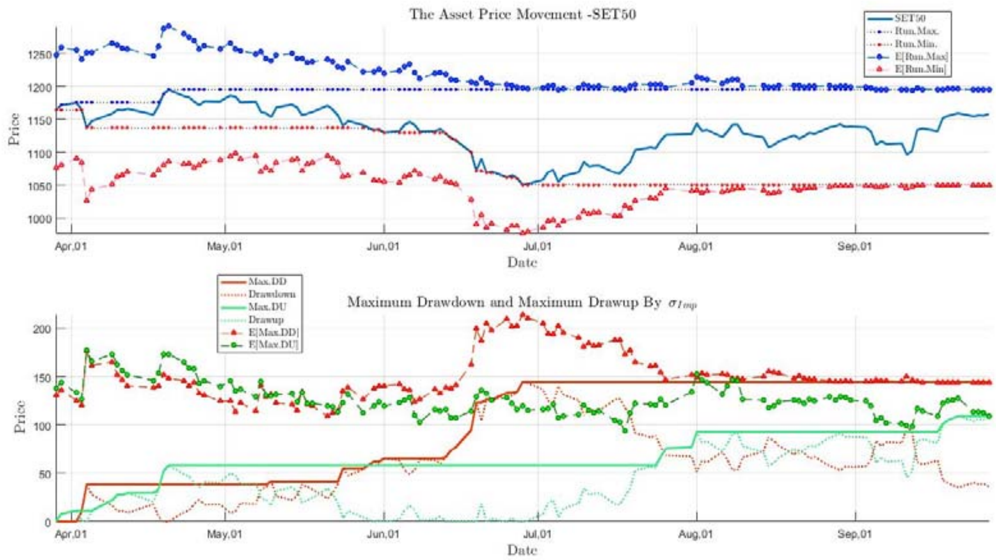

Fig. 18 The convergence of the ex-ante expectation in case of the implied volatility based on the S50U18 series put options

The difference between the ex-ante running minimum/maximum and the current asset price represents the opportunity of the price movement. The approaching between the expected running maximum and the asset price indicates a decreasing potential of the price rising up. For example, at the end of S50H18, the approaching between the expected running maximum and the asset price led to the pricing falling down in the next window frame during the life of the S50M18 contracts. Similarly, the decreasing gap between the expected running minimum and the asset price indicates an increasing potential of the pricing rising up. For example, the approximate same value between the expected running minimum and the asset price led to the market reversion appeared at the middle age of S50U18 lifespan.

The expected value of the maximum drawdown indicates the investment risk while the expected value of the maximum drawup implies the investment opportunity. The positive different between the maximum drawup and the maximum drawdown during the lifespan of S50H18 series implies the investment opportunity. On the contrary, the intersection between the path of the maximum drawup and the maximum drawdown indicates the investment risk, i.e. the negative differences between the expected maximum drawup and the expected maximum drawdown appeared during the lifespan of S50M18 and S50U18.

The evidences of the convergence of the ex-ante value to the ex-post value presented in this section are used to insist about the precision of the ex-ante value. Then, we present the concept of the *stochastic analysis* to forecast the market trend based on these ex-ante values. Anyway, the trend forecast presented in this section is limited to a single option series such as Z17, H18, M18 and U18. The next section will aggregate information from all of the option series traded in TFEX available at time t . Therefore, the estimated ex-ante value based on the implied volatility will fully reflect the information provided by the market.

4.4 The application: the market-trend forecast

In order to aggregate all information about the market view in the future, all series of the SET50 option prices available in the market are used to extract the implied volatility. The minimum implied volatility at the bottom of the smiles is used as the proxy of the SET50 volatility based on the market agreement. The assumption behind the parameter estimation is that the SET50 index has already reflected to all market information. A *stochastic analysis* through the minimum implied volatility based on the 5-quarter daily data from Jun 29, 2017 to Sep 27, 2018 is exhibited in Fig. 19.

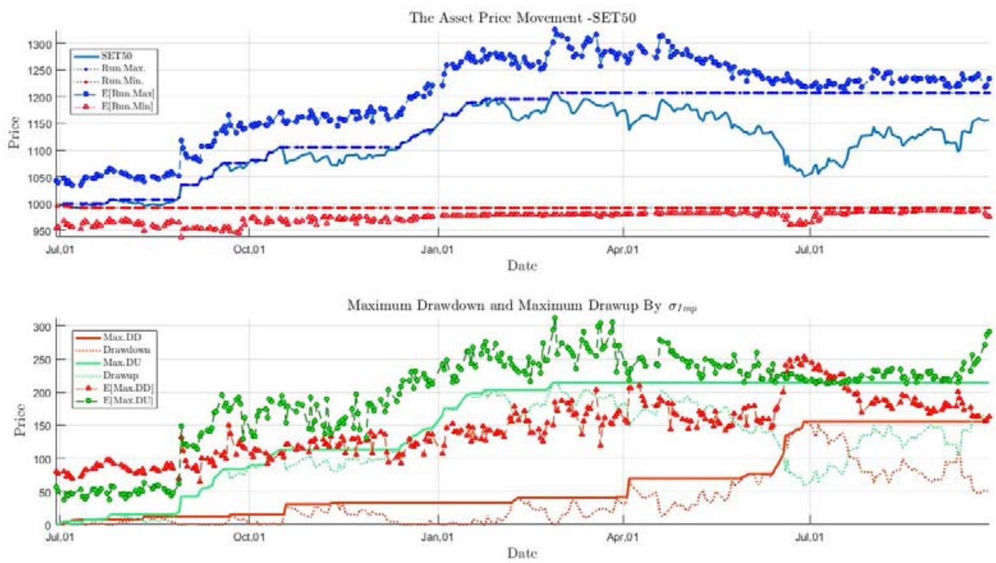

Fig. 19 The stochastic analysis of asset movement at the end of 2018 based on implied volatility during Jun 29, 2017 to Sep 27, 2018

