IMPACT OF ECONOMIC FACTORS ON THE RETURN OF EIGHT INDUSTRY GROUP INDEX IN THE STOCK EXCHANGE OF THILAND

KUNTIDA MASAEN

MASTER OF ECONOMICS

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GRADUATE SCHOOL
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IMPACT OF ECONOMIC FACTORS ON THE RETURN OF EIGHT INDUSTRY GROUP INDEX IN THE STOCK EXCHANGE OF THILAND

KUNTIDA MASAEN

A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ECONOMICS

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THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ECONOMICS

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หัวข้อวิทยานิพนธ์	ผลกระทบของปัจจัยทางเศรษฐกิจต่อการขึ้นลงของผลตอบแทนของดัชนีราคากลุ่มอุตสาหกรรมแปดกลุ่มในตลาดหลักทรัพย์แห่งประเทศไทย	
ผู้เขียน	นางสาวกุลธิดา มาแสน	
ปริญญา	เศรษฐศาสตรมหาบัณฑิต	
คณะกรรมการที่ปรึกษา	ผศ.ดร.ชัยวัฒน์ นิ่มอนุสสรณ์กุล	อาจารย์ที่ปรึกษาหลัก
	ผศ.ดร.อนัสปรีย์ ไชยวรรณ	อาจารย์ที่ปรึกษาร่วม

บทคัดย่อ

ปริญญานิพนธ์เล่มนี้จัดทำขึ้นเพื่อ ศึกษาถึงผลกระทบของปัจจัยทางเศรษฐกิจต่อผลตอบแทนของดัชนีราคากลุ่มอุตสาหกรรมแปดกลุ่มในตลาดหลักทรัพย์แห่งประเทศไทยโดยวัตถุประสงค์ของวิทยานิพนธ์นี้คือเพื่อทดสอบความสัมพันธ์ระหว่างปัจจัยเศรษฐกิจและดัชนีราคากลุ่มอุตสาหกรรมทั้งแปดกลุ่มในตลาดหลักทรัพย์แห่งประเทศไทยรวมถึงทดสอบหาความสัมพันธ์ระหว่างดัชนีราคากลุ่มอุตสาหกรรมแต่ละกลุ่มทั้งแปดกลุ่มและเพื่อทดสอบผลกระทบของการเปลี่ยนแปลงของปัจจัยเศรษฐกิจต่อความน่าจะเป็นของผลตอบแทนในแต่ละดัชนีราคากลุ่มอุตสาหกรรมทั้งแปดกลุ่มในตลาดหลักทรัพย์แห่งประเทศไทย ใช้ข้อมูลทุติยภูมิรายเดือนตั้งแต่เดือนมกราคม 2549 ถึงเดือนธันวาคม 2561 รวมทั้งสิ้น 156 เดือน หรือ 13 ปี โดยใช้แบบจำลอง Multivariate probit ในการวิเคราะห์ความสำพันธ์ ตัวแปรที่ใช้ในการศึกษาประกอบด้วยตัวแปรอิสระ (ปัจจัยทางเศรษฐกิจ) ได้แก่ อัตราผลตอบแทนพันธบัตรรัฐบาลรุ่น10ปี ดัชนีตลาดหลักทรัพย์แห่งประเทศไทย ดัชนีอุตสาหกรรมดาวโจนส์ อัตราแลกเปลี่ยนบาทต่อดอลลาร์สหรัฐอเมริกา ดัชนีราคาผู้บริโภค ดัชนีความเชื่อมั่นทางธุรกิจ และ ดัชนีราคาน้ำมัน ตัวแปรตาม (ดัชนีกลุ่มอุตสาหกรรม) ได้แก่ กลุ่มเกษตรและอุตสาหกรรมอาหาร กลุ่มสินค้าอุปโภคบริโภค กลุ่มธุรกิจการเงิน กลุ่มสินค้าอุตสาหกรรม กลุ่มอสังหาริมทรัพย์และก่อสร้าง กลุ่มทรัพยากร กลุ่มบริการ และกลุ่มเทคโนโลยี ผลการศึกษาแสดงให้เห็นว่าปัจจัยทางเศรษฐกิจมีผลกระทบต่อดัชนีกลุ่มอุตสาหกรรมแปดกลุ่มในลักษณะที่แตกต่างกัน

