AN EVALUATION OF RISK ADJUSTED PERFORMANCE RATIOS FOR THAI MUTUAL FUNDS

BY

MS. WIPHA THOMYAMONGKOL

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (ENGINEERING AND TECHNOLOGY)

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was approved as partial fulfillment of the requirements for
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ABSTRACT

A mutual fund is one of the best alternative investment for saving. Most investors and companies concern about risk and return, so they decide to invest in mutual funds. Mutual funds are managed by professional managers and the assets in mutual funds are diversified to avoid risks.

The performance of mutual funds can be one of the important factors that can lead the financial company's success and can build financial stability for that company. There are several tools that can be used for measuring risk and return. Risk adjusted performance ratios are common tools that many financial companies frequently use. The study aims to find the performance of ratios, which one is appropriate for Thai mutual fund evaluation. Five popular risk adjusted performance ratios including Sharp ratio, Treynor ratio, Jensen's alpha ratio, Information ratio, and Sortino ratio are used. Sample funds in the bond sector, the real estate sector, the gold sector, the commodity sector, the emerging market sector, the global equity sector, the European and US equity sector, and the equity sector are selected. Data are taken from a period of six years, starting from January 2013 and ending at the end of December 2018 are used for the evaluation. The results of the analysis show that Jensen's alpha ratio outperforms

the other four ratios in the bond sector, the equity sector, the global equity sector and the real estate sector. For the emerging market sector and the commodity sector, Sharpe ratio and Sortino ratio outperform the other ratios. For the gold sector, Sortino ratio performs better than the other four ratios. For the European and US equity sector, Sharpe ratio, Information ratio and Sortino ratio outperform the other ratios.

Keywords: Thai mutual funds, Risk adjusted performance ratios, Sharpe ratio, Treynor ratio, Jensen's alpha ratio, Information ratio, Sortino ratio

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Symbols/Abbreviations	Terms
IR	Information Ratio
JR	Jensen's alpha ratio
SHR	Sharpe ratio
SR	Sortino ratio
TR	Treynor ratio

CHAPTER 1
INTRODUCTION

1.1 Introduction and background

Mutual funds have been a popular investment vehicle in Thailand. For the last ten years, Thai mutual funds industry has increased rapidly and become an alternative trading channel savings for investors (Suthiranart, Kraisornsuthasinee, and Rompho, 2018). A mutual fund is an investment that collected money from individual investors to invest in many securities such as stocks, bonds, cash, and other investments to diversify the risk. Mutual funds in Thailand can be divided into many sectors such as the gold sector, the commodity sector, the equity sector, the real estate sector, and the bond sector. In general, mutual funds offer better returns than fixed deposit interest rates and they are an alternative safest way to invest than stocks (Amarjeet, 2014). The major factors that make investors interest to invest in mutual funds because investors want to save their money after the retirement and want to earn tax benefits. Mutual funds have various alternatives for savings serve long term such as retirement mutual funds. The greatest advantage of investing in mutual funds versus other investment are consisting of the risk diversification and low transaction cost. They are also considered as a better choice investment for beginner investors because they are operated by expert managers.

In finance, there are several ways in which investors can measure the performance of funds. Some investors may want to look beyond the return of funds when evaluating the performance. Measuring the risk and volatility that are involved in return is one of the important aspects for investors before deciding to invest in some assets. The risk adjusted performance ratios are one of the popular tools that investors used as future predictors. The risk adjusted performance ratio measures the risk that is involved in return on the investment through a given period of time. If two assets of the same type have the same return over a given time period, the one that produces the lower risk will have a better risk adjusted performance. There are several risk adjusted performance ratios that investors can use for measuring the performance of funds.

In this work, we aim to determine which risk adjusted performance ratios are most appropriate for evaluating Thai mutual funds performance. Five popular risk adjusted performance ratios including Sharpe ratio (SHR), Treynor ratio (TR), Jensen's alpha ratio (JR), Information ratio (IR), and Sortino ratio (SR) are considered. Data from 279 Thai mutual funds from January 2013 to December 2018 were collected for the evaluation. The data consist of 57 bond funds, 46 real estate funds, 15 emerging market funds, 6 global equity funds, 3 European and US equity funds, 4 commodity funds, 16 gold funds, and 132 equity funds. The five ratios are used for evaluating Thai mutual fund performance in each asset sector. After the evaluation, top five funds in the bond sector, the real estate sector, the equity sector, the emerging market sector, the global equity sector, and the gold sector of each ratio ranking are selected. The top two funds in the commodity sector and the European and US equity sector of each ratio ranking are also selected. For a comparison of the risk adjusted performance ratios, these top five funds and these top two funds are used for calculating the total average annualized return over six years. To validating the results, the actual average annualized returns of the next following years are used for consideration.

1.2 Statement of problem

In Thailand, mutual funds are divided into several different asset sectors. In each asset sector, there are containing in many funds. So, it is difficult for investors to make a decision for investing in some funds within a single asset sector. In general, most investors choose the fund based on its past performance. The fund past performance is one of the aspect that investors consider before investing. The historical performance of the fund can find in the fund fact sheet or business newspaper. The fund which produces the high historical returns is chosen because the investors expect to obtain high returns in the next following year. However, the problem is that high returns can come with the high volatility of risk.

In finance, investors can determine risk and volatility that are involved in return by using some measurement techniques. There are many risk adjusted measurement techniques that investors can use for predicting the fund performance. Thus, it can be difficult for investors to decide which tool is appropriate to use. The most common tools that popular use, are called risk adjusted performance ratios. Moreover, there are

popular five ratios that investors can use to evaluate the fund performance. They are namely Sharpe ratio, Treynor ratio, Jensen's alpha ratio, Information ratio, and Sortino ratio. If investors use all of the five ratios to evaluate the fund performance, it will take a lot of time. There no single ratio that is good for all asset sectors because each of them has limitations and slightly different. So, the question is which ratio is the best indicator for using to evaluate the performance of funds. According to these reasons, this paper can help investors to determine which risk adjusted performance ratios are appropriate to use for evaluating the performance of funds in which asset sector.

1.3 Research objectives

The studied that popular in a financial topic is the evaluation of the investment performance. The performance is computed by using ex post data. The historic data can predict the future results. Several studies use risk adjusted performance ratios to measure the performance of the investment. Risk adjusted performance ratios can be used to explain and compare the volatility of risk that involving in the return. The better investment should not come with additional risk. As a financial analysis, it is important to not consider a single ratio for evaluating the investment performance. Multiple ratios and other aspects should be considered before making a final decision.

This research has the following scope and purposes:

1. To examine the fund's past performance by performing various statistical and financial techniques of risk adjusted performance ratios.
2. Risk adjusted performance ratios including Sharpe ratio, Treynor ratio, Jensen's alpha ratio, Information ratio, and Sortino ratio are used for the evaluation.
3. To identify, which risk adjusted performance ratios is most suitable for measuring the performance for which asset class.
4. Validate the results for looking the actual returns that investors can be obtained.

1.4 Report Structure

The remainder of this paper is structured into seven sections. Section 2 gives a review of the literature that are relevant in the area of the fund performance. Section 3

provides the basic concept of mutual fund investment and explain the detail of all types of mutual fund that use in this study. Section 4 provides an overview of statistical tools and risk adjusted performance ratios that are used in the study. Section 5 describes data and our research methodology. It also presents the data analysis of this study. Section 6 contains our experimental results. Section 7 shows the validation of the results analysis. The last section provides the conclusions.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Introduction

Evaluating the performance of the funds is an important part for many financial companies and investors. Risk and return are the significant key that most fund managers use for evaluating the fund performance. Most of the financial analyst examine the sample data by using risk adjusted performance ratio for comparing risk and return that the investment can be taken on. In finance, there are many popular risk adjusted performance ratios that can be used for examining the fund performance. It is difficult to analyze which risk adjusted performance ratio proper for using to evaluate the performance of the funds. In the research of financial field and science field, some authors provided the concept of risk adjusted performance ratios and evaluate the sample data to compare the performance of risk adjusted performance ratios which ratios are appropriate for evaluating which asset sector.

2.2 Comparative evaluation by using various risk adjusted performance ratios

Bansal, Kumar, and Gupta (2012) examined randomly 12 Indian mutual funds. The study period was selected from May 2005 through April 2009. They evaluated the funds performance by using standard deviation, average return, and Sharpe ratio. They attempted to compare which fund was outperformed or underperformed over BSE SENSEX benchmark. The result showed that only three selected mutual fund schemes outperformed than the benchmark index and showed positive value of Sharpe ratio. However, they concluded that almost all of the mutual funds that were selected underperformed during the period of study.