Fig. 19 illustrates an example of the trading system based on *the stochastic analysis* to forecast the market trend at the end of 2018. According to *the stochastic analysis*, the ex-ante maximum drawup is above the ex-ante maximum drawdown since the end of Aug before the SET50 index continue rising up for a few months. The market forecast based on the implied volatility is quite stable. There are just few intersections between two paths of those ex-ante values. The path of expected maximum drawdown crosses the one of the expected maximum drawup at the middle of Jun 2018 before the index collapse to the bottom at the beginning of Jul 2018. It took about 4 weeks before the index can recover, but the path of expected maximum drawup is above the other since the third week of Jul 2018, one week before the price recovery. Because *the stochastic analysis* consider not only all market anticipation in the future, but also the realized historical data, it can generate the precise and quick trading signal. If there do not exist the noteworthy events emerged after the end of this string of data, the stochastic analysis hints that the expected running maximum can slightly increase and the expected maximum drawup will take off. Anyway, since the index is close to the expected resistance line, there is a great probability of index falling down in the next window frame. Therefore, the index collapse might be one of the reasons why the expected maximum drawup, based on *the stochastic analysis*, at the end of 2018 might be soaring.

5. Conclusion

This article present the evidences of the convergence of the ex-ante values of 4 characteristic parameters of the asset movement to the ex-post values. The expected parameters are the maximum drawdown, the maximum drawup, the running maximum and the running minimum. The article started at the introduction of the pricing PDE, the boundary conditions and the numerical root-finding approach. Then, the surface solutions of the expected value are illustrated. These surfaces are the expected value of those 4 parameters on the forward contract expiry date. These expected values have to compute at each step of time in order to foresee the market trend. The precision of the ex-ante value is depend on the model input parameters especially on the volatility. Three kinds of volatility were examined. These types are the 25% constant volatility, the 30-day historical volatility and the implied volatility. The last one is recommended. The convergence investigation performed based on daily closed-price data of the SET50 index as the underlying. The implied volatility was extracted form four series of options, S50Z17, S50H18, S50M18 and S50U18. The minimum value at the bottom of each smiles at the specific date is used as the proxy of the market-agreement volatility. Therefore, the ex-ante expectations of the 4 characteristic of the asset movement reflect not only the historical path, but also the market view in the future. This article ended at an application example of the market-trend forecast. *The stochastic analysis* proposed here is a new trading system. This system continue monitoring the process of the expected values on the maximum drawdown and the others. The numerical evidence found that the proposed trading system can generate the precise and quick trading signals before falling down or rising up. Therefore, the ex-ante maximum drawdown, the ex-ante maximum drawup can prevent all investors from the down side risks and help them search the investment opportunities.

This article suggest that the policy maker and the market regulator introduce the parameters of the expected maximum drawdown and the ex-ante maximimum drawup as the market's risk indicators. The ex-ante maximum drawdown can be exhibited along with the old traditional standard deivation as the risk measurement. The ex-anted maximum drawup can be presented in the fund-fact sheet together with the expected return in order to present the opportunity required, on average, by the investment. Since the maximum drawdown and the maximum drawup are related to the asset movement, it is easier for each individual investor to conceive the change in the asset prices than the old traditional statistical parameter such as the standard deviation. The separate illustration of the risk parameter from the return in the prospectus can help the investors just engage in the investments suitable to their degree of risk aversion.

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SEC WORKING PAPERS

FORUM 2018

REGULATING BY MARKET FORCES

Value-at-Risk (VaR) and Performance Predictability: Evidence on Skewed distribution mutual fund in Thailand

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Value-at-Risk (VaR) and Performance Predictability: Evidence on Skewed distribution mutual fund in Thailand

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July 2018

Abstract

As mutual fund in Thailand still keep growing and become a good choice of investment while Value-at-Risk (VaR) is a popular risk measurement among financial industry so this study empirically studies the effect of Value-at-Risk (VaR) on mutual fund performance along with investigating mutual performance predictability by using data of mutual funds in Thailand from 2004 to 2017. This study focus on Skewed distribution mutual funds in Thailand.

This study first finds performance of low VaR and high VaR mutual funds of two types of mutual funds, which are equity Skewed distribution mutual funds and Fixed Income and Money Market Skewed distribution mutual funds. The first study shows that the low VaR portfolio insignificantly different from the high VaR portfolio for both equity and Fixed income and Money market mutual funds. The result does not consistent with previous literature. The possible explanation for result of equity fund is the result from previous literature may dominate by normal distribution. While, possible explanation for Fixed Income and Money Market mutual funds is that both return and risk of Fixed Income and Money Market mutual funds may do not move so this is possible to be a reason that this study see nothing from the study of low VaR and high VaR of Fixed Income and Money Market mutual funds.

Then, this study continue to tests whether past Value-at-Risk can predict performance of Equity funds whose have Skewed distribution or not. Slope of VaR from Fama-Macbeth regressions fails to have statistical significance. Even though result from Fama-Macbeth regressions on this study does not consistent with previous literature, it still similar with some previous studies like Prasopa (2011) and Aziz and Ansari (2017) as they also report insignificant on coefficient of VaR.

1. Introduction

Currently, the mutual fund in Thailand still keep growing and become a good choice of investment for the investors whether individual investor or institute. As of 2017, aggregate total asset of mutual funds in Thailand is about 5,034 billion baht1[1] compared to year 2015, which is only about 4,063 billion baht. Most cash inflows to mutual funds in Thailand over past two decades are to fixed income fund. The market share of fixed income is still keep growing from 14.33% at end of 2016 to 30.18% as of Q3/2017 which resulting from popularity of global bond fund.

Many researches keep reporting other variables that are related to mutual funds return. For example, fund performance relates to various factors; size, past performance, volatility, etc. The return predictability is helpful for investors in order to predict the future performance of their investment based on current and past information e.g. past return (momentum), risk (risk anomalies).

Under risk and risk anomalies topics, there are many studies. For example, Jordan and Riley (2015) find that the effect of vol anomaly is large and pervasive and strongly affects realized mutual fund returns. Siamwalla (2016) studied Risk and Return in The equity mutual fund industry. She finds that the Pearson product moment correlation between risk and return during the study period of 2003-2012 showed that there was a significant negative relationship with correlation of -0.299 between the risk and return of the sample funds during this ten-year period. Each paper may use different risk parameters e.g. beta, standard deviation, coskewness.