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ABSTRACT

This study examines the impact of economic factors on the return of eight Industry Group Index in the Stock Exchange of Thailand. The main objectives of this Study are to study the relationship between economic factors and each eight Industry Group Index include relationship between each eight Industry Group Index in the Stock Exchange of Thailand and examine on impacts of the economic factors on probability of returns of eight Industry Group Index in the Stock Exchange of Thailand. The data of this study using secondary data monthly period from January 2006 to December 2018, total for 156 months or 13 years by using Multivariate Probit Model (MVP). The variables used in the study consisted of independent variables (economic factors): yield 10 year, SET Index, Dow Jones Industrial Index, Currency Exchange Rate US Dollar to Thai Baht, Consumer Price Index, Business Sentiment Index and oil price index and the dependent variables (Industry Group Index): Agro & Food Industry, Consumer Products, Financials, Industrials, Property & Construction, Resources, Services and Technology. The findings show economic factors have impact on eight industry group index in difference way.

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CHAPTER 1

Introduction

1.1 The Rationale Background

Capital market is the meeting central of person who has the saving for giving to borrower or investors in a long run. Nowadays, capital market in Thailand is playing an increasingly important role. Due to Thailand has been developing and promoting investment in the money and capital markets from the government's policies, including private sector investment.

Capital market which is playing an important role and also be the largest market of Thailand that is Stock Exchange of Thailand (SET) was established by national economic and social development plans, it aims to support the economic and industrial development of the country and also encourages people with savings to invest in capital markets.

The Stock Exchange of Thailand (SET) has classified listed companies into industry groups and sectors so that companies in similar businesses are grouped together, making it easier for investors to compare listed companies and make prudent decisions. Generally, principles of classification are the classification system should clearly differentiate between various types of listed companies and be comparable to international industry classification standards and The definition of each industry group and sector should be flexible enough to allow for potential listed companies and new businesses. The eight groups are Agro & Food Industry, Consumer Products, Financials, Industrials, Property and Construction, Resources, Services and Technology.

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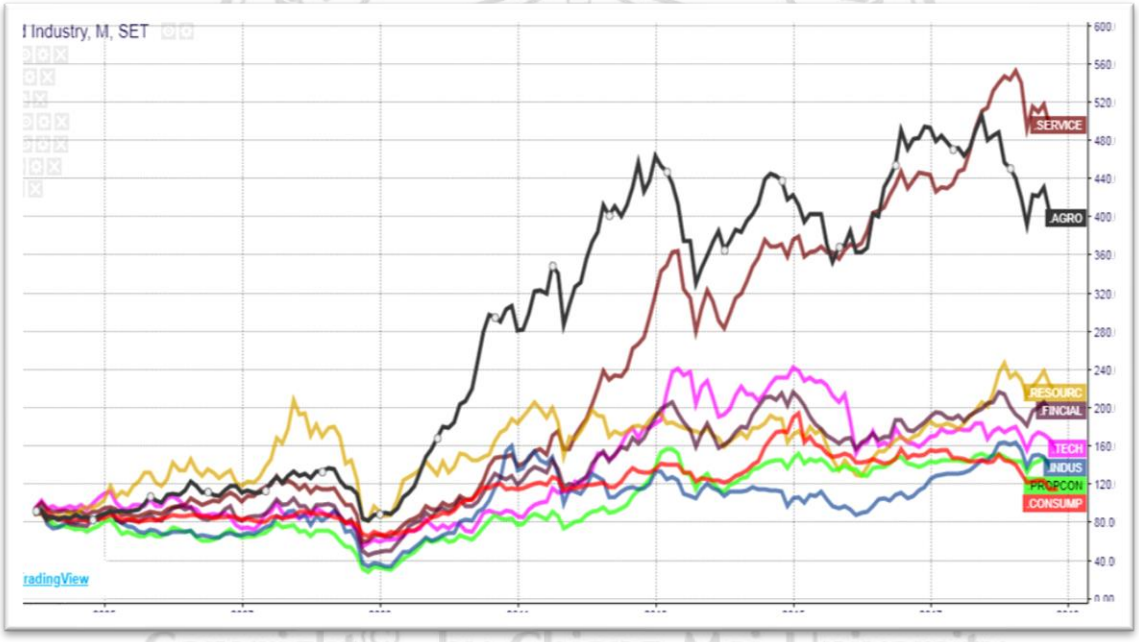
It is well known that the change in stock prices can be attributed to several factors. One of the factors that caused the price change is the effect of the movement of the company itself and external factors that we can't control. Economic factors is one of the factors as important to the change in stock prices because the economic mechanism