Vyšniauskas and Rutkauskas (2014) proposed to analyze the performance of Lithuanian mutual funds and observed which risk adjusted performance ratio was performed the best for evaluating the performance of the funds. They compared the performance of funds with their benchmark index and calculated buying fee, management fee, and selling fee to identify these funds if it worth for paying. They selected ten Lithuania mutual funds with the period that starting from January 2012 to

October 2013 for the evaluation. For the evaluation, risk adjusted performance ratios including standard deviation, beta, Sharpe ratio, Treynor ratio, and Jensen's alpha ratio were applied. The analysis of this study showed that the best performed fund was lower fees than the worst performed fund. The result of the study suggested that Jensen's alpha ratio performed better performance than the other four measurements.

Rohitraj and Rao (2015) used standard deviation, beta, Sharpe ratio, Treynor ratio, and Jensen's alpha ratio for evaluating the performance of funds. They considered only open-ended schemes for the study. They compared two open-ended equity mutual funds, i.e., "SBI emerging business fund" and "HDFC top 200 fund". The performance of the two funds were also compared against the CNX Nifty benchmark index. The period of the study was from 2009 to 2014. Their study showed that both funds outperformed the benchmark index. The "SBI emerging business fund" outperformed the "HDFC top 200 fund" when Sharpe ratio, Treynor ratio and Jensen's alpha ratio were considered.

Kuhle and Lin (2018) aimed to analyze the appropriate risk adjusted performance ratio for mutual funds in the real estate sector. Various popular risk adjusted performance ratios including Sharpe ratio, Treynor ratio, and Sortino ratio, were used for consideration. Top forty mutual funds in the real estate sector that reported by Morningstar, at least ten years of high yield return were used for evaluation. The period of the study was based on the data from June 2008 to June 2017. The total return of top five and top ten funds for each ratio ranking were used for the comparison. After the evaluation, the result of the study indicated that Sharpe ratio performed better than the other two risk adjusted performance ratios.

Mamta and Ojha (2017) attempted to evaluate the performance of Indian mutual funds in the equity sector. They used standard deviation, beta, coefficient of determination, Sharpe ratio, Treynor ratio to consider the relationship between risk and return. A sample of top ten Indian mutual funds from January 2013 to February 2017 were selected. The average return of funds also compared against the average return of BSE Sensex benchmark index. The analysis of this study revealed that three out of ten funds yielded better performance than the benchmark index. The only one fund had a greater value of the Sharpe ratio than the benchmark index. The four out of them had a greater value of the Treynor ratio than the benchmark index. Thus, they concluded that

most of the selected mutual funds were underperformed the market during the time period of the study.

Oran, Avci, Ashoor, and Tan (2017) proposed to evaluate the performance of Turkish mutual funds and pension funds. A sample of 15 Turkish mutual funds and 10 pension funds were selected for this study. The period of the study was selected from January 2009 to December 2015. They used Sharpe ratio, Treynor ratio, Jensen's alpha ratio, Information ratio, Sortino ratio, and TOPSIS model. The results of the study indicated that most of the selected funds were underperformed the market. They suggested that the pension funds outperformed the mutual funds when Treynor ratio, Jensen's alpha ratio and Information ratio were considered. On the other hand, the mutual funds outperformed the pension funds when Sharpe ratio and Sortino ratio were considered. The mutual funds outperformed the pension funds when all measures were combined using the TOPSIS model.

Jani and Jain (2014) aimed to observe the performance of three Indian mutual funds by applied Sharpe ratio. They compared the performance of the funds against the BSE Sensex benchmark index. The period of the study was from January 2013 to December 2013. In the study, transaction cost and dividend payout were not considered. After the evaluation, results of the study showed that two over three funds performed better than the benchmark index. From the consideration of Sharpe ratio, only one of fund had a positive value of Sharpe ratio which is a better option for investing than the other funds.

Jensen (1967) attempted to develop the model for evaluating the portfolio performance which concerning in risk and returns. Name of the model known as Jensen's alpha ratio. Sample of 115 mutual funds were selected from 1945 to 1964. The study attempted to forecast the securities selection ability of mutual fund managers. The Jensen's alpha formula was based on the theory of Sharpe ratio and Treynor ratio. The analysis of the study showed, there was very little evidence that sample funds performed better than managers expected. The study concluded that, managers were not be able to forecast securities price movements.

Rohatgi, Kavidayal, Mishra, Singh, and Dixit (2020) aimed to validate the performance of two risk adjusted performance ratios, i.e., Sharpe ratio and Treynor ratio. Top six Indian mutual funds in the equity sector that gave high valuation of asset

under management (AUM) were selected for the study. The annualized returns and risk adjusted performance ratios from year 2017 to year 2018 were calculated. After the calculation, the performance of each fund was ranked by each ratio ranking. The performance of risk adjusted performance ratios were validated by calculated the monthly returns of each fund during a one-year period starting from April 2018. The result showed that the ranking given by Sharpe ratio and Treynor ratio were not justified in the monthly returns.

CHAPTER 3
MUTUAL FUND INVESTMENT

3.1 Mutual funds

A mutual fund is an investment that gathering money from many individual investors to invest in many assets such as stock, bond, cash, and other assets. Mutual fund is considered as the safest investment for beginners because it is operated by professional managers. A mutual fund provides the opportunity for a small investor to invest in the large sized of companies at a low cost. It is selling the shares to investors that the investor expected to earn return without a very high of risk. Mutual fund managers invest in different types of asset to diversify the degree of risk. So, the investors not worry to deal the risk of putting all the eggs in one basket (Annapoorna & Gupta, 2013). Mutual fund is suitable for investors that have not much time for analyzing all of the individual investments. For example, if investors want to invest in stocks and want to diversify their portfolio. Instead of analyze all of the individual stock, they decide rather buy a single equity mutual fund, which will be similar to buying entire stocks in the market. The other advantage of mutual funds are low transaction cost, transparency, and liquidity. Each mutual fund has specific goal and strategy. It is invested according to its objectives. For example, the real estate mutual fund invests in the main income that producing from the various of real estate trust.

The investors can be used the historical fund record, fund fact sheet, and business newspaper to measure the performance of fund before investing. Many investors use mutual fund fact sheet to compare the performance of funds. The fund fact sheet is considered as one of the essential documents. It shows the performance of fund that can be performed in the past. Basically, a mutual fund fact sheet gives an overview of fund in three-page documents, it easy to read and understand. It provides the fund return and shows the top five asset holdings of that fund. It also provides the risk assessment, fees, and charges. Risk assessment shows the information of the risk level that investors can be taken on.

3.1.1 Types of mutual funds based on asset sectors

In the history, mutual funds can be classified and available into three categories, i.e., equity, bonds, and cash. Compared with the past, there are more many categories, i.e., commodity, gold, and real estate. In Thailand, mutual fund investments can be divided into different types of asset sectors such as the bond sector, the real estate sector, the gold sector, the emerging market sector, the global equity sector, the European and US equity sector, the commodity sector, and the equity sector.

3.1.1.1 Bond sector

Mutual fund in the bond sector is primarily invested in the government bonds, corporate bonds, treasury bill, and other debt securities. A bond fund offers the return better than the deposit interest rates. If due to a relationship between the risk of deposit and bond fund, a bond fund can yield a higher risk than deposit. Compare to the other investment, bond funds offer the lowest potential return with the lowest risk. The price of bond fund is less volatile than other assets. Typically, the bond fund can be divided into three segments which based on the time frame, i.e., short-term bond, intermediate-term bond, and long-term bond. Additionally, long-term bonds yield higher return than short-term bonds. In term of risk, long-term bonds can produce a higher risk than short-term bonds. The other advantage of investing in bond funds, the investors can obtain interest income in vary monthly.

3.1.1.2 Real estate sector

Mutual fund in the real estate sector is primarily invested in the stocks that related in real estate trusts. It invests on various types of real estate projects including hotels, shopping centers, office buildings, industrial factories, apartments, and other project properties that produce income. Each real estate fund has different its objectives. The investors should understand the situation of the owner property before investing. Each individual owner property faces different level of risk.

