

Multi-Factor Investing Model for the Thai Stock Market



- 1) Chonradee Tangtongwechakit Student ID 63011138
- 2) Kittipak Tanmahasamut Student ID 63011173
- 3) Treethasate Soonthornthum Student ID 63011367

Bachelor of Engineering in Financial Engineering

School of Engineering

King Mongkut's Institute of Technology Ladkrabang

Academic Year 2023

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Thesis – Academic Year 2023

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Title: Multi-Factor Investing Model for the Thai Stock Market

Authors

- | | |
|-------------------------------|----------------------|
| 1. Chonradee Tangtongwechakit | Student ID: 63011138 |
| 2. Kittipak Tanmahasamut | Student ID: 63011173 |
| 3. Treethasate Soonthornthum | Student ID: 63011367 |

Approved for submission



(Assoc. Prof. Nada Chunsom)
Advisor

Date 19 / 4 / 24



(Dr. Pimprapai Thainiam)
Advisor

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Abstract

This report presents a comprehensive strategy for maximizing portfolio returns through the adoption of a Multi-factor Investing model. The Multi-factor Investing model integrates foundational principles from the Fama-French asset pricing model with supplemental factors sourced from various financial theories, including Carhart (1997), Gyntelberg (2009), and other pertinent literature.

The methodology seeks to leverage the strengths of diverse factors to construct portfolios that surpass market benchmarks while prudently managing risk. Through empirical data analysis and quantitative techniques, this study aims to identify key determinants of asset returns and their impact on portfolio performance.

Primary objectives include developing a resilient investment framework that incorporates multifactor models, optimizing portfolio allocation strategies, and assessing portfolio performance against established benchmarks. Furthermore, the research explores the potential for outperformance compared to passive investment strategies.

By synthesizing theoretical insights with empirical evidence, this research contributes to the advancement of portfolio optimization strategies tailored to modern market dynamics. The findings offer valuable insights for investors seeking to elevate their portfolio performance using a Multi-factor Investing model.

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Chapter 1

Introduction

1.1 Motivation

It is important to develop a new strategic investment because it gives investors the option to invest in the new financial product. Additionally, the new tactical funding is expected to yield returns surpassing the index or outperforming the market. Furthermore, by introducing this new strategic investment, we aim to provide investors with diversified opportunities while maximizing potential returns beyond conventional market benchmarks.

The motivation to create the novel strategic investment, utilizing multiple factors, stems from KWIAM's requirement for a new investment strategy capable of outperforming the Thai market. Since investments in Thailand are similar and may still lose the market due to this problem, we would like to create other types of investment that overcome the market.

Moreover, the introduction of this innovative strategic investment aligns with broader industry trends and imperatives, wherein traditional investment paradigms are being reimaged to meet the evolving demands of global markets. In an era characterized by rapid technological advancements and shifting investor preferences, the imperative for adaptive and forward-thinking investment strategies has never been more pronounced. By embracing a multi-factor approach and pioneering novel investment methodologies, we endeavor to position ourselves at the forefront of industry innovation, setting new benchmarks for investment excellence and unlocking untapped value for our stakeholders. Through this strategic initiative, we aspire not only to enhance investor returns but also to catalyze a paradigm shift in investment philosophy, where the pursuit of alpha converges harmoniously with the principles of sustainability and long-term value creation.

1.2 Objectives

1. To create a comprehensive Multi-Factor Investing Model tailored for the Thai equity market, integrating diverse factors to inform and guide investment decisions effectively.
2. To maximize returns by employing a data-driven approach within our multi-factor investing model, targeting the achievement of the highest possible returns in the Thai equity market.
3. To manage risk effectively, balancing the pursuit of high returns with the imperative of risk containment through the integration of risk-adjusted return optimization techniques and strategic portfolio rebalancing.
4. To align the investment strategy with the portfolio's financial objectives, ensuring that the multi-factor investing model complements and supports the broader goals and financial health of the portfolio.

By articulating these objectives, we aim to underscore the dual priorities of achieving superior market performance and maintaining financial stability, through a sophisticated, data-driven investment strategy that is specifically designed for the complexities and opportunities of the Thai equity market.

1.3 Scope of Work

The scope of this project can be listed as follows:

1. To conduct a literature review relevant to the project objectives, synthesizing existing research on multi-factor investing models and their application in portfolio construction.
2. To gather historical data on overall stocks from the stock exchange in Thailand, providing a comprehensive dataset for analysis and model development.
3. To select stocks for the portfolio based on selected factors, ensuring a rigorous screening process to identify securities with favorable prospects for inclusion in the investment portfolio.
4. To develop a model for stock selection and estimate the expected return of individual stocks, incorporating multiple factors to inform investment decisions and optimize portfolio performance.
5. To construct optimal portfolios based on criteria from the research framework and construction criteria, employing the developed model to assemble diversified portfolios tailored to specific investment objectives and risk preferences.
6. To evaluate and visualize portfolio performance within the constructed framework, assessing the effectiveness of the multi-factor investing approach in enhancing risk-adjusted returns and portfolio efficiency through quantitative analysis and visualization techniques.

1.4 Thesis Structure

This thesis consists of five chapters which are arranged as follows:

- Chapter 1 Introduction - provides an overview of the motivation behind the study, outlines the objectives, defines the scope of work, and presents the structure of the thesis.
- Chapter 2 Literature Review – conducts a comprehensive review of relevant literature pertaining to multi-factor investing models, comparing various approaches and discussing their implications for portfolio construction and performance.
- Chapter 3 Research Methodology – delineates the methodology employed in conducting the research, detailing the process of formulating the multifactor model and constructing the portfolio based on empirical analysis and theoretical frameworks.
- Chapter 4 Results and Discussion – presents the findings obtained from the empirical analysis, discussing the implications of the results in relation to the objectives of the study and analyzing any limitations encountered during the research process.
- Chapter 5 Conclusion and Recommendations – summarizes the key findings and conclusions drawn from the study, offers recommendations for future research directions in the field of multi-factor investing, and suggests potential areas for further exploration to enhance the effectiveness of portfolio construction and optimization strategies.

Chapter 2

Literature Review

In An investing world, knowledge in the Financial Sector demands a comprehensive understanding and development of the existing literature to inform and guide contemporary research endeavors. In the literature review part, we seek to synthesize and analyze the scholarly works relevant to the Multi-Factors Model, shedding light on the current state of knowledge, identifying possibilities, and paving the way for future development.

2.1 Financial Models

2.1.1 Multi - Factors Investing

Multi-factor investing is a method of investing that builds on established long-term drivers of relative returns: factors, with the goal of producing superior long-term risk-adjusted returns through security selection. By determining any risk that can have an effect on the stock return, then conduct the stock selection process based on risk criteria that have been set up from the risk factors. Multi-factor models can be used in all industries, be it finance, economics, or mathematics. Mainly there are three types of multi-factor models that can be classified based on the type of factors employed: Macroeconomic, Fundamental, and Statistical. The existing Multi - Factors Models are Fama and French (3 Factors model) , Fama and French (5 Factors model), Q factors model, and Carhart 4 factor model.