that drive various businesses and the changes in the economy, whether in better or worse, can also indirectly affect the psychology of securities investors.

The movement of the stock index has been affected by economic conditions both inside and outside the country, causing fluctuations in both prices and trading volume of securities. When economic conditions changed each industry has not changed in the same direction as the economy and each industry will not change at the same size. Securities in some industries may be slightly affected by the change of the economic conditions, while the securities in some industries may be heavily impacted by the changing economic conditions. Therefore, the analysis of securities it is necessary to analyze the economy to help in their decision what Industrial should invest. (Capital Market Development Institute, 2011)



Source: www.tiscoetrade.com (2018)

Figure 1: The change of Industry Group Index from January 2005 to 2018

This study will study relationship between economic factors and probability of rate of return of eight Industry Group Index in the Stock Exchange of Thailand. The Stock Exchange of Thailand (SET) has classified the industrial groups into eight groups as follows

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Table1: Industry groups on the Stock Exchange of Thailand

Industry Group Name	**Sector Name (En)**
Agro & Food Industry [AGRO]	Agribusiness
	Food & Beverage
Consumer Products [CONSUMP]	Fashion
	Home & Office Products
	Personal Products & Pharmaceuticals
Financials [FINCIAL]	Banking
	Finance & Securities
	Insurance
Industrials [INDUS]	Automotive
	Industrial Materials & Machinery
	Packaging
	Paper & Printing Materials
	Petrochemicals & Chemicals
	Steel
	Mining
Property&Construction [PROPCON]	Construction Materials
	Construction Services
	Property Development
	Property Fund & REITs

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Table1: Industry groups on the Stock Exchange of Thailand (continued)

Industry Group Name	**Sector Name (En)**
Resources [RESOURC]	Energy & Utilities
	Mining
Services [SERVICE]	Commerce
	Health Care Services
	Media & Publishing
	Professional Services
	Tourism & Leisure
	Transportation & Logistics
Technology [TECH]	Electronic Components
	Information & Communication Technology

Source: www.settrade.com (2018)

The industrial structure of the listed companies is organized so that similar companies are in the same category for a good way to make comparisons and to make investment decisions. The grouping approach can clearly reflect the type of business, and reflect the industry of Thailand. It also supports the type of business that the new business is expected to register in the future.

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Economic factors that are presented in everyday as news are information that the public has access to is sufficient or not for bringing to be a number of securities investment decisions. Therefore, this research aims to study the relationship of economic factors that people can find information easily to analyze their association with the eight groups of securities indexes to see how they are similar or different in each group, to help decide for speculators what industry should invest while, economic factors Change.

The SET Index is a Thai composite stock market index which is calculated from the price of all ordinary shares in the main board of the Stock Exchange of Thailand (SET), except for shares that have been suspended for more than one year. It is the weighted price index of market capitalization which compares the current market price of all registered ordinary shares with the value as of April 30, 1975, which is the period when the index was established and set at 100 points.

Source: www.settrade.com (2018)

Figure2: The SET Index from January 2005 to 2017.