The major advantage of the real estate funds, they allow small investors to invest and earn profits from the large company with a reasonable cost. The large company scale including skyscrapers and Empire state building. Generally, the price of real estate funds follows the economic situation and inflation. In some of the period, the real estate

funds can be performed better than stocks market or underperformed than stocks market. Real estate funds have more volatility of risk than bond funds. The investors should prepare to handle the risk when risk impact the price. The real estate fund is appropriate for investors who want to diversify risk in their portfolio. The investors can obtain high dividend that paid from companies when they earn excess income such as a hotel in high season. In Thailand, a real estate fund become popular and available in 2014 (Jamar, 2016)

3.1.1.3 Emerging market sector

Mutual fund in the emerging market sector is primarily invested in the securities or assets such as bonds and stocks from countries with economies that are considered to be emerging. The emerging market, also known as an emerging country or developing country. Currently, some of the emerging countries are including China, Thailand, Indonesia, Brazil, Mexico, Venezuela, Russia, Egypt, and Israel. The emerging market mutual funds have varied risk more than the other sector. The majority of risks that can affect the price of emerging market mutual funds are including political risk, currency risk, country risk, and regional risk.

Generally, the emerging market mutual funds are managed by managers that specialize in the field of developing countries. They study deeply in the domestic situation of the countries before investing. They also study the gross domestic product rate, political stability of the countries. The emerging market mutual funds are considered as a one of the well-diversified funds because the fund managers usually invest in different countries. The investors should hold this type of funds in long-term if they want to earn high potential returns because the developing countries take a lot of time to become developed countries and growth in the market.

3.1.1.4 Gold sector

Gold is known as a yellow precious metal that exists in nature. Gold has been used as a money for trading throughout the world in the past and still today. Moreover, gold is used for making jewelry, coins and including in medical and electronics. In history, gold can be found in a stream by humans. Today, most of the gold is found in mine and can be used as a recycled metal. Most of the gold factory is melting the old

gold to make the new jewelry. They sell the gold in new forms such as a gold bar or a gold ornament.

However, the gold mutual funds are referred to as electronic gold or paper gold. The cost of gold mutual funds is movement directly along with the price of physical gold. If the investors invest in the gold mutual funds, they are having a gold without to purchase a physical gold. The investors can trade the gold throughout the internet at any time. They are not having to worry about the storage to store the physical gold. The gold mutual fund offers greater options than physical gold. The major advantage of investing in the gold mutual fund is the investor not concern about storage cost, safety, and liquidity. There is no possibility of stealing the gold.

The factor influencing the price of gold is consisting of the real demand and supply of the world gold market. Many investors invest in the gold mutual funds because they want to diversify their portfolios. The gold market is fluctuating wildly from the other market. Generally, the value of gold is moving in opposite the value of crude oil. Due to the relationship between the value of gold and crude oil, when the value of gold rise, the price of crude oil down.

3.1.1.5 Commodity sector

In this study, the commodity sector refers to the mutual funds that invest only in the crude oil funds. The crude oil mutual fund is primarily invested in the stocks that related in the crude oil industries. The price of oil funds is rise and fall over time like the gold funds. It is important to study deeply and understand the characteristic of oil funds before investing. The investors should prepare the best strategy for making a benefit from investing in this type of fund. The value of oil funds is more risk volatile than the other funds. The crude oil fund is appropriate for the investors who want to diversify their portfolio to invest in the foreign investment.

3.1.1.6 Global equity sector

The global equity mutual funds are considered as one of the investments that suitable for investors who want to invest in the global equity. The global equity funds mainly invest in equities of companies that located in worldwide. Typically, the global equity invests a certain portion in United State stocks and any international stocks to

balance the fund. This includes the companies in developed countries and developing countries. The global equity funds hold a variety of the asset categories such as industries, health care, deposits, and communication. These funds allow small investors to invest in some biggest companies in the world such as Google, Facebook, and Youtube. The global equity mutual funds are considered as one of the well-diversified funds because they diversify the risk by investing in many companies around the world, including the asset's own country. These investments are appropriate for investors who want to hold the investment in long-term because they offer the highest potential return for long-term. The most benefit of investing in the global equity mutual fund is the investors not focus to invest in one country and one asset category. It is diversified to invest across the various market from around the world through international trade.

However, fluctuation of the currency is concerned as a major risk. A strong and weak dollar can be against the other foreign currencies. The value of the international stock can decrease when converting the other foreign currencies into dollars in the foreign exchange market. So, the investors should analyst with in-depth knowledge in the situation of any countries around the world before investing. The situation that investors should aware is the current political, economic, and including the natural disaster like floods, earthquakes, storms, and other geologic processes. The investors must be willing to accept when lost on price because the value of this type of funds can fall down as well as rise.

3.1.1.7 European and US equity sector

The European and US equity funds mainly invest in equities that the companies located in European countries and the United States. There are around 50 countries that state in Europe continents. Some of the European countries are including Sweden, Norway, Germany and Spain. The European and US equity funds are one of the wide funds that allow investors to invest in several companies with different company sizes within one fund around the European countries and the United States. Typically, the European and US equity funds hold a variety of the asset categories such as industries, health care, and Information technology.

However, the term of equities and stocks are the same. That means, if the investors buy equities or stocks of the company, they are a portion of the ownership in

a company. For example, if company A has 100 shares of stocks and the investor owns 20 shares, it means the investors own or portion in 20 percent of the company.

3.1.1.8 General equity sector

The general equity mutual funds invest in stocks of open-end and closed-end funds. The manager of this type of funds primarily invests more stocks or equities than bonds. The equity funds are also known as stock funds. This type of funds can invest the equity funds in domestic (home country) or international country. The funds in this sector can be passive or active managed. A more diversified fund means more diversified of risk.

The general equity funds in Thailand are investing at least 80% in Thai equity funds. The general equity funds can be classified by capitalization market into five segments, i.e., mega-cap equity fund, large-cap equity fund, mid-cap equity fund, small-cap equity fund, and micro-cap equity fund. The greatest advantage of buying the general equity mutual funds compare to buying each individual stock is, less expensive to invest, lower transaction costs, and lower risk. The investors easily understand and easily buy the general equity mutual funds than each individual stock. The individual stock has an own unique characteristic, which means if investors want to buy some stock, they should deeply study and understand in each stock. It is taking a lot of time and it difficult to understand them all. So, the general equity mutual funds are suitable for investors who want to invest in multiple equity funds and want to diversify their portfolios. That means, they can purchase multiple equities funds within a single general equity fund.

CHAPTER 4
STATISTICAL TOOLS AND RISK ADJUSTED PERFORMANCE RATIOS

4.1 Risk-free rate

The risk-free rate is the rate of return that paid from the investment with no risk involved. The investment that nearest completely free from risk usually refers to government debt securities. Generally, government bonds are most commonly used as a risk-free rate. In this study, 2 years Thailand government bond have been considered, which is equal to 1.8%

4.2 Beta

The formula of beta is calculated by using the covariance between the fund return and the market return and divided by the variance of market return over a given time period. A beta is used for measuring the volatile of the fund pricing against the market. It also provides investors about whether the fund pricing move along in the same direction with the market. A beta value of the fund equal to 1.0 indicates that its price is strongly moving along with the market. A beta value that less than 1.0 means the pricing of that fund is less volatile than the market. A beta value that greater than 1.0 means the pricing of that fund is more volatile than the market. A negative beta value of the fund indicates that its price is strongly inverse with the market. For example, if the beta value of the fund is equal to 1.2, it indicates that the fund is 20% more volatile than the market.

4.3 Standard deviation

In finance, a standard deviation is a statistical tool that use to measure the volatility of the fund. For example, if the standard deviation value of the fund is high, it indicates that the fund return can be more deviates from the expected returns.

4.4 Annualized return

In this study, the annualized return formula is calculated as the geometric mean to show the total annualized return of each fund that can be obtained during a given time period. The annualized return can be calculated as the following equation:

$$\text{Annualized Return} = ((1 + R_1) \times (1 + R_2) \times (1 + R_3) \times \ldots \times (1 + R_{pn}))^{\frac{1}{n}} - 1 \quad (4.1)$$

where R_{pn} is daily return of the fund, and

n is the number of periods.