2.1.2 Fama and French (1993)

The Fama-French Three-factor Model is an extension of the Capital Asset Pricing Model (CAPM). The Fama-French model aims to describe stock returns through three factors: (1) market risk, (2) the outperformance of small-cap companies relative to large-cap companies, and (3) the outperformance of high book-to-market value companies versus low book-to-market value companies. The concept of this model is that high-value and small-cap companies tend to outperform the overall market. The model was developed by University of Chicago professors Eugene Fama and Kenneth French. In the original model, the factors were specific to four countries: the U.S., Canada, Japan, and the U.K. Later on, Fama and French

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adjusted the factors, making them applicable for other regions, including Europe and the Asia-Pacific region. Including Thailand, the research showed that in a Thai Stock Equity Market, the Fama and French Three-factor Model are more effective than the normal CAPM model but the Fama and French Five-factor Model are the most efficient ones. According to the research of พรชิตา ชินตานนท์ (2022) have conducted the test of stock selection using Fama-French three factors model consisting of BCH, BDMS, BH, CHG and MEGA in linear regression of explaining changes in rate of return shown that the adjusted r-square for each stocks are 0.3331, 0.4660, 0.5647, 0.2499, 0.3719.

2.1.3 Carhart four factor model (1997)

The Carhart four-factor model is an extension of the Fama-French Three-factor model. It was proposed by Mark Carhart in 1997. The Carhart model included a new factor called cross-sectional momentum into the Fama-French Three-factor model in which it improved the explanatory of multifactor models aimed at explaining mutual funds performance. The momentum factor is defined as the speed or velocity of price changes in a stock, security, or tradable instrument by assuming that stocks that have performed well in the past will continue to perform well, and conversely, stocks that have performed poorly will continue to perform poorly. The equation is here as follows:

$$R_{it} - R_{ft} = \alpha + \beta_1(R_{Mt} - R_{ft}) + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4(UMD_t) + \epsilon_{it}$$

2.1.4 Fama and French (2015)

The Fama-French Five-factor Model is an extension of the Fama-French Three-factor model by adding two new factors into the equation which are investment and profitability, to the dividend discount model to better capture the relationship between risk and return. The result of adding two new factors make the new model more effective for the Thai Stock Equity Market. The equation is as follows:

$$\begin{aligned} R = & \alpha + \beta_m MKT + \beta_s SMB \\ & + \beta_h HML + \beta_r RMW \\ & + \beta_c CMA \end{aligned}$$

where

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- MKT (Market risk premium) is the excess return of the market. It is the return on the value-weighted market portfolio.
- SMB (Small minus Big) is the return on a diversified portfolio of small-cap stocks minus the return on a diversified portfolio of big-cap stocks.
- HML (High minus Low) is the difference between the returns on diversified portfolios of stocks with high and low Book-to-Market ratios.
- RMW (Robustness minus Weak) is the difference between the returns on diversified portfolios of stocks with robust (high and steady) and weak (low) profitability.
- CMA (Conservative minus Aggressive) is the difference between the returns on diversified portfolios of the stocks of low and high investment firms, which we call conservative and aggressive. Here, low/high investment means reinvestment ratio is low/high.

According to the research of พรชิตา ชินตานนท์ (2022) have conducted the test of stock selection using Fama-French five factors model consisting of BCH, BDMS, BH, CHG and MEGA then using a descriptive statistic to show data of standard deviation and mean of each stock in which CHG has the highest mean followed by BCH, MEGA, BH and BDMS.:

In which proven the factor of SMB that small-cap stocks are given higher return than big-cap stocks as the risks are higher. Then create a correlation matrix to see the relationship between those factors. Also test the efficiency of the model in explaining changes in rate of return by using linear regression with the same stocks in our portfolio. The results are better compared to the Fama-French Three factor model, then it can explain the profitability and investing factor furthermore.

เมษิณี เจริญเหล่า (2017) compares the performance of the Capital Asset Pricing Model (CAPM) with the 3-factor and 5-factor asset pricing models proposed by Fama-French. The data used for the study comprises information from 175 securities. The findings indicate that the 5-factor model by Fama-French provides the best explanation for changes in excess returns, particularly for 70 securities. The 3-factor model by Fama-French follows closely behind. Additionally, the study identifies the characteristics of security groups associated with the highest average returns: mid-sized securities with high book-to-market ratios (MH), followed by small-sized securities with high book-to-market ratios (SH). Conversely, securities with the lowest average returns are those across all sizes with low book-to-market ratios.

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2.2 Financial Factors

2.2.1 Book-to-market ratio (Value factor - HML)

The book-to-market (BTM) ratio is a financial metric used by investors and analysts to assess the relative value of a company based on its accounting book value and market value.

To compute the BTM ratio, you divide the book value per share (BVPS) by the market value per share (MVPS). The book value per share is determined by dividing the company's total equity by its total number of outstanding shares, while the market value per share is the current market price of one share.

The BTM ratio can be an essential tool for investors seeking value opportunities in the market. A higher BTM ratio typically suggests that a company's stock is undervalued in comparison to its book value, which may indicate an attractive investment opportunity. Conversely, a lower BTM ratio may imply that a company's stock is overvalued relative to its book value.

2.2.2 Debt to equity ratio (DE)

The Debt to Equity (DE) ratio is a financial metric that compares a company's total debt to its shareholders' equity. It's calculated by dividing the total liabilities of the company by its total shareholders' equity.

Total debt includes all of a company's short-term and long-term debt obligations, such as bank loans, bonds, and other borrowings. Shareholders' equity, on the other hand, represents the residual interest in the company's assets after deducting its liabilities. It includes items such as retained earnings and contributed capital from shareholders.

The Debt to Equity ratio is used by investors, creditors, and analysts to assess a company's financial leverage and risk. A higher Debt to Equity ratio indicates that a company has a higher proportion of debt relative to equity, which may imply higher financial risk since the company has more debt to repay. Conversely, a lower Debt to Equity ratio suggests that a company relies more on equity financing rather than debt financing, which may indicate lower financial risk.

2.2.3 Foreign In-direct Investment (FI)

The participation of foreign investors in a market plays a significant role in shaping stock performance. Capital inflows from foreign investors can increase demand for local

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stocks, potentially driving up stock prices. Conversely, capital outflows may result in selling pressure, which could have a dampening effect on stock prices. The overall level of foreign investment often reflects investor confidence in the market's stability and growth prospects, which can positively influence market sentiment. Improved market sentiment is frequently associated with higher stock returns as investors become more willing to invest in equities, driving up demand and prices. According to the Stock Exchange of Thailand, there is a significant relationship between influential factors and Net foreign portfolio investment therefore in Table 1 shows the relationship between Market return and Net foreign portfolio.

Relationship	Net foreign portfolio investment	Net foreign equity securities investment	Net foreign debt securities investment
Market returns	+	+	
Currency returns			
Interest rate difference	+		+
VIX	-	-	-
BSI	+		+

Sources: Stock Exchange of Thailand; Bank of Thailand; author's calculations.