Bond yields are another important factor affecting the stock market changes. Higher bond yields mean higher borrowing costs for both business and household sectors affecting the overall economic growth rate because according to the financial theory, interest or bond yield in the market is considered as one of the important variables that must be used in calculating the discount rate to be used to calculate the appropriate value of all types of financial assets allowing the appropriate value of assets to decrease.

Foreign factors have an impact either directly or indirectly to the Stock Exchange of Thailand. Because foreign factor foreign will affect the economy, society and politics in Thailand. War, change the government or the president of countries in the world, the global economic situation and financial institutions problems will reflect through the stock price index in foreign stock exchanges, such as Dow Jones Industrial

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index of United States. Foreign exchange rates directly affect on stock market of Thailand, when the value of the baht appreciation has resulted in rising Thailand stock market because foreign Want to invest in the stock market increased because they will have the opportunity to earn profit from High price. Also have the opportunity to profit from the value of the baht appreciation. And the important exchange rate used to study the relationship is Currency Exchange Rate US Dollar to Thai Baht because the United States It is a powerful country in the world. United States economic condition always has an impact on other countries including Thailand.

The Consumer Price Index (CPI) is the most widely used economic indicator. It is indicates the percent in the average prices of the market basket of goods and services. Since it shows the direction of prices, it is considered an indicator of inflation and one of the most important economic indicators. When CPI increases, it means more inflation or higher demand for goods and services than the expansion of existing goods and services. Demand for goods and services will be higher and prices are generally higher as well. Consequently, the CPI affects stock market trading include Industry Group Index of the Stock Exchange of Thailand. When there is more consumption. Some industry groups are affected more than others such as consumer products and services groups.

Oil Price Index was also studied in this research because in all industries, the oil industry is the industry that is the most relationship with many countries around the world. Because oil has a higher demand than other types of energy .S0, it has a role in human life and oil is used as a tool for economic and political bargaining. Since Thailand imports almost 100 percent of its oil from abroad, it is growing at an average annual rate of 5 percent per year, so oil prices have a direct impact on Thailand's economy and it also affects the stock market of Thailand as well. When prices change, Affecting to each industry groups not equal. Industry groups are affected more than others such as resources and industrials.

The Business Sentiment Index (BSI) is a one type of business indicator that can be used to warn of economy. The purpose is to prepare. It is a tool for both the public and private sectors to monitor overall business and economic conditions. So, the BSI shows the overall economy of the country and this affects the capital market. When BSI

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increases, it means the overall economy improved and the stock market also rises. If BSI impact to the Stock Exchange, that means impact Industry Index as well. This study would like to study. How does each group correlate to the change in BSI.

This thesis studies about the impact of Economic Factors on probability of returns of eight Industry Group Index in the Stock Exchange of Thailand by used a multivariate probit model. Although previous studies have studied about industrial indexes, such as studied economic and financial factors, which affected a security price index of a foods and beverages group (Krisakorn Tinwattnaporn 2009)but those researches often use multiple regressions to find the relationship and the results are different from the multivariate probit model. When economic factors change will cause the probability of the each Industry Group Index to increase and decrease and each Industry Group Index are not affected equally by the changing of economic factors, so the probability of each group was not the same. The results of the study are used as a guideline for agencies or individuals involved in planning economic development policies, to help make the decision to change the policy to suit the changing of economic situation and economic factors. In addition, the results can help every investor to invest, especially short-term investment or speculators know that, when the economic factors change which industry has the probability that the stock price will rise more than any other group. They adjust their investment proportion, move the investment into each group to be appropriate and profitable.

1.2 Purpose of the Study

1. To study the relationship between economic factors and eight Industry Group Index in the Stock Exchange of Thailand.

2. To study the correlation between each eight Industry Group Index in the Stock Exchange of Thailand.

3. To examine on impacts of the economic factors on probability of the returns of eight Industry Group Index in the Stock Exchange of Thailand.