4.5 Annualized return of the market

Benchmark or also known as the market is very important index which investors and financial companies use for analysis and making a decision before invested in the investment. The benchmark return can be used as a standard performance of the market. Generally, most financial companies use the benchmark return in order to compared the performance of market against the performance of the fund. The appropriate benchmark is often chosen as the same sector as the investment. For example, benchmark bonds are usually compared against the bond sectors, benchmark golds compared against the gold sectors, etc. For the calculation, a daily price of the market is used. The formula of annualized return of the market is calculated as the same as the annualized return of the investment. The annualized return of the market can be calculated as following equation:

$$\text{Annualized Return} = ((1 + R_{m1}) \times (1 + R_{m2}) \times (1 + R_{m3}) \times \ldots \times (1 + R_{mn}))^{\frac{1}{n}} - 1 \quad (4.2)$$

where R_{mn} is daily return of the market, and

n is the number of periods.

4.6 Sharpe ratio (SHR)

Sharpe ratio was proposed by William F. Sharpe. Sharpe ratio is used to compare the return of an investment with its risk. It also describes how much excess return that investors can be obtained compare with the risk-free rate. Alternatively, an investor can be used this ratio to expect future performance of the fund. The greater

Sharpe ratio value, the better risk adjusted performance of the fund and greater chance for earning excess returns per unit of risk. The formula can be calculated using the subtraction between the fund return and risk-free rate and dividing by the standard deviation. Sharpe ratio can be calculated as following equation:

$$SHR = \frac{R_p - R_f}{\sigma_p} \tag{4.3}$$

where R_p is the annualized return,

R_f is the risk free rate, and

σ_p is the value of standard deviation.

4.7 Treynor ratio (TR)

Treynor ratio was proposed by Jack L. Treynor. The formular of this ratio is similar to the Sharpe ratio but with one difference, it uses the beta instead of using the standard deviation. Treynor ratio is used to observe the excess return that investment can be generated per unit of risk that it has taken on. It also describes how sensitivity of the investment to the market, the return that obtained it opposite to the market movement or moves along the same direction with the market. The greater Treynor ratio value, the better performance efficiency of the investment. The formula can be calculated using the subtraction between return and risk-free rate and dividing by the value of beta. Treynor ratio can be calculated as following equation:

$$TR = \frac{R_p - R_f}{\beta_p} \tag{4.4}$$

where R_p is the annualized return,

R_f is the risk free rate, and

β_p is the value of beta.

4.8 Jensen's alpha ratio (JR)

Jensen's alpha ratio was introduced by the famous economist, named Michael C. Jensen. Jensen's alpha ratio is used to determine the earning of the investment compared with the overall market. It is also measuring the selection skill of investment

managers whether they can beat the market. The value of Jensen's alpha ratio can be positive, negative, or zero. A zero value for Jensen's alpha ratio means the investment is earning return the same as the market. A positive value for Jensen's alpha ratio means the investment is earning excess return or it can be performed better than the market. Conversely, A negative value for Jensen's alpha ratio means the investment can be performed worse than the market. The comparison between two funds with the same asset sector, the higher Jensen's alpha ratio value is usually desirable for an investment manager. Jensen's alpha ratio can be calculated as following equation:

$$\alpha_p = R_p - R_f - \beta_p(R_m - R_f) \tag{4.5}$$

where R_p is the annualized return,

R_f is the risk free rate,

R_m is the market return, and

β_p is the value of beta.

4.9 Information ratio (IR)

Information ratio can be used to measure how much the amount of excess return that manager can be generated compare with the market. It is also used to determine the quality of the manager's skill. Generally, a high value of Information ratio is considered to indicate that the fund manager can beat the market index over a specified period of time. The formula can be calculated using the subtraction between the fund return and the market return and dividing by the standard deviation of the difference between the fund return and the market. Information ratio can be calculated as following equation:

$$IR = \frac{R_p - R_m}{\sigma(R_p - R_m)} \tag{4.6}$$

where R_p is the annualized return,

R_m is the market return, and

$\sigma(R_p - R_m)$ is the standard deviation of the difference between the annualized returns and the market return.

4.10 Sortino ratio (SR)

Sortino ratio was introduced by Frank A. Sortino. Sortino ratio is developed from the Sharpe ratio. It is calculated by using the downside deviation or downside risk instead of the standard deviation. The Sortino ratio considers only the return that is given in the bad risk. The downside deviation can be defined as the deviations of the fund return that are underperform. In this study, the return that falling below average return is considered as a downside deviation. The formula can be calculated using the subtraction between the fund return and risk-free rate and dividing by the downside deviation. If investors want to compare two funds with the same asset sector, the higher Sortino ratio value is performed better performance than the other. The Sortino ratio can be calculated as following equation:

$$SR = \frac{R_p - R_f}{\sigma d_p} \tag{4.7}$$

where R_p is the annualized return,

R_f is the risk free rate, and

σd_p is the downside deviation.

CHAPTER 5
METHODOLOGY

5.1 Data cleansing and data selection

The details of each step are explained below. Fig. 5.1 provides an overview of the processes of our methodology. Most of data that use in this study are mainly collected from the "securities and exchange commission" database and the "Thai mutual fund" database (www.thaimutualfund.com). In this study, multiple appropriate benchmarks are recommended by finance professionals. The benchmarks that they selected are most commonly and standard used for representing as markets. Therefore, K corporate bond fund is selected as an appropriate market index for the bond sector, MFC property wealth fund for the real estate sector, SET 50 TRI index for the equity sector, iShares MSCI world ETF fund for the global equity sector, iShares MSCI emerging markets ETF fund for the emerging market sector, crude oil WTI fund for the commodity sector, Aberdeen standard gold ETF trust fund for the gold sector, and S&P 500 TR index for the European and US equity sector.

Preparing data before analysis is the most important thing to do. This process usually examines whether data incorrect, incomplete or improperly formatted. Incomplete data can lead inaccurate results. So, in this study some data cleansing steps were performed. Instead of dropping the row that containing missing values, we handling these missing data by filling the data. For example, the price row that has missing values were filled with the average price. Converted the date format in dataframe from string to datetime. The collected data were classified into eight sectors, i.e., the bond sector, the real estate sector, the equity sector, the global equity sector, the emerging market sector, the commodity sector, the gold sector, and the European and US equity sector. The data that have the period from January 2013 to December 2018 are used for the evaluation. The study period of this paper is from January 2013 to December 2018. It can be divided into six sub-periods, i.e., year 2013, year 2014, year 2015, year 2016, year 2017, year 2018.

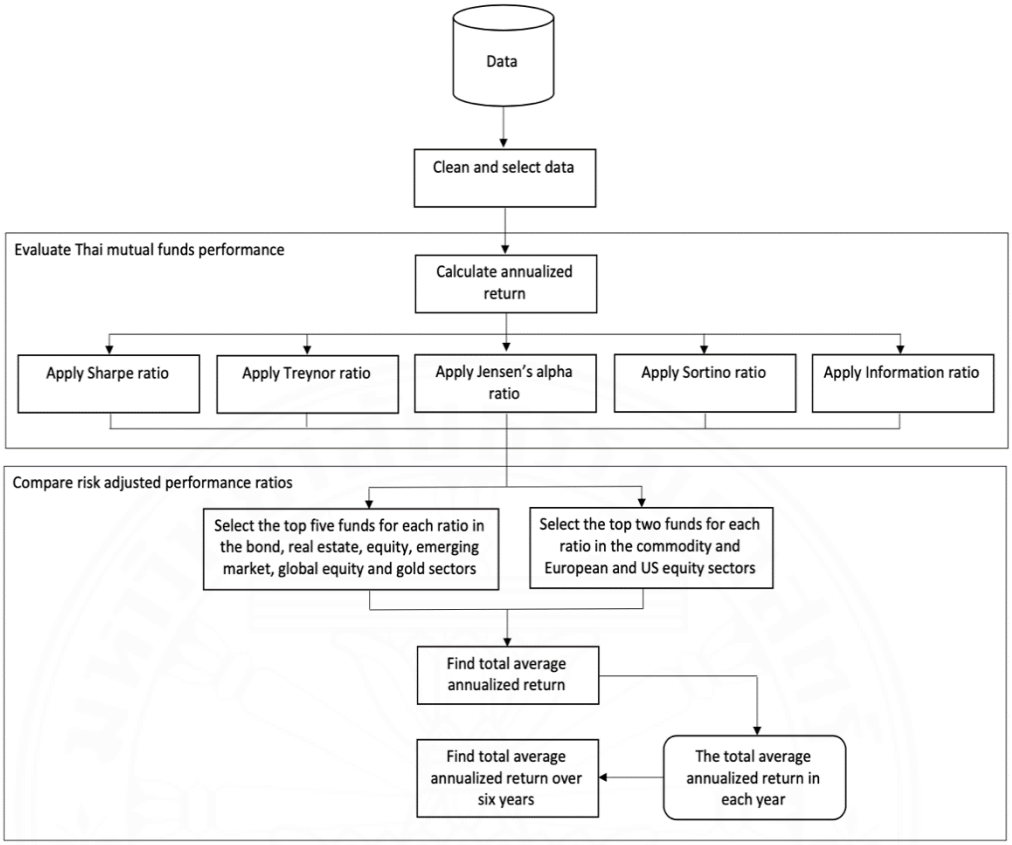

Figure 5.1 Overview of The Study Processes

5.2 Thai mutual funds performance evaluation

The historical fund performance can be useful for investors and financial companies to predict the future of fund performance. The performance evaluation of funds can be one of aspect indicator to help investors for selecting successful funds. Several studies have investigated the performance of funds based on total returns. The study aims to investigate which risk adjusted performance ratio has performed best for evaluating the performance of funds for which asset sector. In this study, the annualized return and the value of risk adjusted performance ratios of each fund in each year are used to measure the performance of Thai mutual funds. Risk adjusted performance ratios, namely, Sharpe ratio (SHR), Treynor ratio (TR), Jensen's alpha ratio (JR), Information ratio (IR), and Sortino ratio (SR) are used for the analysis.