Table 2.1 Relationship between Net foreign portfolio with market return

The data for foreign portfolio investment gathered by using NVDR from the Stock Exchange of Thailand have shown that most high return stocks are having a high NVDR percentage as well. According to Nathapong Rujiravanich (2544) Foreign portfolio investment flow has significance on the direction, or tendency, of large-scale stock prices as well as direct impacts on the SET (Stock Exchange of Thailand) index. After 2007, the accumulated foreign portfolio investment and SET index have followed a similar direction. Thus, the fluctuation of stock prices demonstrates how it can be affected by the trading volume of major investors, in particular, the popular big market SET 50 cap due to high liquidity and security. Foreign investment, nevertheless, in the form of hedge funds or individual investors, shows funds will move in a circular flow under the fundamental principle of money movement. Funds shall flow into markets where investors see higher profits when compared to investment risk. When the Thai Stock Market gives high profit, foreign investors who had been investing in other stock markets, for example, bond markets, money markets and commodities markets, will turn to the Thai Stock Market. This will raise

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stock prices as well as stimulate the SET index movement. However, if there is an economic crisis or changes in profit or investment risk, funds may flow out to other markets. The traditional approach, or “flow-oriented theory”, states that a depreciation of domestic currency can have a crucial impact on stock prices, by increasing firms’ competitiveness, while, in turn, raising their profitability. When firms are able to pay more dividends to stockholders, stock prices will increase and also attract more foreign investment. Thus, there should be a positive relationship between exchange rates and foreign investment flows. In this case, exchange rates lead stock prices and foreign investment flows. However, the “portfolio balance approach” indicates that stock prices and foreign investment flows lead exchange rates when a rising trend in stock prices induces foreign investors to invest more in domestic stocks. This causes more capital inflows, which, in turn, cause domestic currency appreciation. In addition, a rise in domestic stock prices causes wealth to increase, and thus induces investors to increase their demand for money, which results in a rise in domestic interest rates. Higher interest rates induce capital inflows, and thus cause an appreciation in domestic currency. According to this approach, stock prices and foreign investment flows have a negative impact on exchange rate. The details of the flow-oriented model are in Dornbusch and Fisher (1980), while the portfolio balance approach is discussed by Branson and Henderson (1985).

2.2.4 Momentum Factor (UMD)

The momentum factor in the Carhart model aims to capture the tendency of stocks with recent strong performance to continue performing well and stocks with recent weak performance to continue underperforming. Nagy, B. Zs., Dezméri, T. (2022) conducted a comparative analysis between the FF5 specification and a six-factor model that incorporates momentum, utilizing data from a transitioning market—the Warsaw Stock Exchange (WSE), which recently transitioned from an "emergent" to a "developed" market status. The study underscores a noteworthy enhancement in the explanatory power and statistical significance of the coefficients within the multifactor asset pricing model, attributable to the inclusion of the momentum effect. Moreover, Asness et al. (2013) provided robust justification for the incorporation of momentum as a crucial factor in any comprehensive asset pricing model. Their research yielded compelling evidence supporting the existence of both the value and momentum effects across diverse regions and various asset classes, encompassing currency and bond markets. The study delved into the intricacies behind the intriguing negative correlation observed between value and momentum.

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How the momentum factor can affect the Thai stock market and other factors in the Fama-French 5-factor model:

1. Market Risk (RM-RF):

- Positive Momentum: If there is a positive momentum factor, it suggests that stocks that have performed well recently are expected to continue outperforming. This could lead to higher overall market risk, affecting the market risk premium.
- Negative Momentum: Conversely, if there is negative momentum, it implies that stocks that have underperformed in the recent past may continue to do so. This could result in a lower market risk premium.

2. Size (SMB - Small Minus Big):

- Positive Momentum: If smaller stocks with positive momentum are driving the market, this could contribute to a positive SMB factor, indicating that small-cap stocks are outperforming large-cap stocks.
- Negative Momentum: Negative momentum among small stocks may lead to a negative SMB factor, suggesting underperformance of small-cap stocks compared to large-cap stocks.

3. Value (HML - High Minus Low):

- Positive Momentum: Positive momentum in value stocks could contribute to a positive HML factor, indicating that high book-to-market (value) stocks are outperforming low book-to-market (growth) stocks.
- Negative Momentum: Negative momentum in value stocks may lead to a negative HML factor, signaling underperformance of value stocks compared to growth stocks.

4. Profitability (RMW - Robust Minus Weak):

- Positive Momentum: If momentum is positive for stocks with high profitability, it may contribute to a positive RMW factor, indicating that stocks of companies with strong profitability are outperforming those with weak profitability.
- Negative Momentum: Negative momentum among high-profitability stocks may result in a negative RMW factor, suggesting underperformance of high-profitability stocks compared to low-profitability stocks.

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5. Investment (CMA - Conservative Minus Aggressive):

- Positive Momentum: Positive momentum among conservative investment stocks may lead to a positive CMA factor, indicating that stocks of companies with conservative investment policies are outperforming those with aggressive investment policies.
- Negative Momentum: Negative momentum in conservative investment stocks may result in a negative CMA factor, signaling underperformance of conservative investment stocks compared to aggressive investment stocks.

2.2.5 Market Risk Premium (Market factor - MKT)

The market risk premium represents the extra return investors expect to receive for investing in risky assets like stocks, compared to safer investments like government bonds. It essentially reflects the compensation investors demand for taking on the additional risk associated with investing in the stock market rather than opting for risk-free assets.

Calculating the market risk premium involves subtracting the risk-free rate, typically represented by government bond yields, from the expected return on the risky asset.

This premium is crucial in determining the required rate of return for investments and is a key element in various financial models like the Capital Asset Pricing Model (CAPM). It's essentially a reflection of investors' perceptions of the additional compensation needed to justify the risks of investing in stocks as opposed to safer alternatives, considering factors such as inflation, economic conditions, and market volatility.

2.2.6 Market Capitalization (Size factor - SMB)

Market capitalization, often referred to as market cap, is a measure of the total value of a publicly traded company's outstanding shares of stock. It is calculated by multiplying the current market price of the company's shares by the total number of outstanding shares.

In essence, market capitalization reflects the market's valuation of a company and represents the aggregate value that investors are assigning to the company's equity. It is an important metric used by investors, analysts, and financial professionals to assess the size, relative importance, and investment attractiveness of a company.

Market capitalization is typically categorized into three main tiers:

- Large-cap: Companies with a market capitalization typically greater than 50,000 million baht.

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- Mid-cap: Companies with a market capitalization generally between 10,000 million baht and 50,000 million baht.
- Small-cap: Companies with a market capitalization usually below 10,000 million baht.

2.2.7 Operating Profit (Profitability factor - RMW)

Operating profit, sometimes referred to as operating income or operating earnings, is a financial metric that indicates the profitability of a company's core business operations. It represents the profit generated from the company's primary activities, excluding certain expenses such as interest and taxes.

To calculate operating profit, you subtract operating expenses from gross profit. Operating expenses typically include costs directly related to running the day-to-day operations of the business, such as wages, rent, utilities, marketing expenses, and depreciation.

Operating profit is an important measure of a company's financial performance as it provides insight into its ability to generate profits from its primary business activities. It is commonly used by investors, analysts, and stakeholders to assess the efficiency and profitability of a company's operations.

2.2.8 Price-to-Earnings ratio (PE)

The Price-to-Earnings (P/E) ratio is a financial metric used by investors to evaluate the relative value of a company's stock. It is calculated by dividing the current market price per share of the company's stock by its earnings per share (EPS). The EPS is determined by dividing the company's net income by the total number of outstanding shares.

The P/E ratio provides insight into how much investors are willing to pay for each dollar of earnings generated by the company. A higher P/E ratio suggests that investors are willing to pay a higher price for the company's earnings, indicating optimism about its future growth prospects. Conversely, a lower P/E ratio may suggest that the stock is undervalued or that investors have lower expectations for future earnings growth.