Value-at- Risk (VaR) is a level of maximum loss that in line with probability indicated by investor (Khanthavit, 2004). It is an attempt to provide a single number summarizing the total

[1] AIMC and Sornpaisarn(2018)

risk in a portfolio of financial assets (Hull, 2012). It also a popular risk parameters among Risk managers in Banking and Finance industry. VaR belongs to the family of risk measures that are used for estimating downside risk. Academic downside risk measures such as coskewness have not got popularity among practitioners. VaR, on the other hand, is widely used by commercial banks, insurance companies, investment firms, and many other institutions. This popularity is partially due to its simple calculation, interpretation and recommendations in its favor by several agencies including Basel II accords (Aziz and Ansari, 2017). Hence , it motivate me to think about useful of Value-at- Risk (VaR) if it can be used not only for risk measurement but also be used as a variable for predict the return.

Nevertheless, papers linking VaR with expected returns (e.g. expected stock returns) are sparse. In Thailand, Prasopa (2011) studied Value-at-Risk and the cross-sectional regression of expected stock returns: evidence from SET but Value-at-Risk with mutual fund has not been studied.

In addition, in practical world, I find that mutual fund firms in Thailand now have launched low-volatilities fund e.g. Low beta, low VaR and LHSTRATEGY fund from LHFUND which stated low VaR in the prospectus (as of 29 Dec 2017) have the best performance among peers (as of Dec 2017) so it is another motivation to make me interest in Value-at- Risk (VaR) as a variable to predict the mutual fund return.

However, you may notice that Parametric VaR which assumed normal-distribution of return may be considered as a same variable as standard deviation because Value-at-Risk is a linear function of standard deviation so in order to avoid argument on this issue, this study decide to study on non-normal distribution (Skewed distribution) because Moreno and Rodriguez (2009) state that the distribution of fund return was not Gaussian and then this study apply historical Value-at-Risk for study about performance predictability.

This study focus on to investigate performance predictability by Value-at- Risk (VaR) for skewed distribution mutual fund. This study try to find the performance of low VaR and high VaR mutual funds for all type of skewed distribution mutual funds. We expect to see negative relation between risk and return under skewed distribution. Siamwalla (2016) find negative relation between risk and return in Thai equity mutual funds by use the Pearson product moment correlation between risk and return, this study that follow Jordan and Riley (2015) also expect to see negative relation between risk and return under skewed distribution.

Furthermore, This study would like to test whether past Value-at-Risk can predict performance of Equity funds whose have skewed distribution or not. We expected to see historical VaR has predictability power. Even though Prasopa (2011) show that Value-at-Risk (VaR) has less power to capture the cross-sectional of expected returns at the stock level, at least she still finds that VaR can explain expected return in Thai stock level. Thus, under skewed distribution mutual fund, therefore it is expected to see historical VaR has predictability power.

For Conceptual Framework this study obtain return data and concerned information about mutual fund from morning star. Historical Value-at-Risk will be used a proxy of risk. In order to study the performance of low VaR and high VaR mutual funds for all type of mutual funds, this study mainly follow Jordan and Riley (2015). Furthermore, to answer another research question, does fund Value-at-Risk predict future performance? this study also follow Jordan and Riley (2015). However, in order to ensure that all variable exist in Thailand, partial of Siamwalla (2016)'s data and methodology will also be applied.

After data gathering process, we first try to find the performance of low VaR and high VaR mutual funds for (1) Equity skewed distribution mutual funds and (2) Fixed Income and Money Market skewed distribution mutual funds. We cannot do all type of mutual fund due to size of our sample. The result is no statistically to show different between portfolio of low VaR and high VaR for both equity skewed distribution mutual funds and Fixed Income and Money Market skewed distribution mutual funds

Furthermore, this study continue test whether past Value-at-Risk can predict performance of Equity funds whose have skewed distribution or not. Result from Fama-Macbeth regressions shows that Value-at-Risk is tend to have relationship with abnormal return in “high risk, high return fashion” but fails to have statistical significance.

2. Literature Review

There are many researches so far that report other variables that are related to mutual return. To illustrate, In Thailand, Piboonsak (2015) finds that in the concurrently year, fund size goes along with fund alpha. Funds with larger size relatively have higher alphas. However, as funds grow in size after one year, size seems to deteriorate the persistence of performance and there is also no predictability exists in two to three years periods after.

Under Risk and Risk anomaly aspect, there are also many researches still keep reporting the risk factor reports. For example, Frazzini and Pederson (2014) find that the BAB factor earns significant returns. Portfolios of high-beta assets have higher volatility than portfolios of low-beta assets. They find empirically that portfolios of high-beta assets have lower alphas and Sharpe ratios than portfolios of low-beta assets. Jordan and Riley (2015) find that the effect of volatility anomaly is large and pervasive and strongly affects realized mutual fund returns. In Thailand, Kittisommanakun (2015) study about volatility and mutual fund performance: evidence from Thailand. His study examines the low volatility anomaly phenomenon on Thai equity mutual funds and find that although average Thai equity fund managers cannot add value to their investors' portfolios over a 10-year period, investors can benefit from creating self-financing portfolio which takes a long position on the stocks held by low volatility fund managers while short-selling the stocks held by high volatility fund manager. Furthermore, Kaewthammachai, Kongsawadsak and Thammathorn, (2016) studied Betting against beta model: Evidence from Thai Stock Market and find similar result to those found in the US (Frazzini &Pederson, 2014) and India (Agarwalla, Jacob, Varma, & Vasudevan, 2014).

In addition, Siamwalla (2016), the most similar to my topic and also the most recent research in this field in Thailand, studied Risk and Return in The equity mutual fund industry: An unorthodox relationship and its application to new investment strategies. She find that the idiosyncratic risk of a fund and the age of a fund have positive effects on the probability that the fund will deliver a low-risk, high-return performance. The total number of funds managed by the asset management company was seen to have an adverse effect on the probability that funds will deliver such performance.