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1.3 Advantage of the Study

The results of the study have three parts of benefit from this study as follows,
Investors can use the information obtained from this study help to make investment decisions and it is the basis for relevant research for those interested in the future.
The institute will know the result that, affects their industry and the indirect industry, help to make decisions to modification of business strategy under changing economic conditions. Finally the government brings information from this study to help adjust the appropriate policies under changing economic conditions.

1.4 Scope of the Study

This study aims to study the relationship between independent variables as a number and factor of Macroeconomics. By using 10 year Bond Yield (TH10Y), SET Index (SET), Dow Jones Industrial Index (DJI), Currency Exchange Rate US Dollar to Thai Baht (EXC), Consumer Price Index (CPI), Business Sentiment Index (BSI) and OPEC oil price index (OIL). It will be considered that the relationship with the Industry Group Index in the Stock Exchange of Thailand, according to the Stock Exchange, divided the industry into eight groups as mentioned above there are Agro & Food Industry, Consumer Products, Financials, Industrials, Property & Construction, Resources, Services and Technology. The data used in the study consisted of secondary data. The study was conducted monthly. In the period from January 2006 to December 2018, total for 13 years.

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CHAPTER 2

Theoretical background and literature review

2.1 Theoretical Background

2.1.1 Single-index model (SIM)

The single-index model (SIM) is a simple asset pricing model to measure both the risk and the return of a stock. The model has been developed by William Sharpe in 1963 and is commonly used in the finance industry. Mathematically the SIM is expressed as:

$$r_{it} - r_f = \propto_i + \beta_i(r_{mt} - r_f) + \epsilon_{it} \quad (2.1)$$

$$\epsilon_{it} \sim N(0, \sigma_i)$$

where , r_{it} is return to stock i in period t

r_f is the risk free rate

r_{mt} is the market portfolio's return in period t

$\propto_i$ is the stock's alpha, or abnormal return

β_i *is* the stocks's beta, or responding to market returns

Note that $r_{it} - r_f$ is called the excess return on the stock, $r_{mt} - r_f$ the excess return on the market

ϵ_{it} is the residual (random) returns, which are assumed independent normally distributed with mean zero and standard deviation σ_i

These equations show that the return on equity is influenced by the market (beta), with company-specific expectations (alpha) and unexpected components (residual). Each stock's performance is related to the performance of the market index. Security analysts often use SIM for functions such as stock calculations, assessment of stock selection skills, and conducting event studies.

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Assumptions of the single-index model

The single index model assumes that there is only one macroeconomic factor that creates a systematic risk that affects all stock returns and this factor can be expressed by the rate of return on the market index, such as the S&P 500.

According to this model, the return of any stock can be divided into the expected surplus of each stock due to the specific factors the company will generally show with the alpha coefficient (α), the returns due to macroeconomic events that affect the market and unexpected microeconomic events that affect the firm only. The term $\beta_i(r_m - r_f)$ represents the movement of the market, adjusted by the beta of stock, while ϵ_i represents the Non-system risk of security due to specific factors of firm. Macroeconomic events, such as changes in interest rates or labor costs, create a systematic risk that affects the return of all stocks, and the firm-specific events are an unexpected microeconomic event that affects the return of a specific company, such as the death of an important person or reducing the credit rating of the company which will affect the company but will have a slight impact on the economy. In the non-systematic risk portfolio, due to the specific factors of the company can be reduced to zero by diversifying investments.

The index model is based on the following:

1) Most stocks have positive variances because they respond similarly to macroeconomic factors.

2) However, some companies are more sensitive to these factors than other companies, and this company-specific variance is represented by beta (β) which measures variance compared to the market for at least one economic factor

3) Covariance between the results of securities from responses to different macroeconomic factors Therefore, the covariance of each stock can be found by multiplying their betas and the market variance:

The single index model assumes that when the market returns are removed, the remaining returns will not be compared:

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$$E\left(\left(R_{i,t}-\beta_i m_t\right)\left(R_{k,t}-\beta_k m_t\right)\right)=0, \tag{2.2}$$

where, $Cov(R_i, R_k) = \beta_i \beta_k \sigma^2$

This is not really true, but it provides a simple model. A more detailed model would have multiple risk factors. This will require more calculations but still less than calculating the covariance of possible securities in each portfolio. With this equation, there must be an assessment of the reliability of each securities and market variance in calculating covariance. Hence, the index model greatly reduces the number of calculations that would otherwise have to be made to model a large portfolio of thousands of securities.