2.2.9 Return on Equity ratio (ROE)

Return on Equity (ROE) is a financial ratio that measures a company's profitability by evaluating its ability to generate returns on the shareholders' equity invested in the business. ROE is calculated by dividing the net income attributable to common shareholders by the

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average shareholders' equity during a specific period. It is expressed as a percentage and indicates how efficiently a company is utilizing its equity to generate profits.

ROE is a fundamental measure used by investors, analysts, and stakeholders to assess a company's financial performance and management effectiveness. A higher ROE generally indicates better profitability and efficiency, as it signifies that the company is generating more profits relative to the shareholders' equity invested in the business.

2.2.10 Total Asset (Investment factor - CMA)

Total assets refer to the sum of all tangible and intangible resources owned by a company, which are used to generate revenue and operate its business. These assets can include cash, accounts receivable, inventory, property, plant, equipment, investments, and intangible assets like patents and goodwill.

Total assets are listed on a company's balance sheet and provide insight into its financial health and resources available to support its operations and growth. Investors, analysts, and stakeholders use total assets to assess a company's liquidity, solvency, and overall financial strength.

Chapter 3

Research Methodology

Our research methodology is founded upon an analytical framework that articulates the conceptual foundation guiding our collaborative efforts, along with the methodological approach applied throughout our study.[*Appendix A1*]

3.1 Data Collection

Collecting financial data from various sources, including SETSMART, CEIC, ThaiBMA, Yahoo Finance, and Bloomberg. We will collect the data for each factor from the Fama-French 5 Factors Model with Foreign Investment and Momentum.

The needed data will be listed as follows:

1. Book-to-market ratio
2. Debt-to-equity ratio (DE)
3. Government Bond Yield
4. Market Capitalization
5. NVDR
6. Operating Profit
7. Price-to-earnings ratio (PE)
8. Relative share price momentum
9. Return on equity ratio (ROE)
10. SET 100 Total Return Index (SET100 TRI)
11. Total Asset
12. Total Return Index (TRI) for our selected stocks
13. Trading volume of selected stocks

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3.2 Data Preprocessing

3.2.1 Data Cleaning

- Stocks will be excluded from the dataset if the proportion of missing data exceeds 50%, as such high levels of missing data may compromise the integrity of our analysis.
- To address missing data that falls below this threshold, we will employ backward and forward-filling techniques. This approach involves substituting missing values with the most recently observed value (backward-filling) or the next available value (forward-filling) in the dataset, ensuring continuity and preserving the temporal sequence of the data. By utilizing these methods, we aim to mitigate the impact of missing data on our analytical outcomes and maintain the robustness of our findings.

3.2.2 Checking stationary

Indeed, ensuring stationarity is crucial in time series analysis. Stationarity suggests that a time series' statistical properties, such as mean, variance, and autocovariance, remain constant over time. This stability enables dependable analysis and forecasting by indicating a consistent underlying data generating process.

3.2.2.1 Testing Method

To verify stationarity, various methods are available, but our group has chosen to employ the Augmented Dickey-Fuller (ADF) Test. [*Appendix A2*]

Augmented Dickey-Fuller (ADF) Test: The ADF test is a statistical hypothesis test that assesses the stationarity of a time series. It tests the null hypothesis that a unit root is present in the time series data, indicating non-stationarity. A low p-value (typically less than a chosen significance level, e.g., 0.05) suggests rejecting the null hypothesis and concluding stationarity.

3.2.2.2 Fixing non-stationary data

We have addressed the non-stationarity issue in our data by employing the percentage change (% change) transformation. This transformation calculates the percentage difference between consecutive data points, effectively removing trends and ensuring stationarity.

3.3 Testing for significant factors

We will conduct an Ordinary Least Squares (OLS) regression analysis to assess the significance of various factors in relation to the Thai equity market. This analysis is essential for determining the factors that have a meaningful impact on the market and are crucial for the stock selection process.

Before testing the significance of factors, it's crucial to first determine the optimal lag time for each factor. This ensures the accuracy of our analysis. Additionally, it's essential to address potential issues by examining the correlation matrix for relationships between variables, assessing multicollinearity to ensure the independence of predictors, checking for heteroskedasticity to confirm the homogeneity of variance, and detecting serial correlation to ascertain the independence of residuals. These steps are vital for ensuring the reliability and validity of our analysis. Lastly, after solving every problem will be doing factor testing.

Here is the list of factors we will analyze:

1. Book-to-market ratio
2. Debt-to-equity ratio (DE)
3. Market Capitalization
4. Market Risk Premium
5. Momentum
6. NVDR
7. Operating Profit
8. Price-to-earnings ratio (PE)
9. Return on equity ratio (ROE)
10. Total Asset

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3.3.1 Number of suitable lags

The lag selection for each factor is determined in accordance with well-established financial theory, ensuring the integrity of our analysis.

Factors	Number of lags
1. Book-to-market ratio	1
2. Debt-to-equity ratio (DE)	1
3. Market Capitalization	0
4. Market Risk Premium	1
5. Momentum	0
6. NVDR	0
7. Operating Profit	1
8. Price-to-earnings ratio (PE)	1
9. Return on equity ratio (ROE)	1
10. Total Asset	1

Table 3.1 Number of suitable lags

3.3.2 Identifying Potential Issues

3.3.2.1 Correlation Matrix

Examining the correlation matrix allows us to understand the relationships between different factors. This is crucial because highly correlated factors can introduce multicollinearity issues in our analysis, which can distort the results and interpretation of our model. By checking the correlation matrix, we can identify and address any strong correlations between factors before proceeding with further analysis. This helps ensure the reliability and validity of our findings

	BOOK_TO_MKT	DE	MKT_CAP	MKT_RISK	MOM	NVDR	OPERATING_PR	PE	ROE	TOTAL_ASSET
BOOK_TO_MKT	1.000000	0.531458	-0.979265	-0.975868	-0.246926	-0.435674	-0.295344	-0.009125	-0.034677	-0.049757
DE	0.531458	1.000000	-0.512723	-0.469661	-0.121760	-0.251937	-0.226700	0.111947	-0.045738	-0.048628
MKT_CAP	-0.979265	-0.512723	1.000000	0.982970	0.338224	0.383633	0.295719	-0.011169	-0.035733	0.106984
MKT_RISK	-0.975868	-0.469661	0.982970	1.000000	0.200911	0.369555	0.343826	-0.032332	0.008662	0.111726
MOM	-0.246926	-0.121760	0.338224	0.200911	1.000000	0.148636	-0.138010	0.181790	-0.224780	0.155588
NVDR	-0.435674	-0.251937	0.383633	0.369555	0.148636	1.000000	0.297841	0.010483	0.319164	0.038273
OPERATING_PROFIT	-0.295344	-0.226700	0.295719	0.343826	-0.138010	0.297841	1.000000	-0.087819	0.247080	0.226516
PE	-0.009125	0.111947	-0.011169	-0.032332	0.181790	0.010483	-0.087819	1.000000	-0.100991	0.254389
ROE	-0.034677	-0.045738	-0.035733	0.008662	-0.224780	0.319164	0.247080	-0.100991	1.000000	-0.147751
TOTAL_ASSET	-0.049757	-0.048628	0.106984	0.111726	0.155588	0.038273	0.226516	0.254389	-0.147751	1.000000

Table 3.2 Correlation Matrix

When the correlation coefficient between two independent variables surpasses 0.75 and -0.75, it signals a significant correlation between them. In our analysis, we observe that Market Capitalization, Market Risk Premium, and Book-to-market ratio exhibit such high correlation. Despite this, we've opted to retain these factors for further examination and prioritize addressing other potential issues before proceeding.