As this study uses Value-at-Risk (VaR) as a risk factor/variable, there is also has a paper that study about Value-at-Risk (VaR) and expected return which quite similar to this study. For example, Bali and Cakici (2004) investigated the role of VaR in the cross-sectional stock pricing of the US stock market in the period from January 1958 to December 2001. They found that stocks with high VaR outperform low VaR stocks. In addition, Aziz and Ansari (2017) studied "Value-at-risk and stock returns: evidence from India" and find positive risk premium associated with VaR in the Indian stock market during 2001-2008, the period of short selling constraint for institutional investors. For Thailand research, Prasopa (2011) show that Value-at-Risk (VaR) has less power to capture the cross-sectional of expected returns at the stock level.

So far, this literature review section unveiled that risk and risk anomalies are reported world-wide as well as Value-at-Risk and expected return. Nevertheless, paper about Value-at-Risk and mutual fund has not been studied before so this study will study about "Value-at-Risk (VaR) and Performance Predictability"

According to this paper require asset pricing model. The basic pricing model is CAPM which is famous model among Finance and practitioner but it has been attacked by many empirical test. For example, Banz (1981) find that small firm (low market capitalization) tend to has higher return than large firm. So far, many paper also study about this issue and the model that widely used is Fama-French three factor and Fama-French-Cahart four factor. Blanco (2012) point out that Fama and French Three Factor Model is better than CAPM according to the goal of explaining the expected returns of the portfolios. In addition , Rehnby (2016) and Lopez (2014), find that three-factors model improves explanatory power for portfolio returns in comparison the CAPM, and the four-factor-factor model gives a small improvement in the explanatory power compared to the three-factor model. Hence, this study will apply Fama-French three factor which also similar with Siamwalla (2016).

3. <u>Data</u>

The study use morning star database to build our sample of mutual fund return. This study selected mutual funds in Thailand during 2004-2017. It exclude closed-end, retirement (RMF) and long-term fund (LTF). The way that data of this study start in 2004 is as same as Piboonsak (2015) while the way that this study exclude such equity funds is as same as Siamwalla (2016).

For Fixed income fund, the closed-end and term fund also be excluded like equity fund.

The reason that I exclude such fund is owing to the fact that RMF and LTF funds are managed under some regulations because they are tax-benefit. For closed-end fund and term fund, they work like fixed portfolio.

3.1) return

Following morning star

3.2) Risk free rate

This study use risk free return from Bloomberg for yearly data and also use Morning Star for Daily data

3.3) Risk

Following Aziz and Ansari (2017), there are two methods of estimating VaRs.

3.3.1). Parametric VaR

The traditional parametric approach to VaR assumes a normal distribution of returns. Thus, the value of VaR depend on the mean and standard deviation of the distribution and the critical value that corresponds to a confidence interval. As in Khanthavit (2004), Parametric VaR is computed as

$$VaR(\alpha) = \mu_R - Z_\alpha \sigma_R$$

3.3.2) Non-parametric VaR

The non-parametric VaR is calculated based on the tail of the actual empirical distribution of the returns in the window period.

Comparison of these two methods, the main this advantage of Parametric VaR is that it is assumes normal-distribution however distribution of return is not always normal-distribution. To illustrate, Moreno and Rodriguez (2009) state that the distribution of fund return was not Gaussian. Hence, Historical VaR is chosen in this study.

Additionally, Interpretation of Value-at-Risk (VaR) is that decreasing in VaR (i.e. -1% to -3%) can be interpreted as a higher risk (higher downside risk) whereas increase in VaR (i.e. -1% to 0.5%) can be interpreted as a lower risk (lower downside risk). In addition, this study apply historical method VaR 99% 1 day because (1) one day as we gather data in daily (2) 99% level of confidence as in practical practice , we mostly see 99% level of confidence (i.e. asset management company in Thailand) (3) VaR 99% 1 day is widely used among practitioner

3.4) Fama-French three factor model

Declaration of the Fama-French three factor model is as following;

$$R_{i,t} - R_{f,t} = \alpha_{\mathrm{i}} + \beta_{1\mathrm{i}} \cdot MKT_t + \beta_{2\mathrm{i}} \cdot SMB_t + \beta_{3\mathrm{i}} \cdot HML_t + \varepsilon_{i,t}$$

In order to apply Fama-French three factor model with this study and Thai data, all variables are explained as Piboonsak, 2015.

$R_{i,t}$ is the daily return of equity funds

$R_{f,t}$ is a risk free. Recall that this study uses T-bill total return index from ThaiBMA or Morning Star as proxy for risk free rate.

MKT_t is the market factor which is the return of SET index less the risk free rate.

SMB_t is the size factor which is the premium of longing on small capitalization stocks and shorting on big capitalization stocks.

HML_t is the book-to-market factor which is premium of longing on high book-to-market (B/M) stocks and shorting on low-book-to market stocks

3.5) Variable from Jordan and Riley (2015) model.

In order to apply Jordan and Riley (2015) with my study and Thai data, all variables are explained as below

$Alpha_{i,t+1}$ is the annualized percentage alpha for fund i in calendar year t+1 calculated from the Fama-French three factor model using daily return

$Alpha_{i,t}$ is the same alpha in the prior year

$VaR_{i,t}$ is the Value-at-Risk of the daily return in year t. The non-parametric VaR or Historical VaR is calculated based on the tail of the actual empirical distribution of the returns in the window period.

$Idio_{i,t}$ is the idiosyncratic standard deviation of the daily return in year t. Siamwalla (2016) computed the idiosyncratic volatility of each mutual fund using Fama-French three-factor model. The measurement of the idiosyncratic risk of funds is the standard deviation (volatility) of the regression residuals.

$FundControls_{i,t}$ include the natural log of size, age, Fama-French three factor SMB(size), HML (value), exposures calculated from daily return during calendar year t.

Lipper class dummy variables are also included. Jordan and Riley (2015) stated that they use funds with lipper class code associated with market cap and value/growth tilt. In order to apply Jordan and Riley (2015) with Thai data and my study, this variable will be adjusted to Fund objective dummy variable as Siamwalla (2016). The Fund Objective (Dobj) is a dummy variable technique as a measurement of fund objective (Dobj) and used a Morningstar Style box as the basis for categorizing fund objectives. The assignment of the dummy variable for the fund objectives take a value of one if the fund is invested in the "growth stock" and zero otherwise.