The single index model of the previous section has been extended to many index models in various ways. For example, the popular parameter model for data with multiple response variables (Represents more than two individual options) is a multi-index index format. In the Multinomial Logit model the return of asset i is given by

$$R_i = a_i^* + b_{i1}^* l_1^* + \cdots + b_{iL}^* l_L^* + \epsilon_i^* \tag{2.3}$$

where, $l_1^*$is the actual value of index l.

In principle, l_1^* are correlated. We can get rid of the correlation using an orthogonalization technique, e.g., principal component.

$$R_i = a_i + b_{i1} l_1 \ldots + b_{iL} l_L + \epsilon_i \tag{2.4}$$

where, $l_1$is the uncorrelated or orthogonalized value of index l.

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2.1.2 Multi-Factor Model

A multi-factor model is a financial model that uses many factors to calculate the phenomenon of the market and / or the price of a balanced asset Multiple factors can be used to describe personal safety or securities. It is so by comparing two or more factors in analyzing the relationship between the variables and the resulting performance.

Multi-factor models are use to create portfolios that have certain characteristics such as risks or to track the index. When creating a multi-factor model, it is difficult to decide how much to combine and what factors. In addition, the model is based on historical figures that may not be able to accurately predict future values.

Multi-factor models can be divided into three categories: macroeconomic models, fundamental models and statistical models. Macroeconomic models compare the returns of securities with factors such as employment, inflation and interest. Fundamental models analyze the relationship between he returns of basic and financial securities such as income. Statistical models are used to compare the returns of different securities depending on the statistical performance of securities.

Beta of security, systematic risk measurement of security related to the overall market. The beta value of 1 indicates that theoretical security is volatile at the same level as the market and is moving in tandem with the market beta eta greater than 1 means that security is more theoretical volatility in the market. On the other hand, beta less than 1 means that security is less volatile than theoretically. Factors are compared using the following formula:

$$R_i = a_i + \beta_{im}^* R_m + \beta_{i1}^* F_1 + \beta_{i2}^* F_2 + \cdots + \beta_{in}^* F_n + \epsilon_i \qquad (2.5)$$

where,R_i is the return of security i

$R_m$is the market return

$F_{(1,2,3,..,n)}$is is each of the factors used

$\beta_i^*$is he beta with respect to each factor including the market (m)

$\epsilon_i$is the error term

$a_i$isthe intercept

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2.1.3 Arbitrage pricing theory - APT

In finance, arbitrage pricing theory (APT) is a general theory of asset pricing that holds that the expected return of a financial asset can be modeled as a linear function of various factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient. The model-derived rate of return will then be used to price the asset correctly—the asset price should equal the

expected end of period price discounted at the rate implied by the model. If the price diverges, arbitrage should bring it back into line. The theory was proposed by the economist Stephen Ross in 1976.

Risky asset returns are said to follow a factor intensity structure if they can be expressed as:

$$r_j = a_j + b_{j1}F_1 + b_{j2}F_2 + \cdots + b_{jn}F_n + \varepsilon_j \quad (2.6)$$

where, a_j is a constant for asset

F_n is a systematic factor

b_{jn} is the sensitivity of the j asset to factor n

ε_j is the risky asset's idiosyncratic random shock with mean zero.

Idiosyncratic shocks are assumed to be uncorrelated across assets and uncorrelated with the factors.