3.3.2.2 Multicollinearity

Testing for multicollinearity to ensure the independence of predictors in our analysis. Multicollinearity occurs when independent variables in a regression model are highly correlated with each other, which can lead to unreliable estimates of the coefficients and affect the interpretation of the results. By detecting and addressing multicollinearity, we can ensure the accuracy and stability of our model, enabling us to make valid inferences about the relationships between the predictors and the outcome variable.

Testing Result:

If the Variance Inflation Factor (VIF) exceeds 10 for a variable, it indicates severe multicollinearity, meaning that the variable's coefficient estimates are highly unreliable due to its strong correlation with other predictors. This situation requires corrective measures such as removing or combining correlated variables to ensure the validity of the regression analysis.

Variance Inflation Factors
 Date: 03/03/24 Time: 21:40
 Sample: 1 40
 Included observations: 39

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	3.33E-05	11.60928	NA
BOOK_TO_MKT(-1)	0.013202	40.45391	39.91496
DE(-1)	0.000939	1.878977	1.870879
MKT_CAP	0.000707	1.925762	1.867238
MKT_RISK(-1)	0.014013	37.44934	36.87772
MOM	1.92E-07	3.111149	1.411060
NVDR	0.003275	2.177475	1.747066
OPERATING_PRO...	3.95E-13	9.367051	1.393505
PE(-1)	7.95E-06	1.469012	1.401870
ROE(-1)	0.000590	1.227317	1.183805
TOTAL_ASSET(-1)	0.002786	1.566744	1.514219

Figure 3.1 Result before solving the multicollinearity problem

In this case, two factors, Book-to-market ratio and Market Risk Premium, have VIF values over 10, indicating a strong multicollinearity problem. This might affect the reliability of our analysis, so we need to address this issue.

Addressing Multicollinearity:

Removing the Book-to-market ratio as a predictor variable is a valid decision to address the multicollinearity issue. By eliminating one of the highly correlated variables, we aim to improve the stability and reliability of the regression model. This action helps mitigate the multicollinearity problem and enhance the validity of our analysis.

Variance Inflation Factors
 Date: 03/03/24 Time: 21:42
 Sample: 1 40
 Included observations: 39

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	2.92E-05	10.33423	NA
DE(-1)	0.000824	1.672862	1.665652
MKT_CAP	0.000651	1.798718	1.744055
MKT_RISK(-1)	0.000602	1.631327	1.606427
MOM	1.89E-07	3.097556	1.404895
NVDR	0.002643	1.781400	1.429280
OPERATING_PRO...	3.68E-13	8.835074	1.314365
PE(-1)	6.63E-06	1.242455	1.185668
ROE(-1)	0.000569	1.199972	1.157429
TOTAL_ASSET(-1)	0.002448	1.395823	1.349028

Figure 3.2 Result after solving multicollinearity

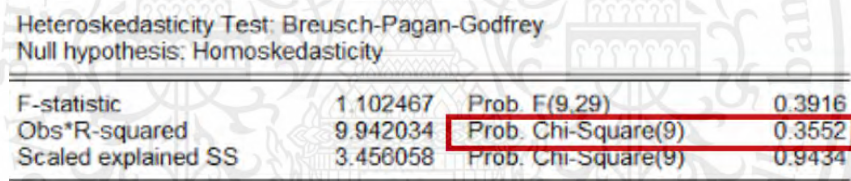
3.3.2.3 Heteroskedasticity

Checking for heteroskedasticity is to ensure the validity of the regression model's assumptions. Heteroskedasticity refers to the unequal variance of residuals across the range of predictor variables. Detecting heteroskedasticity is important because it can lead to biased and inefficient coefficient estimates, affecting the reliability of statistical inference and hypothesis testing. By identifying and addressing heteroskedasticity, we aim to improve the accuracy and robustness of the regression analysis.

Testing Method:

The Breusch-Pagan test is a statistical test commonly used to formally assess whether the variance of the residuals in a regression model is dependent on the predictor variables. If the p-value associated with the Breusch-Pagan test is below a chosen significance level (e.g., 0.05), it suggests that heteroskedasticity is present in the data. This significant result indicates that the assumption of constant variance of residuals across all levels of the predictor variables is violated, thus warranting further investigation and potentially corrective actions.

Testing Result:



Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.102467	Prob. F(9,29)	0.3916
Obs*R-squared	9.942034	Prob. Chi-Square(9)	0.3552
Scaled explained SS	3.456058	Prob. Chi-Square(9)	0.9434

Figure 3.3 Result of Heteroskedasticity testing

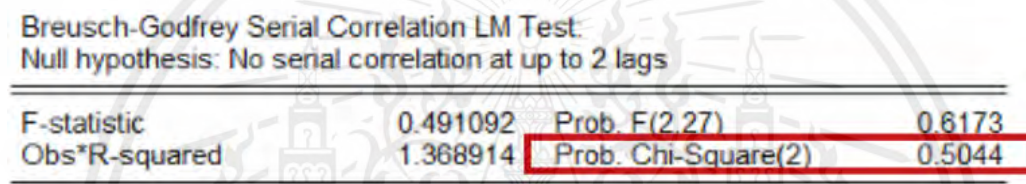
The p-value obtained from the Breusch-Pagan test is greater than 0.05, it suggests that there is no significant evidence to reject the null hypothesis. In this context, a p-value above 0.05 indicates homoskedasticity, implying that the assumption of constant variance of residuals across all levels of the predictor variables is not violated. Therefore, we can conclude that there is no significant heteroskedasticity in the data, and the regression model's assumptions regarding the variance of residuals hold.

3.3.2.4 Serial Correlation

Testing for serial correlation, also known as autocorrelation, is essential in regression analysis to ensure the validity of the model's assumptions. Serial correlation occurs when the residuals of a regression model are correlated with each other over time or across observations.

The presence of serial correlation can lead to biased coefficient estimates and unreliable standard errors, which can affect the accuracy and interpretability of the regression results. By detecting and addressing serial correlation, we can improve the reliability of the regression analysis and ensure that the model's assumptions are met. This helps to produce more accurate and trustworthy conclusions from the data.

Testing Result:



Breusch-Godfrey Serial Correlation LM Test
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.491092	Prob. F(2,27)	0.6173
Obs*R-squared	1.368914	Prob. Chi-Square(2)	0.5044

Figure 3.4 Testing result of serial correlation

It suggests that there is no significant evidence to reject the null hypothesis. In this context, a p-value above 0.05 indicates that there is no significant serial correlation present in the residuals of the regression model. Therefore, we can conclude that the assumption of independence of residuals over time holds, ensuring the validity of the regression analysis.

3.3.3 Factor testing

Following the comprehensive resolution of identified issues and the application of the Ordinary Least Squares (OLS) method for analysis, the factors under consideration have demonstrated statistical significance with p-values below 0.05, indicating a confidence level of 95%. This discerning selection underscores their pivotal role in shaping market behavior and offers invaluable insights for investment decision-making in the Thai equity market. Moving forward, we will harness the predictive power of these factors in our stock selection process.

3.4 Stock Selection

In our stock selection process, we begin by focusing on the SET100 Index, comprising a diverse range of companies listed on the Stock Exchange of Thailand. From this index, we identify the top twenty stocks based on a comprehensive scoring system, which evaluates each stock across four key factors: Return on Equity (ROE), Operating Profit, Momentum, and Market Capitalization.