So far, this study unveiled the data that will be applied through this study so below table is shown the variable that mentioned in this section or/and mentioned in methodology. This is for reader can quick see all important variable for this study.

Table 1
Variable Summary Table
All variables that needed in order to achieve objective of this study

Variable	Description	Unit	Source
Alphai,t+1	the annualized percentage alpha for fund i in calendar year t+1	% per year	Self-calculation from the Fama-French three factor model using daily return
SMB	the premium of longing on small capitalization stocks and shorting on big capitalization stocks	% per year	Self-calculation
HML	the premium of longing on high book-to-market (B/M) stocks and shorting on low-book-to market stocks	% per year	Self-calculation
Idioi,t	the standard deviation (volatility) of the regression residuals.	decimal	Self-calculation (the standard deviation (volatility) of the regression residuals.)
FundControlsi,t	natural log of size, age, Fama-French three factor SMB(size), and HML (value)		Self-calculation
log of size	Follow Siamwalla (2016) , LogSizei,t = log (NAVi,t) where NAVi,t is the net asset value of fund i at the end of year t	logarithmic scale	Self-calculation. Data from morning star
age	Follow Siamwalla (2016) ,Agei,t = (No.Mths)/12 where Agei,t is are of fund i at time t and No,Mths is number of months from incenption to the observed month	year(s)	Self-calculation. Data from morning star
Lipper class dummy variables	The assignment of the dummy variable for the fund objectives take a value of one if the fund is invested in the "growth stock" and zero otherwise	1 or 0	Self-calculation. (Dobj) and used a Morningstar Style box as the basis for categorizing fund objectives.
VaRi,t	the Value-at-Risk of the daily return in year t.	Percent (%)	Self calculation
Sharpe ratio	measure the reward to (total) volatilities. (Bodie, Kane, Marcus and Jain , 2014)	ratio	Self-calculation
Rf	Risk free.	Percent (%)	Bloomberg and Morning Star

4. Methodology

4.1 Evaluating the normal or non-normal distribution (Skewed Distribution)

4.1.1 Skewness and kurtosis (Wooldridge, 2016)

The third moment of the random variable Z is used to determine whether a distribution is symmetric about its mean. We can write $E(Z^3) = E[(X-\mu)^3]/ \sigma^3$ and it is viewed as a measure of skewness in the distribution of X. Because a normal random variable is symmetric about its mean, it has zero skewness. That is $E[(X-\mu)^3] = 0$

Further, it can be shown that $E[(X-\mu)^4]/ \sigma^4 = 3$, or $E(Z^4) = 3$, where Z has a standard normal distribution. This fourth moment is called kurtosis. If that E[(X-μ)4]/ σ4 > 3, then the distribution of X has fatter tails than the normal distribution (a somewhat common occurrence, such as with the *t* distribution) : If E[(X-μ)4]/ σ4 < 3 , then the distribution has a thinner tails than the normal

Hence, according to (Wooldridge, 2016), $E[(X-\mu)^3]$ is not 0 and $E[(X-\mu)^4]/ \sigma^4$ is not equal to 3, such distribution should be defined as skewed distribution.

4.1.2 Histrogram

Ross (2014) states that many of the large data sets observe in practice have histograms that are similar in shape. These histograms often reach their peaks at the same median and then decrease on both sides of this point in a bell-shaped symmetric fashion. Such data sets are said to be normal and their histograms are called normal histograms.

Hence, If any return distribution is not have shape like described by Ross (2014), it will be defined as a non-normal distribution.

4.1.3 Quantile plot[2]

The Q-Q plot, or quantile-quantile plot, is a graphical tool to help us assess if a set of data plausibly came from some theoretical distribution such as a Normal or exponential.

[2] http://data.library.virginia.edu/understanding-q-q-plots/

Hence, this study will apply Wooldridge (2016) to identify normal or skewed distribution by below criteria

$H_0 : E[(X-\mu)^3] = 0$

$H_1 : E[(X-\mu)^3] \neq 0$

And then we will do t-test to test this hypothesis and if we reject the null hypothesis, we will say that such mutual fund is skewed distribution.

Kurtosis can also be applied with the same logic as skewness. Histogram or/and Quantile plot, may be applied as a second choice.

4.2 The performance of low VaR and high VaR mutual funds

There are several performance measurements used in evaluating mutual funds. Evaluating performance based on average return alone and ignore risk is not useful and incorrect so the return-based measurement such as Treynor ratio or Sharpe ratio measures returns per unit of risk should be applied. In order to ensure that one performance measurement can be applied to every type of fund, this paper will apply sharpe ratio for all type of mutual funds. The reason is it is easy to compute and widely used among practitioners (e.g. asset management firms) and Jordan and Riley (2015) also compute sharpe ratio and apply it to measure performance of mutual funds

Follow Bodie, Kane, Marcus and Jain (2014). Sharp ratio is computed as below formula

Sharpe measures: $\frac{\mathrm{Rp-Rf}}{SDp}$

Sharpe's measures divides average portfolio excess return over the sample period by the standard deviation of returns over that period. It measure the reward to (total) volatilities.

Follow Jordan and Riley (2015), I first explore the performance of low and high Value-at-Risk of mutual fund by sorting funds into portfolios based on past Value-at-Risk. At the beginning of each calendar year, we sort funds into decile (or quartile in case of small sample) based on the Value-at-Risk of their daily fund return during the prior calendar year. The low Value-at-Risk portfolio holds the 10% of mutual funds in the sample with the lowest Value-at-

Risk. The high Value-at-Risk portfolio holds the 10% of mutual funds in the sample with the highest Value-at-Risk in the prior calendar year. Each portfolio is equal weighted and has the same number of funds at the start of the year. A fund remains in the same portfolio for the entire year. This study will rebalance portfolio every year.

This method will be applied to all type of mutual fund.

4.3 Does fund Value-at-Risk predict future performance of Equity mutual funds?

In order to evaluate performance of mutual funds, many study uses alphas as the proxy of performance on a risk-adjusted basis. Alpha, or the excess returns of funds, gauges the performance of an investment against a benchmark index.