The resulting of funds performance in the bond sector in 2013 is evaluated based on the annualized return, SHR, TR, JR, IR, and SR are given in Table 5.1. To determine

which fund is the best performance, each risk adjusted performance ratios are applied. For example, according to the Table 5.1, the value of SHR, TR, JR, IR, and SR of Fund B4 is greater than Fund B1, which means that Fund B4 is well managed and performed better than Fund B1.

Table 5.1 The Bond Sector Performance in 2013.

Fund Name	Annualized Return	Risk adjusted performance ratios				
		SHR	TR	JR	IR	SR
B1	2.852%	2.08912	0.03015	0.0102	1.41545	3.38502
B2	2.035%	2.85211	0.27014	0.00235	0.26097	3.05599
B3	2.164%	1.50846	0.0741	0.00363	0.4186	2.55229
B4	3.105%	3.87828	0.04364	0.01302	2.07958	7.28513
B5	2.677%	7.81297	0.21743	0.00877	1.08634	8.93545
B6	2.423%	0.28156	0.00327	0.00648	0.36721	0.40971
B7	2.785%	1.59461	0.01988	0.01077	1.87223	2.59852
…	…	…	…	…	…	…
B57	2.367%	0.10737	0.00307	0.00546	0.10889	0.15115

5.3 Comparative analysis of the risk adjusted performance ratios

After we analyzed Thai mutual funds performance, we attempt to compare the risk adjusted performance ratios which ratio is appropriate to use for measuring the performance of an individual investment category. Since we obtained the real value of SHR, TR, JR, IR, and SR, we convert the real value into the rank numbers. Then, we select the top five funds and top two funds for each ratio ranking in each year for calculating the total average annualized return. To compare the performance of risk adjusted performance ratios, the total average annualized returns for each ratio ranking over six years is used. In this study, several asset sectors are used for the evaluation and each asset sector is containing several funds. The data that we obtained some asset sectors are inadequate data to select the top five funds for the calculation. So, for the commodity sector and the European and US equity sector can be used only top two funds in each ratio ranking for comparing the performance of risk adjusted performance ratios. The other sectors can be used top five funds for comparing the performance.

The annualized return and the rank numbers of each risk adjusted performance ratio of the bond sector in 2013 which are given in Table 5.2. The funds are sorting in descending order of annualized returns. According to the Table 5.2, the top five funds is belonging to JR, which means that in 2013 if we invested the funds in bond sector by using JR to evaluate the performance of the fund we have a better chance to earn high annualized returns. The top five funds for the bond sector in 2013 according to JR ranking are showed in Table 5.3. The average annualized return of these five funds is equal to 3.293%.

Table 5.2 The Rank numbers of Risk Adjusted performance ratios of the Bond Sector in 2013

Fund Name	Annualized Return	Risk adjusted performance ratios				
		SHR	TR	JR	IR	SR
B30	3.753%	19	19	1	1	17
B21	3.299%	24	29	2	5	25
B46	3.180%	20	24	4	3	18
B44	3.167%	43	37	5	42	43
B4	3.105%	11	15	7	6	8
B42	3.101%	16	18	6	4	14
B37	3.065%	22	25	3	2	19
…	…	…	…	…	…	…
B51	-10.155%	57	56	56	57	57

Table 5.3 Top Five Jensen's alpha ratio values of the Bond Sector in 2013

Fund Name	Annualized Return	Risk adjusted performance ratios	
		JR	JR Rank
B30	3.753%	0.01939	1
B21	3.299%	0.01483	2
B37	3.065%	0.01373	3
B46	3.180%	0.0137	4
B44	3.167%	0.01346	5
Average annualized return	3.293%		

CHAPTER 6
RESULTS ANALYSIS

The results of the calculation of the mutual funds performance that use the method of SHR, TR, JR, IR, and SR for each year in each sector can be seen in Table 6.1, Table 6.2, Table 6.3, Table 6.4, Table 6.5, Table 6.6, Table 6.7 and Table 6.8.

For example, Table 6.1 demonstrates the average annualized returns of top five funds for each ratio ranking for the bond sector from 2013 through 2018. The average annualized returns of top five funds for 2013 according to SHR, TR, JR, IR, and SR ranking are 2.694%, 2.453%, 3.293%, 3.280%, and 2.705%, respectively. As the result of Table 6.1, JR ranking gives the highest total average annualized return over the six years. It also shows that JR better performance than other ratios. It can be considered as the best of risk adjusted performance ratio for evaluating the performance of Thai mutual fund for the bond sector.

Table 6.2, Table 6.3, and Table 6.4 show similar information for the real estate sector, the equity sector, and the global equity sector, respectively. An analysis of Table 6.2, Table 6.3 and Table 6.4 reveal that JR also yields the highest total average annualized returns over the six years for these three asset sectors. That means, the JR outperforms the other four ratios in all four sectors, i.e., the bond sector, the real estate sector, the equity sector, and the global equity sector.

Based on Table 6.5 and Table 6.6, the results of the analysis show that the ratios namely SHR and SR are the best performing for the investors to use these two ratios for evaluating the performance of the fund in the emerging market sector and the commodity sector, respectively. From the results, it also means that if we used SHR and SR for evaluating the performance of funds in the emerging market sector and the commodity sector, we have more opportunity to earn high return than use other ratios for evaluating the performance.

Table 6.7 shows the result of the performance for each ratio ranking for the gold sector that starting from 2013 to 2018. Total average annualized return over the six years according to SHR, TR, JR, IR and SR ranking are -2.973%, -3.72%, -3.021%, -3.355%, and -2.953%, respectively. An analysis of Table 6.7 indicates that

the risk adjusted performance ratio named SR performs better than the other four ratios. Based on the period of the study, the top five gold funds were selected by SR has more opportunity to produce the lowest negative annualized return than the other ratios selection.

Table 6.8 demonstrates the average annualized returns of top two funds for each ratio ranking for the European and US equity sector from 2013 through 2018. Table 6.8 reveals that the performance ratio that namely SHR, IR, and SR have earned the highest total average annualized returns than the other two ratios.