Factors Considered:

1. Return on Equity (ROE): A measure of a company's profitability relative to shareholder equity. Higher ROE values indicate stronger performance. For example, if Company X has the highest ROE among SET100 stocks, it receives a score of 1 for this factor.
2. Operating Profit: Accounting figure that measures the amount of profit realized from a business's operations after deducting operating expenses. Stocks with higher operating profit values are ranked higher. Similarly, the stock with the highest operating profit within the SET100 Index receives a score of 1 for this factor.
3. Momentum: Indicates the rate of change in a stock's price. Strong momentum suggests positive investor sentiment and potential for future price appreciation. Stocks with the highest momentum values are given a score of 1 in this category.
4. Market Capitalization: This represents the total market value of a company's outstanding shares. In our methodology, we prioritize stocks with lower market capitalization, as they often exhibit higher growth potential. Thus, the stock with the lowest market capitalization within the SET100 Index receives a score of 1 for this factor.

To score each stock, we assign a value of 1 to the highest-ranking stock for each factor (ROE, Operating Profit, and Momentum), and to the lowest-ranking stock for Market Capitalization. Once scores are assigned for each stock, we sum them up to obtain a composite score for each stock. Subsequently, we rank the stocks based on their composite scores and select the top twenty for inclusion in our portfolio.[*Appendix A3*]

3.5 Portfolio Construction

Our portfolio construction aims to create a max information ratio portfolio in comparison with the SET100 TRI benchmark by using criteria and constraints for managing risk, diversifying the portfolio, and minimizing cost associated.

3.5.1 Portfolio Construction Criteria

- Portfolio Size: 1 billion baht.
- Individual Stock Weight: Not exceeding 10% of the portfolio size.
- Trading Liquidity: Ensure each trading transaction is not over 1/3 of the stock's trading volume.
- Trading fee: 0.2% of portfolio size
- Market Benchmark: SET100 Total Return Index (SET100 TRI)

3.5.2 Steps of Portfolio Construction

Step 1: Evaluating the expected return of chosen stocks

First step is to calculate the expected return of each stock.

Step 2: Finding excess return of stocks

Once the expected return of each stock is estimated, the next step is to calculate the excess return of each stock. Excess return refers to the return achieved by a stock in excess of a benchmark or risk-free rate. For our portfolio the benchmark will be SET100 TRI.

Step 3: Finding Information Ratio

The information ratio is a measure used to evaluate the risk-adjusted return of an investment strategy or portfolio. It is calculated by dividing the excess return of the portfolio (or individual stocks) by the standard deviation of the excess return in which we use excel for calculation.

Step 4: Using Max Information Ratio to determine the weight of each stock

In this step, to allocate weights to each stock in the portfolio based on their respective information ratios. The stock with the highest information ratio is typically assigned the highest weight, while stocks with lower information ratios are assigned lower weights. This approach aims to maximize the risk-adjusted return of the portfolio by overweighting stocks that have historically provided superior risk-adjusted returns.

Step 5: Verifying the availability of trading volume for each stock

Finally, it's essential to ensure that there is sufficient trading volume for each stock in the portfolio. Adequate trading volume ensures liquidity, allowing investors to buy and sell shares without significantly impacting the market price. Lack of liquidity can lead to wider bid-ask spreads, increased transaction costs, and difficulty in executing trades, which can adversely affect portfolio performance.

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Chapter 4

Results and Discussion

4.1 Valid Factors

We have identified four factors that significantly influence the Thai equity market: Market Capitalization, Momentum, Operating Profit (lagged by one period), and Return on Equity (lagged by one period). These factors have been found to be statistically significant, with p-values below 0.05, indicating their importance with 95% confidence. This selection underscores the critical drivers shaping market dynamics and offers valuable insights for investment decision-making in the Thai equity market.

Dependent Variable: SET100_TRI
 Method: Least Squares
 Date: 03/03/24 Time: 21:45
 Sample (adjusted): 2 40
 Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MKT_CAP	1.015790	0.020022	50.73282	0.0000
MOM	-0.002642	0.000342	-7.735444	0.0000
OPERATING_PROFIT(-1)	1.15E-06	2.64E-07	4.339225	0.0001
ROE(-1)	-0.059639	0.021601	-2.760924	0.0091
R-squared	0.987528	Mean dependent var		0.012478
Adjusted R-squared	0.986459	S.D. dependent var		0.087157
S.E. of regression	0.010142	Akaike info criterion		-6.247312
Sum squared resid	0.003600	Schwarz criterion		-6.076690
Log likelihood	125.8226	Hannan-Quinn criter.		-6.186095
Durbin-Watson stat	2.153672			

Figure 4.1 Valid Factors

4.2 Stock Selection

After implementing the scoring and ranking methodology outlined in Section 3, we have identified the top twenty stocks for portfolio construction. These stocks were chosen based on their cumulative scores across the identified factors, and their final ranking is depicted in Table 4.1.

	SCORE	ranking
SIRI TB Equity	88	1
MTC TB Equity	96	2
BH TB Equity	97	3
ADVANC TB Equity	103	4
AP TB Equity	104	5
PTTEP TB Equity	107	6
COM7 TB Equity	108	7
MEGA TB Equity	108	7
DELTA TB Equity	112	9
BCP TB Equity	113	10
ORI TB Equity	114	11
FORTH TB Equity	114	11
TTB TB Equity	117	13
WHA TB Equity	117	13
SPALI TB Equity	118	15
MINT TB Equity	119	16
KTB TB Equity	121	17
TISCO TB Equity	121	17
ERW TB Equity	122	19
NEX TB Equity	123	20

Table 4.1 Selected stocks

In Table 4.1, each stock's final rank is determined by the cumulative score, where a lower score indicates a higher rank. This score is the summation of individual rankings across four factors: Return on Equity (ROE), Operating Profit, Momentum, and Market Capitalization. The methodology applied here ensures that the stocks selected not only excel in individual factors but also demonstrate a balanced performance across all considered metrics. This balanced approach aims to construct a diversified portfolio capable of delivering superior returns while managing risk effectively.

4.3 Portfolio Construction and Performance

4.3.1 Portfolio Construction

Following a rigorous screening process utilizing factor-based analysis, we have identified a selection of 20 stocks that exhibit promising attributes in line with our investment strategy.

Stocks	Weights
DELTA	0.0246
ADVANC	0.1000
PTTEP	0.0981
KTB	0.1000
BH	0.1000
MINT	0.0170
MTC	0.0473
TISCO	0.1000
WHA	0.0810
BCP	0.0199
COM7	0.1000
SPALI	0.0617
MEGA	0.0721
AP	0.0061
SIRI	0.0143
ERW	0.0180
NEX	0.0001
ORI	0.0153
FORTH	0.0225

Table 4.2 Portfolio Construction

4.3.2 Portfolio Performance

After the process of weighting and adjusting the final portfolio contains 19 stocks in total with max information ratio and the volume not exceeding $\frac{1}{3}$ of trading volume to ensure slippage cost and minimize risk.

1. Port Return	0.1898
2. Port Risk	
Variance	0.0408
S.D.	0.2019
3. Sharp Ratio	0.8357
Risk Free	0.0211
4. Informatio Ratio	2.0847

Table 4.3 Portfolio Performance

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The table above shows the performance of our portfolio from using max information from the stock that we selected from our model which returned more than the SET100 TRI benchmark with minimal risk. Our portfolio beats the market in terms of return and performing cumulatively high over a testing period in which is 10 years.