The APT states that if asset returns follow a factor structure then the following relation exists between expected returns and the factor sensitivities:

$$E(r_i) = r_f + b_{j1}Rp_1 + \cdots + b_{jn}RP_n \quad (2.7)$$

where, RP_n is the risk premium of the factor,

r_f is the risk-free rate,

That is, the expected return of an asset j is a linear function of the asset's sensitivities to the n factors. Note that there are some assumptions and requirements that have to be fulfilled for the latter to be correct: There must be perfect competition in the market, and the total number of factors may never surpass the total number of assets (in order to avoid the problem of matrix singularity).

2.1.4 Fundamental Analysis

Fundamental analysis is a method of assessing safety in an attempt to assess real value by examining economic, financial and other quality related factors. Basic analysts study what might affect the safety value, including macroeconomic factors. (Such as economic and industrial conditions) and microeconomic factors (Such as

financial and management conditions).The final goal of basic analysis is to create a quantitative value that investors can compare to the current price of the securities, which indicates that the security is too low or overestimated. Fundamental analysis defines the health and performance of reference companies by looking at important numbers and economic indicators. The purpose is to identify companies or industries that are fundamentally strong and basic companies or industries. Long-term investor (Buy with the expectation that the stock will have higher value) for companies that are strong and short. (Selling stocks that you believe will be reduced by value with the expectation of buying back at a lower price) is weak. This safety analysis method is the opposite of technical analysis that predicts the direction of Price through historical market data analysis such as price and quantity. Fundamental analysis uses real public information to evaluate the value of securities. Although most analysts use basic analysis to evaluate stock values but this valuation method can be used for any type of security For example, investors can make fundamental analysis of the value of debt instruments based on economic factors such as interest rates and the overall state of the economy. He can also view information about issuers, such as credit rating changes.

2.2 Literature Review

Chaiphat Lertjaruchokekhajorn (2008) Studied factors that affected a security price index of a services group with an objective to study the variables, which influenced the security price index of the services group by using the secondary data according to monthly time series from December 2004 to April 2008.The results of study were found that factors that could significantly explain changing of the security price index of the services group were the Securities Exchange of Thailand (SET) Index, the Thai Baht to U.S. Dollar exchange rate and the Dow Jones Index.

Suvasi Suwannavej (2009) studied the fundamental economic factors that affected the security price index of an energy group by using economic factors such as a consumer price index, the Thai Baht to U.S. Dollar exchange rate, the Hong Kong Stock Exchange Index, the Securities Exchange of Thailand (SET) Index and the West Texas's crude oil price at New York market by using the monthly secondary data from January 2005 to December 2007 and analyzing by Multiple Regression Analysis with the Ordinary Least Square (OLS) method. The results of study were found that the

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Securities Exchange of Thailand (SET) Index, the Thai Baht to U.S. Dollar exchange rate, the Hong Kong Stock Exchange Index and the crude oil price statistical significantly correlated to the security price index of the energy group in the same direction with a confidence interval at 99%, and the consumer price index statistical significantly correlated to the security price index of the energy group in the same direction with a confidence interval at 90%.

Krisakorn Tinwattnaporn (2009) studied economic and financial factors, which affected a security price index of a foods and beverages group by using economic and financial variables such as the Securities Exchange of Thailand (SET) Index, an inflation rate, a 12 months deposit interest rate, a private sector investment index, foreign currency exchange rates and quantities of foods and beverages exports with the monthly secondary data from September 2004 to August 2009, for 60 months, and then analyzing by Multiple Linear Regression analysis. The results of study were found that the economic and financial factors that affected the security price index of the foods and beverages group were the percentage of change in the Securities Exchange of Thailand (SET) Index and the inflation rate. These two variables could significantly explain change in the security price index of the foods and beverages group at a confidence interval of 95% in the same and reverse directions respectively. However, the variables of 12 months deposit interest rate, the private sector investment index, the foreign currency exchange rates, and the quantities of foods and beverages exports did not significantly affect the security price index of the foods and beverages group with a confidence interval at 95%.