Table 6.1 Result Analysis for the Bond Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	2.694%	2.453%	3.293%	3.280%	2.705%
2014	3.269%	4.918%	8.174%	6.932%	3.421%
2015	2.859%	1.510%	3.519%	3.955%	2.603%
2016	2.529%	-1.459%	2.529%	2.481%	2.529%
2017	2.577%	1.711%	3.128%	2.983%	2.577%
2018	2.042%	0.934%	2.319%	2.399%	1.213%
Total average annualized return	2.662%	1.678%	**3.827%**	3.672%	2.508%

Table 6.2 Result Analysis for the Real Estate Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	2.734%	-3.868%	0.845%	3.452%	2.630%
2014	7.395%	2.566%	18.480%	19.656%	3.611%
2015	9.151%	0.237%	5.625%	5.571%	4.265%
2016	16.271%	-1.863%	18.171%	18.801%	16.271%
2017	13.821%	2.737%	18.131%	17.867%	13.821%
2018	5.918%	0.630%	5.479%	-2.630%	5.918%
Total average annualized return	9.215%	0.073%	**11.122%**	10.453%	7.753%

Table 6.3 Result Analysis for the Equity Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	4.194%	4.194%	1.659%	0.868%	4.194%
2014	26.222%	26.222%	28.223%	27.417%	27.344%
2015	1.686%	1.686%	1.230%	-0.308%	1.686%
2016	23.439%	24.900%	26.563%	26.262%	23.439%
2017	31.848%	33.403%	33.403%	33.403%	31.848%
2018	-5.204%	-5.204%	-5.421%	-5.262%	-5.204%
Total average annualized return	13.698%	14.2%	**14.276%**	13.73%	13.885%

Table 6.4 Result Analysis for the Global equity Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	13.754%	7.046%	13.754%	13.754%	13.754%
2014	-6.306%	-6.306%	-6.069%	-6.306%	-6.306%
2015	-7.713%	-12.834%	-7.713%	-7.713%	-7.713%
2016	23.134%	13.596%	23.134%	23.134%	23.134%
2017	6.480%	2.342%	6.480%	6.480%	6.480%
2018	-15.776%	-15.776%	-15.776%	-15.776%	-15.776%
Total average annualized return	2.262%	-1.989%	**2.302%**	2.262%	2.262%

Table 6.5 Result Analysis for the Emerging market Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	5.874%	3.992%	5.874%	5.874%	5.874%
2014	15.638%	9.107%	15.638%	14.475%	15.638%
2015	2.084%	0.878%	1.888%	1.701%	2.084%
2016	9.129%	8.820%	9.129%	9.129%	9.129%
2017	33.841%	31.489%	31.591%	33.841%	33.841%
2018	-13.927%	-14.863%	-13.741%	-13.342%	-13.927%
Total average annualized return	**8.773%**	6.571%	8.397%	8.613%	**8.773%**

Table 6.6 Result Analysis for the Commodity Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	12.597%	10.278%	12.597%	12.597%	12.597%
2014	-42.707%	-43.592%	-42.707%	-43.592%	-42.707%
2015	-36.151%	-38.452%	-38.592%	-36.151%	-36.151%
2016	6.110%	3.856%	3.856%	3.894%	6.110%
2017	2.549%	-2.475%	2.549%	-2.475%	2.549%
2018	-17.723%	-17.377%	-18.061%	-18.061%	-17.723%
Total average annualized return	**-12.554%**	-14.627%	-13.393%	-13.965%	**-12.554%**

Table 6.7 Result Analysis for the Gold Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	-21.552%	-23.799%	-22.222%	-23.357%	-21.568%
2014	-4.495%	-4.666%	-4.373%	-4.944%	-4.373%
2015	-4.279%	-5.595%	-4.279%	-4.279%	-4.279%
2016	9.318%	9.382%	9.582%	9.571%	9.333%
2017	7.840%	7.835%	7.840%	7.870%	7.840%
2018	-4.671%	-5.477%	-4.671%	-4.988%	-4.671%
Total average annualized return	-2.973%	-3.72%	-3.021%	-3.355%	**-2.953%**

Table 6.8 Result Analysis for the European and US equity Sector

Year	Risk adjusted performance ratios				
	SHR	TR	JR	IR	SR
2013	36.108%	15.053%	36.108%	36.108%	36.108%
2014	9.227%	1.342%	9.227%	9.227%	9.227%
2015	0.435%	-4.474%	0.435%	0.435%	0.435%
2016	6.075%	3.944%	6.075%	6.075%	6.075%
2017	16.941%	15.143%	15.416%	16.941%	16.941%
2018	-7.838%	-7.838%	-7.838%	-7.838%	-7.838%
Total average annualized return	**10.158%**	3.862%	9.904%	**10.158%**	**10.158%**

CHAPTER 7
VALIDATION

To confirm the results that the risk adjusted performance ratios are most suitable to evaluate the performance in each asset sector, we have to validate the results. In this paper, we attempt to validate the results in the next four two-year sub periods and a five-year period. To validate the results, we (i) select the top five funds for each ratio ranking in the bond sector, the real estate sector, the equity sector, the emerging market sector, the global equity sector, the gold sector for each ratio ranking for a year N. For the funds in the commodity sector and the European and US equity sector, we select the top two funds. Then, for the four two-year sub periods, these funds are calculated the average annualized return for a year N + 1 and N + 2, where N is the years that begin in year 2013 and ended in year 2016. For the five-year period, we (ii) select the top five funds in the bond sector, the real estate sector, the equity sector, the emerging market sector, the global equity sector, and the gold sector for the year 2013. We select the top two funds in the commodity sector and the European and US equity sector for each ratio ranking for the year 2013. Then, we calculate the average annualized return on these funds for the years 2014–2018.

For example, from Table 5.3, Funds B30, B21, B37, B46, and B44 are the top five funds according to JR ranking in 2013 for the bond sector. Then, from data in 2014-2015 which shown in Table 7.1, we calculate the average annualized return of these five funds, with the resulting value being 2.422%.

Based on Table 7.1, we can conclude that JR is appropriate for measuring the fund performance in the bond sector. The table analysis shows that if we invested according to JR ranking, most of the time period study, we have more opportunity to obtain the highest annualized return. Even though it cannot win in the period study in case of the five years but these five funds that are given by JR ranking are in the top two average annualized return compare to the other ratios.

From the results of Table 7.2 reveals that if we used JR to evaluate the performance of fund compare to use other ratios, we should hold the real estate funds in long term period for obtaining the highest annualized return. According to the results,

JR can be obtained top three annualized return in the two-time from four-time in two years sub period. In this case, we can conclude that if we used JR to evaluate the performance of funds in real estate sector, it might not appropriate to hold the asset less than five years. The investors can obtain the highest annualized return, if they hold the assets for five years that shown in Table 7.2. The real estate funds are more volatile and not stable than other funds. They have outperformed and underperformed the stock in some period. So, the investors should follow and update the news of the property owners, political, inflation in economic, and economic growth.

The results of the analysis in Table 7.3 shows that if we invested in the equity funds by using the JR ranking and holding the funds in all that time period study, we can be obtained at least top two annualized return compare to use other ratios. Some period, the funds that are selected by JR ranking can provide the highest average annualized return such as in the period from January 2014 to December 2015 and the period that starting from January 2016 to December 2017.

The results of Table 7.4 shows that if we evaluated the performance of global equity funds by using the JR ranking, we can be obtained top two annualized return in all the period of the study. If we hold the asset in long-term period, JR can select the funds that produced lowest negative annualized return with the resulting value -1.898%.

Table 7.5 reveals the validation result for the emerging market sector. The results show that SHR and SR select the funds that can generate top two annualized return in all the period of the study. Table 7.6 also reveals that SHR and SR select the funds that can generate top three annualized return in all the period of the study for the commodity sector. In this case, we can conclude that SHR and SR are appropriate to evaluate the performance of funds in the two sectors, i.e., the emerging market sector and the commodity sector.

An analysis of Table 7.7 reveals that, if we used SR for evaluating the performance of gold funds, we have more opportunity to lose money and can be obtained the highest negative annualized return if we hold the funds for five years. Therefore, it is evident that the ranking that given by SR is not proper to use for the evaluation in long term period. Basically, the price of gold asset is very extremely swinging. The pricing of gold is controlled by the international market. That means, the global movement can be a major cause the gold price fluctuates. So, when investors are

investing in the gold funds, the investors should know the current situation of the gold market.

From the results of Table 7.8 reveals that SHR, IR, and SR can be obtained the highest average annualized return in all the period of the study. In this case, we can conclude that SHR, IR, and SR are appropriate to use for evaluating the performance of funds in the European and US equity sector for all period of the study.