Follow Jordan and Riley (2015), this study test whether past Value-at-Risk or other firm characteristics predict performance using the following model.

$$\text{Alpha}_{i,t+1} = \gamma_0 + \gamma_1 \text{Alpha}_{i,t} + \gamma_2 \text{VaR}_{i,t} + \gamma_3 \text{Idio}_{i,t} + \gamma_4 \text{FundControls}_{i,t} + \text{ClassDummy}_{i,t} + \varepsilon_{i,t}$$

In order to apply Jordan and Riley (2015) with my study and Thai data, all variables are explained in data section. We will estimate the Fama-French model for each fund that records a return every day during each calendar year. Declaration of the Fama-French three factor model is in data section.

Back to $\text{Alpha}_{i,t+1} = \gamma_0 + \gamma_1 \text{Alpha}_{i,t} + \gamma_2 \text{VaR}_{i,t} + \gamma_3 \text{Idio}_{i,t} + \gamma_4 \text{FundControls}_{i,t} + \text{ClassDummy}_{i,t} + \varepsilon_{i,t}$. Follow Jordan and Riley (2015), this study estimates the model using the Fama-Macbeth (1973) regression procedure.

Compare OLS with Fama-Macbeth. Due to serial correlation, regular OLS cannot give a consistent estimator for standard error while Fama-Macbeth can give consistent estimator of standard error.

As mentioned in hypothesis session, γ_2 is expected to be significantly different from zero

5. Empirical Result

5.1 Mutual Funds Selection

We gather return from Morning Star during 2004-2017 and then write code in STATA in order to find skewness and test whether their skewness are significantly different from zero or not. We set $H_0 : E[(X-\mu)^3] = 0$ and $H_1 : E[(X-\mu)^3] \neq 0$ then we expect to reject null hypothesis at P-Value less than 10% (or 10% confidential level)

The below table 2 tells us that from all 1059 mutual funds, there are 182 funds that their return distribution are not normal distribution. This result is less than our estimation because our preliminary search was done for data of year 2017 only so the return may possible to be Non-normal distribution. Nevertheless, when we test again with full data, data become more normal distribution. However, our study period is quite long (2004-2017) and most of data are available (i.e. from Bloomberg, Morning Star) for us so we accepted this skewness testing result.

However, please noticed that using Skewness test only is not enough as there is still possible that mutual funds that have not passed skewness criteria may possible to pass kutosis criteria but due to limit of timing to study , we can do only skewness testing. Later, focusing on “Non-normal distribution” has been revised to “Skewed Distribution”

Table 2
Number of Mutual Funds that have Skewed Return Distribution

This table shows 182 mutual funds from 1059 mutual funds are Skewed Return Distribution. Allocation (Mixed Funds), Commodities and Miscellaneous have small sample size of Skewed Return Distribution so this study continue with (1) Equity mutual fund (2) Fixed Income and Money market fund as an our universe to study

Type of Mutual Funds	Total	Skewed Distribution
Equity	561	92
Allocation (Mixed Funds)	174	8
Fixed Income	181	38
Money Market	53	35
Commodities	43	1
Miscellaneous	47	8
Summary	1059	182

As mentioned with previous part that we are going to study "the performance of low VaR and high VaR mutual funds" with all type of skewed but some types of mutual funds have small sample to be tested which are Allocation (Mixed Funds), Commodities and Miscellaneous. Hence, we continue to test two groups of mutual funds. First is Equity funds which has 92 mutual funds as our universe to study. Second is Fixed income and money market funds which has 73 mutual funds as our universe to study. We merge fixed income and money market funds together owing to three main reasons. First is their investment strategy is similar which is low risk. Second, during finding the Value-at-Risk (VaR), we find that their VaR is similar which is zero or close to zero. Third, Combing these two type of mutual funds together, we are going to get bigger sample size.

5.2 The performance of low VaR and high VaR mutual funds

5.2.1. The performance of low VaR and high VaR Equity mutual funds

We calculated VaR by historical method. Result of calculation shown in below table 3

Table 3
Historical Value-at-Risk (VaR) (percent)

Maximum sample size is in 2017. The mean of VaR shows higher risk comparing to Fixed Income and Money market fund as mean of VaR of Equity mutual funds is different from zero than Fixed Income and Money market fund

Data of Year	Sample Size (mutual funds)	Mean of VaR (%)
2017	92	-1.176
2016	73	-2.388
2015	58	-2.758
2014	52	-1.794
2013	49	-2.661
2012	39	-1.738
2011	29	-3.823
2010	27	-2.970
2009	25	-3.710
2008	20	-7.037
2007	20	-3.035
2006	17	-2.525
2005	15	-2.302
2004	14	-3.959

Then we divide equity funds by quartile due to limited sample size in our universe (maximum 92 funds in 2017). The low Value-at-Risk portfolio holds the 25% of mutual funds in the sample with the lowest Value-at-Risk. The high Value-at-Risk portfolio holds the 25% of mutual funds in the sample with the highest Value-at-Risk in the prior calendar year. Each portfolio is equal weighted and has the same number of funds at the start of the year. A fund remains in the same portfolio for the entire year. We rebalance portfolio every year. The result shown in below table 4

Table 4

Result of performance of low VaR and high VaR of Equity mutual funds

After forming four portfolios, each year, we measure 1-year performance, Risk free, yearly standard deviation and then calculate the Sharpe ratio. The result shows the lowest VaR portfolio is the most winner. Nonetheless, after test significant, there is no different between Lowest VaR portfolio and Highest VaR Portfolio