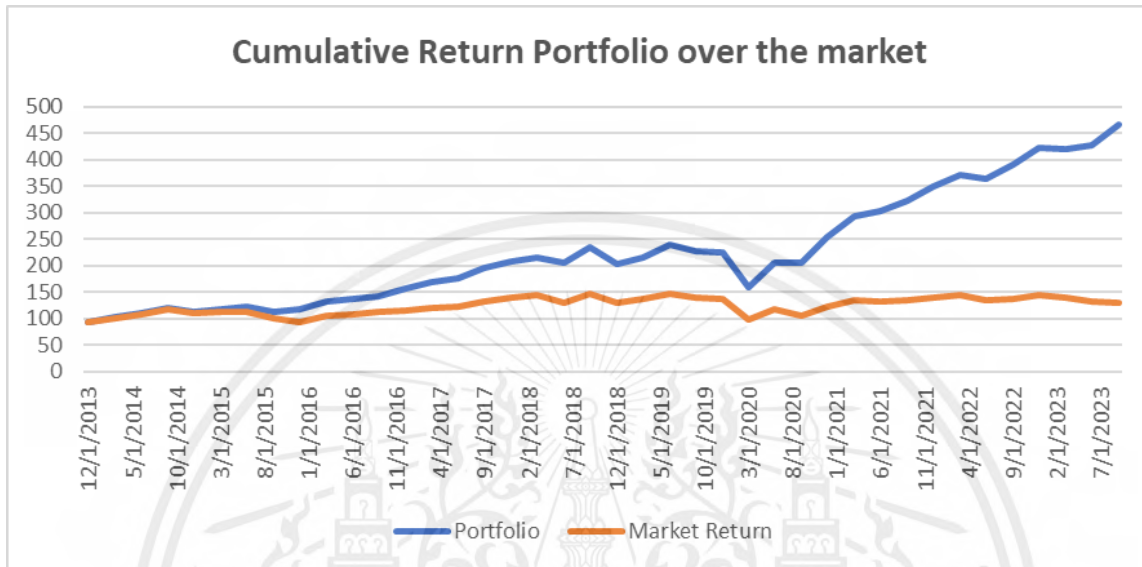


Figure 4.2 Portfolio Cumulative Return

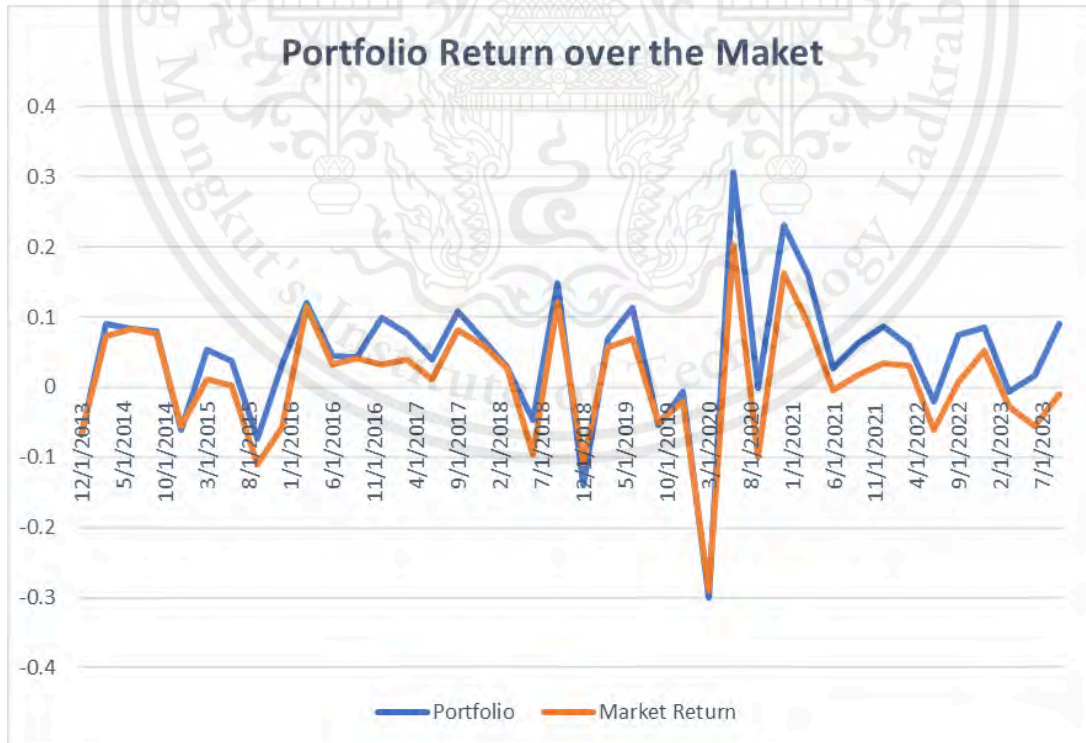


Figure 4.3 Portfolio Return Over The Market

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Chapter 5

Conclusion and Recommendations

5.1 Conclusion

This multi-factor investing model study for the Thai Equity Market revolves around various factors based on economic terms and other financial aspects integrating the foundational Fama-French model with supplementary factors derived from various theories such as Carhart (1997), Gyntelberg (2009), financial fundamentals, and other relevant sources to construct a quality portfolio with diversified stocks. But for the Thai Equity Market, the availability of factors is reduced and through rigorous analysis, we have identified several key factors that significantly impact the performance of stocks selected into our crafted model, consisting of ROE, Operating profit, Momentum, and Market Capitalization. The basic ideas of each factor are as follows:

Factor	Meaning	Value
ROE	Measure of financial performance	The higher the better
Operating Profit	Accounting figure that measures the amount of profit realized from a business's operations after deducting operating expenses	The higher the better
Momentum	Explain the movement of price	The higher the better
Market Capitalization	Smaller size company tend to give returns higher than bigger ones in the long term	The Lower the better

Table 5.1 Meaning of factors

The process of constructing and optimizing a portfolio involves a meticulous evaluation of various financial factors to achieve the desired risk-return profile. By employing methodologies such as assessing expected return, excess return, information ratio, and liquidity constraints, we identified a selection of 19 stocks that initially met our criteria.

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Then using max information ratio to weight and seeing the result of our investment model, it has proven that those factors from our selection have an impact corresponding to stocks return by our portfolio beating the market benchmark of SET100 TRI and giving a very high cumulative return over a 10 years time frame. In conclusion, our multi - factors model is capable of selecting stocks to invest in a long-term investment by looking into those factors that have an impact on stocks return such as ROE, Operating profit, Momentum and Market Capitalization as this model is suitable for Thai Equity Market.

5.2 Recommendations

In our ongoing efforts to enhance our investment strategy, it has become evident that expanding the depth and scope of our analysis is crucial for effectively navigating the dynamic landscape of the Thai equity market. With this objective in mind, we have identified several key recommendations aimed at strengthening our approach and maximizing our investment potential.