Table 7.1 Validation for the Bond Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	1.624%	1.44%	2.422%	2.35%	1.656%
2015-2016	1.552%	1.662%	1.908%	1.88%	1.53%
2016-2017	1.616%	1.2%	1.356%	1.474%	1.528%
2017-2018	1.252%	0.802%	1.252%	0.972%	1.252%
2014-2018	1.298%	1.126%	1.51%	1.674%	1.33%

Table 7.2 Validation for the Real Estate Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	1.286%	4.414%	5.096%	2.446%	1.258%
2015-2016	1.77%	1.104%	0.252%	2.216%	1.402%
2016-2017	5.046%	0.838%	2.338%	3.71%	3.114%
2017-2018	6.816%	0.464%	4.952%	5.592%	6.816%
2014-2018	1.098%	0.826%	4.124%	1.494%	1.04%

Table 7.3 Validation for the Equity Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	7.576%	7.576%	8.554%	7.652%	7.652%
2015-2016	2.962%	2.962%	2.818%	2.306%	1.656%
2016-2017	11.766%	11.766%	14.164%	13.998%	11.766%
2017-2018	5.418%	6.864%	7.34%	8.722%	5.418%
2014-2018	6.456%	6.456%	7.618%	8.324%	6.456%

Table 7.4 Validation for the Global equity Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	-7.662%	-5.746%	-7.662%	-7.662%	-7.662%
2015-2016	1.162%	1.162%	1.01%	1.162%	1.162%
2016-2017	2.442%	7.178%	2.442%	2.442%	2.442%
2017-2018	-5.644%	-1.22%	-5.644%	-5.644%	-5.644%
2014-2018	-1.898%	-3.948%	-1.898%	-1.898%	-1.898%

Table 7.5 Validation for the Emerging market Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	7.534%	8.906%	7.534%	7.534%	7.534%
2015-2016	2.456%	4.464%	2.456%	2.378%	2.456%
2016-2017	7.192%	6.796%	5.798%	5.552%	7.192%
2017-2018	3.394%	4.806%	3.394%	3.394%	3.394%
2014-2018	5.788%	5.504%	5.788%	5.788%	5.788%

Table 7.6 Validation for the Commodity Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	-33.52%	-35.1%	-33.52%	-33.52%	-33.52%
2015-2016	-16.51%	-19.395%	-16.51%	-19.395%	-16.51%
2016-2017	-8.97%	-3.895%	-0.49%	-8.97%	-8.97%
2017-2018	-6.645%	-11.57%	-11.57%	-11.405%	-6.645%
2014-2018	-21.355%	-20.12%	-21.355%	-21.355%	-21.355%

Table 7.7 Validation for the Gold Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	-7.432%	-8.262%	-8.61%	-8.994%	-8.604%
2015-2016	-7.58%	-8.878%	-7.788%	-7.302%	-7.788%
2016-2017	-2.138%	-1.03%	-2.138%	-2.138%	-2.138%
2017-2018	0.196%	0.334%	2.152%	2.316%	0.102%
2014-2018	-4.138%	-3.1%	-3.92%	-3.294%	-4.146%

Table 7.8 Validation for the European and US equity Sector in 2 Years and 5 Years

Year	Risk adjusted performance ratios				
	SHR Rank	TR Rank	JR Rank	IR Rank	SR Rank
2014-2015	1.455%	-0.04%	1.455%	1.455%	1.455%
2015-2016	3.745%	0.505%	3.745%	3.745%	3.745%
2016-2017	7.535%	6.095%	7.535%	7.535%	7.535%
2017-2018	7.085%	6.15%	7.085%	7.085%	7.085%
2014-2018	2.715%	2.39%	2.715%	2.715%	2.715%

CHAPTER 8
CONCLUSION

Risk adjusted performance ratios are the tool that can help investors to compare the volatility of risk which involving in the asset return. Many investors and financial companies use the ratios to predict the future performance of the funds. However, investors should consider the other factors that may affect the fund performance such as political issues, economic issues, and international market issues. The main purpose of this paper aims to find the risk adjusted performance ratios that are most suitable for evaluating the performance of Thai mutual funds. This paper can help investors to make a decision before investing. Risk adjusted performance ratios, i.e., Sharpe ratio (SHR), Treynor ratio (TR), Jensen's alpha ratio (JR), Information ratio (IR), and Sortino ratio (SR) are considered. 279 Thai mutual funds that comprise of 57 bond funds, 46 real estate funds, 15 emerging market funds, 6 global equity funds, 3 European and US equity funds, 4 commodity funds, 16 gold funds, and 132 equity funds are used for the evaluation. The period of the study taken from January 2013 to December 2018.

According to the performance evaluation results, the analysis shows that Jensen's alpha ratio outperforms the other four ratios in the bond sector, the equity sector, the global equity sector, and the real estate sector. For the emerging market sector and the commodity sector, Sharpe ratio and Sortino ratio outperform the other ratios. For the gold sector, Sortino ratio performs better than the other four ratios. For the European and US equity sector, Sharpe ratio, Information ratio, and Sortino ratio outperform the other ratios.

During the period that starting from year 2014 to year 2018, the market trend of this period was sideway market. In this study, we use Thailand Stock Market (SET50 index) to represent as the market overview. For the validation results, most of the funds that are selected by Jensen's alpha ratio in year 2016-2017 and year 2017-2018 show that the funds produce in low return because Jensen's alpha ratio select the funds that based on year 2015 and year 2016. In year 2015, the price of Thailand Stock Market (SET50 index) shows low return, it means in that period the stock market was sideway down market. In year 2016, many countries face the problems. The year of 2016 was

definitely a shocking year for the world because many countries face the problems such as conflict in politics, economic, export stagnation (according to website www.bot.or.th), and the worst natural disasters happened in this year. So, in this period, the stock market was also downtrend market. For the year 2017-2018 the trend of market attempt to go up (reference from SET50 index). Finally, it may be concluded that Jensen's alpha ratio attempts to predict the return of the funds that based on the market trend in the past because Jensen's alpha ratio used the market return and the value of beta for the calculation. It attempts to predict the funds that perform well in the past, they might be performed well in the future if situation of the market in the future has the same situation in past. For example, in year 2016-2017 for the bond sector in the validation result, the funds that selected by Jensen's alpha ratio are not in the top five compare to the other ratios because in year 2016 the trend of market was sideway down market (reference from SET50 index). Jensen's alpha ratio might be performed well if the market in the future similar to the market in the past because Jensen's alpha ratio calculate the value based on the whole market.

Jensen's alpha ratio is appropriate to use for the less volatile asset sectors such as the bond sector and the equity sector. The funds in the real estate sector and the global equity sector might not be able to perform well, if we use Jensen's alpha ratio to calculate the performance in short term periods because these two sectors are volatile sectors. Main factors that can be affected the value of the funds in the real estate sectors and the global equity sector are depended on the external indicators such as political, government policies, economic growth and national income. So, if investors use Jensen's alpha ratio to calculate the performance in the real estate sector and the global equity sector, they should hold the asset in long term period to get high return. It is generally better to hold the assets for the long term period.

For Sharpe ratio and Sortino ratio, they use the value of standard deviation of the investment. It means these two ratios calculate the performance of the investment by looking at the performance of the investment itself in the past. Sharpe ratio and Sortino ratio does not use the value of the market for the calculation. So, the fund that they select have not to compare the market. For Treynor ratio, it is similar to the Sharpe ratio but it uses the beta value instead of using the standard deviation. It means Treynor ratio focus on the return that the investment obtained, it is opposite or move along with

the market movement. For Information ratio, it calculates only the return of the market and does not concern about the volatile of the investment pricing against the market. So, it determines only the investment return against the market return.

We validate the results to see the actual annualized return that we can be obtained in the next following two years and five years. The results that could be worked well might not work well in the next following years. According to the validation results, we can conclude that most of the ratios that outperform for each asset sector are appropriate to use for evaluating the performance of the funds except for the Sortino ratio which underperform in the gold sector. Therefore, it is evident that the ranking given by Sortino ratio does not justify for evaluating the gold funds performance. If we invested in the gold funds which according to Sortino ratio ranking, we can be obtained the highest negative annualized return in the next following two years and five years. There are no absolute best models or tools that can predict fund performance in the future. The fund performance depending on the current market situation. Investors should understand and study other aspects that involving in the pricing of each asset sector.