Return (percent)														
Data of year	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Highest VaR	-6.32	21.33	18.24	-4.80	17.01	8.44	21.74	-3.09	43.38	45.00	-44.35	37.07	3.86	9.25
Second vaR	-4.48	19.84	13.03	-8.23	16.51	5.77	35.04	1.16	41.10	59.09	-44.11	42.36	0.44	11.26
Third VaR	5.83	21.70	13.74	1.78	10.90	4.69	35.62	2.26	16.82	56.64	-43.17	32.75	0.48	9.63
Lowest vaR	2.95	9.55	10.84	5.25	4.40	0.31	27.93	2.29	34.21	52.15	-42.11	21.14	-0.35	9.56
Risk free(percent)	1.41	1.44	1.78	2.19	2.71	3.12	2.64	1.25	1.51	3.57	4.00	4.47	2.19	1.13
Yearly SD (decimal)														
Highest VaR	0.08	0.05	0.14	0.13	0.13	0.16	0.10	0.20	0.16	0.21	0.35	0.14	0.23	0.17
Second vaR	0.10	0.06	0.12	0.13	0.13	0.17	0.14	0.24	0.19	0.26	0.36	0.16	0.27	0.13
Third VaR	0.13	0.06	0.08	0.09	0.04	0.18	0.09	0.12	0.16	0.24	0.32	0.21	0.25	0.15
Lowest vaR	0.06	0.03	0.06	0.05	0.04	0.10	0.07	0.17	0.11	0.22	0.25	0.12	0.22	0.10
Sharpe Ratio														
Highest VaR	-1.02	3.90	1.17	-0.55	1.14	0.33	1.86	-0.22	2.60	2.02	-1.38	2.27	0.07	0.49
Second vaR	-0.57	3.27	0.94	-0.83	1.09	0.15	2.35	0.00	2.11	2.11	-1.34	2.43	-0.07	0.77
Third VaR	0.33	3.62	1.49	-0.05	2.09	0.09	3.55	0.08	0.94	2.23	-1.45	1.32	-0.07	0.56
Lowest vaR	0.27	3.05	1.59	0.63	0.39	-0.29	3.58	0.06	2.88	2.21	-1.84	1.42	-0.12	0.84

Form table 4, Most of the time (not always), Lowest VaR portfolio perform better than highest VaR portfolio. Compare only Lowest VaR vs highest VaR , lowest VaR portfolio performs better for 8 times across data year 2004-2017. Furthermore, Compare all quartile portfolio, Lowest VaR portfolio is the most winner (5 times across data year 2004-2017). The result seem consistent with our hypothesis. However, the result fails to have statically different. In short, there is not statistically different between the lowest VaR portfolio and the highest VaR portfolio. The result is not consistent with previous literature. The possible explanation is that the previous literature study the whole distribution, which may dominate by normal distribution as skewed distribution is a small sample size as mentioned in section 5.1 or shown in table 2. In addition, it also may be because value-at-risk capture only downside risk so when we measure the performance, there is still a chance that portfolio perform well during 1-year holding period. In other word, mathematically speaking, there is possible that positive, zero, and negative skewness may give you a same VaR but there is a chance that performance of negative skewness can perform better when you measure 1-year performance so this point may give us an insignificant difference of performance between Low VaR and high VaR portfolio

5.2.2. The performance of low VaR and high VaR Fixed Income and Money Market mutual funds

We calculated VaR by historical method. Then, the logic is the same as Equity mutual funds. However, Owing to the fact that most of VaR of Fixed Income and Money Market is zero (most of the year, Median of VaR is zero) , we cannot sorting portfolio into whether decile or quartile group so we separate them into two group by use first quartile to be break even points between low VaR and high VaR portfolio. The result shown in below table 5 and table 6

Table 5
Historical Value-at-Risk (VaR) (percent)

Maximum sample size is in 2017. Nonetheless, noted that there are some funds that open before 2017 and close before 2017 so total universe of fixed income and Money market funds is 73 mutual funds. The mean of VaR shows lower risk comparing to Equity fund as mean of VaR of Equity mutual funds is very close zero.

Data of Year	Sample Size (mutual funds)	Mean of VaR (%)
2017	68	-0.037
2016	65	-0.051
2015	64	-0.073
2014	63	-0.031
2013	62	-0.052
2012	55	-0.055
2011	45	-0.081
2010	39	-0.128
2009	34	-0.100
2008	35	-0.141
2007	27	-0.132
2006	21	-0.063
2005	19	-0.080
2004	10	-0.140

Table 6

Result of performance of low VaR and high VaR of Fixed Income and Money Market mutual funds

After Forming two portfolios, each year , we measure 1-year performance , Risk free , yearly standard deviation and then calculate the Sharpe ratio. The result shows high VaR portfolio is the most winner. Nonetheless, after test significant, there is no different between Low VaR portfolio and High VaR Portfolio

Return (percent)														
Data of year	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
High VaR	0.07	1.49	2.08	1.92	3.54	2.28	5.68	3.02	3.09	6.50	-0.86	4.09	4.90	1.15
Low VaR	0.97	1.13	1.23	1.55	2.00	2.35	2.71	2.38	0.96	0.99	3.02	3.54	4.17	2.10
Risk free(percent)	1.41	1.44	1.78	2.19	2.71	3.12	2.64	1.25	1.51	3.57	4.00	4.47	2.19	1.13
Yearly SD(percent)														
High VaR	0.53%	0.76%	2.05%	1.17%	0.65%	1.08%	1.12%	1.59%	2.11%	1.76%	2.61%	2.19%	1.61%	3.41%
Low VaR	1.07%	0.05%	0.15%	0.30%	0.08%	0.24%	0.36%	0.82%	0.04%	0.59%	0.65%	0.55%	0.39%	0.07%
Sharpe Ratio														
High VaR	-2.52	0.07	0.15	-0.23	1.28	-0.77	2.72	1.11	0.75	1.67	-1.87	-0.17	1.69	0.01
Low VaR	-0.41	-5.68	-3.81	-2.11	-8.57	-3.24	0.20	1.38	-12.76	-4.36	-1.49	-1.68	5.02	14.84

There are 9 times over 14 years that sharpe ratio of Low VaR portfolio is lower than high VaR portfolio. However, it fails to have statistically different as shown in table 8. The result does not in line with our hypothesis because the return of Fixed income funds and Money market is limited (General speaking, limited gain) as well as the risk that also limited as a low risk or risk-free (The stock exchange of Thailand, 2015). In brief, both return and risk of Fixed Income and Money Market mutual funds may do not move so this is possible to be a reason that we see nothing from the study of low VaR and high VaR of Fixed Income and Money Market mutual funds.