Below are several recommendations:

1. **Increase Dataset Size:** Recognizing the significance of obtaining a comprehensive understanding of market dynamics, we propose expanding our dataset to encompass a broader range of data points and historical trends. By doing so, we seek to uncover deeper insights into market behavior and identify hidden patterns that can inform our investment decisions more effectively.
2. **Expand Factors Considered:** Given the multifaceted nature of market influences, we advocate for broadening the scope of factors considered in our analysis. By incorporating additional factors, we aim to construct a more robust model capable of capturing the intricacies of market fluctuations and enhancing the predictive power of our investment strategy.
3. **Diversify Stock Selection:** Constructing a resilient and high-performing portfolio necessitates careful stock selection. To this end, we endorse diversifying our stock selection process by expanding the universe of stocks under consideration. This approach not only helps mitigate risk but also allows us to capitalize on a diverse range of investment opportunities.

These recommendations underscore our commitment to continuously refining and optimizing our investment approach. By strategically implementing these measures, we aim to navigate the complexities of the Thai equity market with confidence and precision, ultimately maximizing value for our stakeholders.

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5.3 Limitations

In our ongoing efforts to refine our investment strategy in the Thai equity market, it's crucial to recognize the limitations that have shaped our analysis and decision-making process. Understanding these limitations enables us to identify areas for improvement and develop strategies to mitigate their impact on our investment approach.

Two primary limitations have emerged in our analysis:

1. **Small Dataset Size:** Our analysis is hindered by the relatively small size of our dataset, primarily due to the utilization of quarterly data. This limitation restricts the depth of our insights and may overlook certain market trends or patterns that could be observed with a larger dataset.
2. **Time Constraints:** Time constraints have also posed a significant challenge. We were unable to conduct comprehensive Back Tests, Forward Tests, and portfolio rebalancing exercises due to these constraints. These tests are crucial for evaluating the real performance of our portfolio and understanding its effectiveness in various market conditions.

By addressing these limitations and incorporating strategies to overcome them, we aim to strengthen our investment strategy and enhance our ability to navigate the complexities of the Thai equity market effectively.

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Appendix A: Research Methodology

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Appendix A1: Analytical framework



Appendix A2: Checking Stationary

Augmented Dickey-Fuller Unit Root Test on BOOK_TO_MKT

Null Hypothesis: BOOK_TO_MKT has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.553481	0.1112
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on DE

Null Hypothesis: DE has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.655148	0.4456
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

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Augmented Dickey-Fuller Unit Root Test on MKT_RISK

Null Hypothesis: MKT_RISK has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.556893	0.0000
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on MOM

Null Hypothesis: MOM has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.974048	0.0002
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on NVDR

Null Hypothesis: NVDR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.247326	0.6440
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on OPERATING_PROFIT

Null Hypothesis: OPERATING_PROFIT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.167537	0.0001
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

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Augmented Dickey-Fuller Unit Root Test on PE

Null Hypothesis: PE has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	3.638535	1.0000
Test critical values:		
1% level	-3.670170	
5% level	-2.963972	
10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on ROE

Null Hypothesis: ROE has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.356279	0.5928
Test critical values:		
1% level	-3.621023	
5% level	-2.943427	
10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on TOTAL_ASSET

Null Hypothesis: TOTAL_ASSET has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.216918	0.6575
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test on SET100_TRI

Null Hypothesis: SET100_TRI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.652449	0.0915
Test critical values:		
1% level	-3.610453	
5% level	-2.938987	
10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

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Appendix A3: Stocks are sorted by score

	ROE (-1)	OPER (-1)	MOM	MKT cap	SCORE	ranking
SIRI TB Equity	26	30	16	16	88	1
MTC TB Equity	22	22	6	46	96	2
BH TB Equity	3	26	4	64	97	3
ADVANC TB Equity	4	7	18	74	103	4
AP TB Equity	24	32	23	25	104	5
PTTEP TB Equity	21	3	8	75	107	6
COM7 TB Equity	1	42	21	44	108	7
MEGA TB Equity	12	44	26	26	108	7
DELTA TB Equity	5	12	17	78	112	9
BCP TB Equity	38	38	1	36	113	10
ORI TB Equity	15	35	56	8	114	11
FORTH TB Equity	2	56	42	14	114	11
TTB TB Equity	48	6	3	60	117	13
WHA TB Equity	29	39	2	47	117	13
SPALI TB Equity	20	28	43	27	118	15
MINT TB Equity	14	10	33	62	119	16
KTB TB Equity	41	5	9	66	121	17
TISCO TB Equity	19	24	30	48	121	17
ERW TB Equity	39	63	11	9	122	19
NEX TB Equity	9	61	46	7	123	20
SAWAD TB Equity	18	25	48	35	126	21
AMATA TB Equity	40	64	5	18	127	22
TASCO TB Equity	13	41	63	10	127	22
TCAP TB Equity	46	37	12	33	128	24
KCE TB Equity	32	51	10	39	132	25
CPALL TB Equity	27	8	25	73	133	26
RCL TB Equity	10	47	72	5	134	27
KKP TB Equity	36	16	52	31	135	28
CPN TB Equity	23	15	31	67	136	29
BBL TB Equity	49	4	15	69	137	30
HMPRO TB Equity	7	27	47	59	140	31
PTT TB Equity	52	1	13	76	142	32
PLANB TB Equity	42	59	20	21	142	32
KTC TB Equity	11	21	60	54	146	34
MBK TB Equity	59	58	7	22	146	34
BCPG TB Equity	56	55	19	17	147	36
CK TB Equity	57	57	14	23	151	37
GUNKUL TB Equity	17	49	74	15	155	38
TU TB Equity	43	40	34	40	157	39
BDMS TB Equity	28	17	44	71	160	40
KBANK TB Equity	51	2	39	68	160	40
JMT TB Equity	47	48	22	43	160	40
THANI TB Equity	30	50	76	4	160	40
EA TB Equity	8	19	71	63	161	44
PSL TB Equity	33	53	77	2	165	45
THG TB Equity	44	52	37	34	167	46
BEM TB Equity	45	31	36	56	168	47
GULF TB Equity	37	11	49	72	169	48
SCC TB Equity	50	9	40	70	169	48
PTG TB Equity	53	60	54	3	170	50
INTUCH TB Equity	6	72	29	65	172	51
GLOBAL TB Equity	34	43	45	50	172	51
TOP TB Equity	63	18	41	53	175	53

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BANPU TB Equity	16	45	73	41	175	53
CHG TB Equity	35	65	51	24	175	53
STA TB Equity	60	62	50	6	178	56
CPF TB Equity	67	13	38	61	179	57
LH TB Equity	31	36	61	51	179	57
AOT TB Equity	64	14	27	77	182	59
CBG TB Equity	25	46	62	49	182	59
BCH TB Equity	65	54	35	32	186	61
JMART TB Equity	69	68	32	20	189	62
RATCH TB Equity	58	34	57	42	191	63
CKP TB Equity	55	69	55	12	191	63
STEC TB Equity	62	71	64	1	198	65
AAV TB Equity	78	74	28	19	199	66
EGCO TB Equity	66	33	65	38	202	67
BGRIM TB Equity	71	23	67	45	206	68
SJWD TB Equity	61	67	68	13	209	69
CENTEL TB Equity	54	66	59	37	216	70
IVL TB Equity	72	20	70	57	219	71
BTS TB Equity	70	75	24	52	221	72
GPSC TB Equity	68	29	75	55	227	73
VGI TB Equity	73	73	78	11	235	74
SPRC TB Equity	76	77	58	28	239	75
BYD TB Equity	75	70	69	29	243	76
IRPC TB Equity	77	78	66	30	251	77
PTTGC TB Equity	74	76	53	58	261	78

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