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APPENDIX

APPENDIX A
EVALUATION OF THAI MUTUAL PERFORMANCE
PYTHON SOURCE CODE

```
rf = 0.018

d = []

list_fund = pd.read_csv(list_path, sep=',')

for filename in glob(file_path):

    TBLUE = '\033[34m'
    TBLACK = '\033[30m'
    BOLD = '\033[1m'

    df_date = pd.read_csv(filename, header=0, sep=',',
encoding='utf-8',usecols= ['nav_date', 'last_val'])

    sort_df =
df_date.sort_values(by=['nav_date','last_val'])

    sort_date = pd.read_csv(date_path, header=0, sep=',',
encoding='utf-8',usecols= ['nav_date', 'last_val'])

    bench_date = pd.read_csv(bench_path, header=0,
sep=',', encoding='utf-8')

    sort_bench =
bench_date.sort_values(by=['nav_date','last_val'])

    fundname =
(os.path.splitext(os.path.basename(filename))[0])

    #------- Calculate Daily Return -------#

    val_o = sort_df['last_val']

    sort_df['Daily_Return'] = (val_o/val_o.shift(1))-1

    #--------------------------------------#
    #------------- Cut Date ---------------#

    merge = pd.concat([sort_df, sort_date])
```

```
 merge_sort =
merge.sort_values(by=['nav_date','last_val'])
    merge_drop =
merge_sort.drop_duplicates(subset='nav_date',
keep='last') #Keep only the last value because we want to
drop the date that do not have other matches.
    drop_null = merge_drop.dropna()

    merge_b = pd.concat([sort_bench, sort_date])
    merge_sort_b =
merge_b.sort_values(by=['nav_date','last_val'])
 merge_drop_b =
merge_sort_b.drop_duplicates(subset='nav_date',
keep='last') #Keep only the last value because we want to
drop the date that do not have other matches.
    drop_null_b = merge_drop_b.dropna()

    #--------------------------------------#
    #------------ select date -------------#

    start_date = '2016-01-01'
    end_date = '2019-01-01'

    date = drop_null[(drop_null['nav_date'] >=
start_date) & (drop_null['nav_date'] < end_date)]

    date_b = drop_null_b[(drop_null_b['nav_date'] >=
start_date) & (drop_null_b['nav_date'] < end_date)]

    #--------------------------------------#
    #---------------- order ---------------#

    df_order =
date[['nav_date','last_val','Daily_Return']]

    #df_order = drop_null[['nav_date', 'net_asset',
'last_val', 'previous_val', 'sell_price','buy_price',
'sell_swap_price', 'buy_swap_price']]

    bench_order =
date_b[['nav_date','last_val','Daily_Return']]

    #--------------------------------------#

    #------------ create array ------------#

    r_mtrx = df_order["Daily_Return"].tolist() #convert
to array before calculate the beta
```

```
    df_r = df_order['Daily_Return']
    df_val = df_r.values
    r_mtrx = [0 if math.isnan(x) else x for x in r_mtrx]
    minimum = df_order['Daily_Return'].mean()


    m_mtrx = bench_order["Daily_Return"].tolist()
#convert to array before calculate the beta
    df_m = bench_order['Daily_Return']


    diff = df_val-df_m

    #--------------------------------------#
    #---------------- Return --------------#

    def Average_Daily_Returns(df_r):
        avg = df_r.mean()
        return avg

    def Daily_Mean_power2(df_r):
        dr = df_r
        adr = Average_Daily_Returns(df_r)
        return (dr-adr)**2

    def Daily_Varience(df_r):
        dmp = Daily_Mean_power2(df_r)
        return dmp.mean()

    def Annulized_Varience(df_r):
        dv = Daily_Varience(df_r)
        return dv*250

    def Annualized_SD(df_r):
        return math.sqrt(Annulized_Varience(df_r))

    def Product_Cal(df_r):
        dr = df_r
        return dr+1

    def Annualized_Return(df_r):
#**************#
        nums_product = np.prod(Product_Cal(df_r))
        one_year = ((nums_product)**(1/3))-1
        return one_year

#-------------------------------------#
```

```
    #------------- Market ---------------#

    def Average_Daily_Returns_m(df_m):
        avg_m = df_m.mean()
        return avg_m

    def Daily_Mean_power2_m(df_m):
        dm = df_m
        adrm = Average_Daily_Returns_m(df_m)
        return (dm-adrm)**2

    def Daily_Varience_m(df_m):
        dmp_m = Daily_Mean_power2_m(df_m)
        return dmp_m.mean()

    def Annulized_Varience_m(df_m):
        dv_m = Daily_Varience_m(df_m)
        return dv_m*250

    def Annualized_SD_m(df_m):
        return math.sqrt(Annulized_Varience_m(df_m))

    def Product_Cal_m(df_m):
        dm = df_m
        return dm+1

    def Annualized_Return_m(df_m):
#***************#
        nums_product_m = np.prod(Product_Cal_m(df_m))
        one_year_m = ((nums_product_m)**(1/3))-1
        return one_year_m

    #-------------------------------------#

    def Average_Diff_Returns(diff):
        dff_r = diff
        return dff_r.mean()

    def Diff_Mean_power2(diff):
        dff_r = diff
        a_dff = Average_Diff_Returns(diff)
        return (dff_r-a_dff)**2

    def Diff_Varience(diff):
        dff_m = Diff_Mean_power2(diff)
        return dff_m.mean()

    def Diff_Annulized_Varience(diff):
```

```
        dff_v = Diff_Varience(diff)
        return dff_v*250

    def Diff_Annualized_SD(diff):
        return math.sqrt(Diff_Annulized_Varience(diff))

    #---------------------------------------#
    #------------------Beta-----------------#

    def beta(r_mtrx, m_mtrx):
        x = np.stack((r_mtrx, m_mtrx), axis=0)
        cov = np.cov(x)[0][1]
        var = np.var(m_mtrx)
        return cov/var # cov of m and f/var of m

    #---------------------------------------#
    #-----------Downside Deviation----------#
    def downside(df_r):
        # This method returns a lower partial moment of
the returns
        # Create an array he same length as returns
containing the minimum return threshold
        target = Average_Daily_Returns(df_r)
        df_order['downside_returns'] = 0

        df_order.loc[df_order['Daily_Return'] < target,
'downside_returns'] = df_order['Daily_Return']**2
        dp_daily = df_order['downside_returns'].mean()
        dp_variance = dp_daily*250
        down_stdev = math.sqrt(dp_variance)
        return down_stdev
    #---------------------------------------#

    def Sharpe_Ratio(df_r, rf):
        return (Annualized_Return(df_r) - rf)
/Annualized_SD(df_r)

    def Sortino_Ratio(df_r, rf):
        return (Annualized_Return(df_r) -
rf)/downside(df_r)

    def Treynor_Ratio(df_r, rf, r_mtrx, m_mtrx):
        return (Annualized_Return(df_r) - rf)
/beta(r_mtrx,m_mtrx)

    def Information_Ratio(df_r,df_m,diff):
        diff_return = Annualized_Return(df_r)-
Annualized_Return_m(df_m)
```

```
        d_sd = Diff_Annualized_SD(diff)
        return diff_return/d_sd #np.mean(diff) /vol(diff)

    def Jensen_Ratio(df_r, df_m, rf, r_mtrx, m_mtrx):
#Alpha = R(i) - (R(f) + B x (R(m) - R(f)))
        m_temp = Average_Daily_Returns_m(df_m)
        return Annualized_Return(df_r)-(rf +
(beta(r_mtrx,m_mtrx)* (Annualized_Return_m(df_m)-rf)))

    #return Annualized_Return(df_r)-(rf+(m_temp-
rf)/beta(r_mtrx,m_mtrx))

    for index, data in list_fund.iterrows():

        if(data['proj_id']==fundname):

            df_sd =
'{0:.2f}%'.format((Annualized_SD(df_r) * 100))

            df_re =
'{0:.2f}%'.format((Annualized_Return(df_r) * 100))

            m_sd =
'{0:.2f}%'.format((Annualized_SD_m(df_m) * 100))

            m_re =
'{0:.2f}%'.format((Annualized_Return_m(df_m) * 100))

            bt = beta(r_mtrx, m_mtrx)

            dw = downside(df_r)

            sharpe = round(Sharpe_Ratio(df_r, rf),5)

            sortino = round(Sortino_Ratio(df_r, rf),5)

            treynor = round(Treynor_Ratio(df_r, rf,
r_mtrx, m_mtrx),5)

            information =
round(Information_Ratio(df_r,df_m,diff),5)

            jensen = round(Jensen_Ratio(df_r, df_m, rf,
r_mtrx, m_mtrx),5)

            fundname = data['proj_name_th']

            fundname_en = data['proj_name_en']
```

```
            pro_id = data['proj_id']

            d.append((pro_id, fundname_en, df_re, df_sd,
sharpe, sortino, treynor, information, jensen, m_re,
m_sd))

    #-------------------------------------#


frame = pd.DataFrame(d, columns=('Proj_ID', 'Name',
'Annualized Return','Annualized SD','Sharpe
Ratio','Sortino Ratio',
                         'Treynor Ratio','Information
Ratio','Jensen Ratio','Annualized Return of
Market','Annualized SD of Market'))

frame = frame.sort_values(by=['Proj_ID'])


frame.insert(0, 'number', range(1, 1 + len(frame)))


frame['name_f'] = "R"    #-------------------------


frame['Scheme Name'] = frame['name_f'].map(str) +
frame['number'].map(str)
```

BIOGRAPHY

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