5.3 Does fund Value-at-Risk predict future performance of Equity mutual funds?

In order to answer this research question, we have to gather all data that mentioned in data and methodology sections which be summarized below

$Alpha_{i,t}$: Result from Fama-French Three factor model.

$VaR_{i,t}$: Result from Self-Calculation.

$Idio_{i,t}$: predict residual value and then find their standard deviation by each mutual funds.

$FundControls_{i,t}$: natural log of size can be defined by Morning-Star.

While, the age cannot be directly find by Morning-Star. Nevertheless, Morning Star provides the since-inception date (mean starting data) of each mutual funds, then we can calculated the age of all mutual funds. In addition, for exposure of SMB(size), HML (value), we calculated from daily return during calendar year t from Fama-French three factor.

$ClassDummy_{i,t}$:As mentioned in data section, Moming Star can provide us the Morningstar Style box which then be applied as the basis for categorizing fund objectives. Then, we assign value equal to one if any funds turn to be a growth funds and zero otherwise.

After we get all above variable then the last variable $Alpha_{i,t+1}$ can be defined by we generate variable as a forward alpha or f.alpha. such forward alpha is $Alpha_{i,t+1}$ under Fama-Macbeth regression. Correlation between variable that needed for Fama-Macbeth regression is shown in table 7

Table 7
Correlation between variable that needed for Fama-Macbeth regression

This table summary correlation between alpha, VaR, idio, eSMB, eHML, Log(NAV) , age and class dummy

	ALPHA	VAR	IDIO	ESMB	EHML	LOGNAV	AGE	CLASSDUMMY
ALPHA	1							
VAR	0.2429	1						
IDIO	-0.1229	-0.3131	1					
ESMB	-0.1766	0.1029	0.106	1				
EHML	-0.0267	0.1822	0.2316	-0.0139	1			
LOGNAV	0.0448	0.1108	-0.007	0.0128	0.1181	1		
AGE	-0.1688	-0.1737	-0.3204	-0.1733	-0.1437	0.1026	1	
CLASSDUMMY	0.0626	0.0266	0.184	0.1159	0.005	0.0449	-0.0838	1

Hence, So far, all variable exists for Fama-Macbeth regression. Then we run Fama-Macbeth regression and result shown in below table 8

Table 8
VaR fails to have explanation power to predict future performance of Equity mutual funds
The result shows that VaR has negative slope. Nonetheless, it fails to have significant in statistics.

VARIABLES	(1) falpha
alpha	0.0723
	(0.104)
var	-0.0105
	(0.00929)
idio	-0.00221
	(0.0376)
esmb	-0.0293
	(0.0617)
ehml	-0.0391
	(0.0596)
lognav	-0.000214
	(0.00144)
age	-0.000687
	(0.000557)
classdummy	-0.00929
	(0.00846)
Constant	-0.00125
	(0.0313)
Observations	438
Number of groups	13

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result shows that VaR has negative slope which can be interpret that When VaR decrease (i.e. from -1% into -3%), abnormal return will increase. Anyway, noticed that the way to say VaR decrease (i.e. from -1% into -3%), we can also say “higher risk” owing to the fact that downside risk become bigger from -1% into -3%. Hence, the result show high risk, high return anyway. Nonetheless, it fails to have significant in statistics. Even though, the result is not as our expectation (hypothesis) and not consistent with previous literature (Jordan and Riley, 2015), it still similar with previous empirical study. Aziz and Ansari (2017) reported that in Fama-Macbeth’s regressions, the coefficient of VaR, although positive, fails to have statistical significance then they stated that Fama-Macbeth’s regressions yield different inferences. As well as Prasopa (2011) reported that HVaRL variable (Value-at-Risk factor) does not have statistical significance of its slope coefficient. The reason that may be can explain this result is that there is may be a shock, event, or unexplained variable (i.e. luck of fund manager) that may effect abnormal return and make return behavior changes then the distribution become skewed distribution. In addition, Mutual funds in Thailand is still developing (says, it is not developed like US market) so Thai Mutual funds may cannot hedge those shock, event, or unexplained variable like US market may possible to do.

6. Conclusion

Using data of mutual funds in Thailand from 2004 to 2017, this study first try to find the performance of low VaR and high VaR mutual funds for all type of skewed distribution mutual funds. However, due to limited sample size, we study two groups of mutual which are (1) Equity skewed distribution mutual funds and (2) Fixed Income and Money Market skewed distribution mutual funds. The method that be applied is sorting Value-at-Risk and then form a portfolio. This method follow Jordan and Riley (2015). Under this method, the low VaR portfolio insignificantly different from the high VaR portfolio for both equity and Fixed income and Money market mutual funds. This result does not consistent with our hypothesis and previous literature. For equity fund, the reason may because the previous literature study the whole distribution, which dominate by normal distribution while our study focus on Skewed distribution. Furthermore, additional possible reason is that Value-at-Risk captures only downside risk so when we measure the performance, there is still a chance that portfolio perform well during 1-year holding period. For Fixed Income and Money Market mutual funds, both return and risk of Fixed Income and Money Market mutual funds may do not move so this is possible to be a reason that we see nothing from the study of low VaR and high VaR of Fixed Income and Money Market mutual funds.

Next, this study continue to test whether past Value-at-Risk can predict performance of Equity funds that have skewed distribution or not. In other word, the research question is "Does fund Value-at-Risk predict future performance of Equity mutual funds"? The method that applied for this research question is Fama-Macbeth regression .Under Fama-Macbeth regression, the slope of VaR can be interpreted as a "high risk, high return" but fails to have statistical significance. Result from this test does not as expectation and also previous literature, nevertheless, it still similar with some previous studies like Prasopa (2011) and Aziz and Ansari (2017) as they also report insignificant on coefficient of VaR. The reason that may be can explain this result is that there is may be a shock, event, or unexplained variable that may effect abnormal return and make return behavior changes and then the distribution become skewed distribution. In addition, Mutual funds in Thailand is still developing so Thai Mutual funds may cannot hedge those shock, event, or unexplained variable like US market may possible to do.

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