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Varisara Wattanalikhit (2009) studied factors that affected change of a security price index in a construction materials group by using the secondary data according to time series from March 2001 to June 2009, for 100 months and studying eight factors i.e. an average of prime interest rates of 5 commercial banks, an inflation rate, a changing rate of Thai Baht to U.S. Dollar exchange rate, a changing rate of Gross Domestic Product (GDP), a changing rate of private sector investment index, a changing rate of security price index in construction materials group, a changing rate in real estate loan, and a changing rate of value of security trading. This study was a quantitative data analysis and testing the correlation of variables by using Multiple

Regression Analysis technic. The results of study were found that the factors that significantly affected the changing of the security price index in the construction materials group and in the same direction were the inflation rate, the changing rate of the construction materials price index and the changing rate of the value of security trading. However, the changing rate of the Thai Baht to U.S. Dollar exchange ratereversely correlated to the changing of the security price index in the construction materials group. The independent variables that did not affect the changing of the security price index in the construction materials group were the average of prime interest rates of 5 commercial banks, the changing rate of Gross Domestic Product (GDP), the changing rate of private sector investment index and the changing rate in the real estate loan.

Suvapitch Banluerit (2011) studied economic factors that affected a security price index of a commercial banks group in the Securities Exchange of Thailand (SET) by studying independent variables such as a consumer price index, a prime interest rate of fixed time loan, a minimum interest rate of overdraft, a minimum retail interest rate, an inflation rate, the Thai Baht to U.S. Dollar exchange rate, and a 3 months deposit interest rate, then using monthly secondary data from January 2002 to December 2011, for 10 years or 120 months, and analyzing by econometric method with equation construction in a form of Multiple Regression equation and evaluating with the Least Square method by variables entering according to an All Enter method. The results of study were found that the independent and dependent variables correlated with the level of significance at 0.05. The domestic consumer price index, the prime interest rate of fixed time loan, the minimum interest rate of overdraft and the Thai Baht to U.S. Dollar exchange ratereversely affected the security price index of the commercial banks group in the Securities Exchange of Thailand (SET), while the inflation rate and the minimum retail interest rate affected the security price index of the commercial banks group in the Securities Exchange of Thailand (SET) in the same direction but the 3 months deposit interest rate did not affect the security price index of the commercial banks group in the Securities Exchange of Thailand (SET).

Satirat Choensombat (2013) studied the factors that affected a security price index of a real estate & construction industries group with the independent variables

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such as the Securities Exchange of Thailand (SET) Index, an economic confidence index, the Dow Jones Index, a prime interest rate and an inflation rate, while the dependent variables was the security price index of the real estate &construction industries group. This study used the monthly secondary data from January 2008 to December 2012, for 60 months and analyzing by Multiple Linear Regression with Ordinary Least Square (OLS) method. The results of study were found that with the level of significanceat0.05, the independent variable or the factor that affected the security price index of the real estate & construction industries group was the Securities Exchange of Thailand (SET) Index, which statistical significantly correlated in the same direction. The factors that did not affect the security price index of the real estate &construction industries group were the economic confidence index, the Dow Jones Index, the prime interest rate and the inflation rate.

Thunsita Lertsaravit (2013) studied the factors that affected security price index of petrochemicals and chemicals such as a crude oil price in the world market, the Japan Stock Exchange Index, the Thai Baht Value Index, a prime interest rate, and a net security trading value of the foreign investors, by using the monthly secondary data from January 2008 to December 2012, for 60 months and analyzing by Multiple Linear Regression technic with the Ordinary Least Square (OLS) method. The results of study were found that with the level of significance at 0.05, the economic factors that affected the security price index of the petrochemicals and chemicals group were the crude oil price in the world market, the Japan Stock Exchange Index and the Thai Baht Value Index. These factors statistical significantly correlated to the security price index of the petrochemicals and chemicals group in the same direction but the prime interest rate and the net security trading value of the foreign investors did not affect the security price index of this group.

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Suchanya Sajjawong-ratsami (2013) studied the economic factors that affected the security price index of an agro business group in the Securities Exchange of Thailand (SET) by considering of a crude oil price, the Dow Jones Industries Index, the Thai Baht to U.S. Dollar exchange rate and a palm oil price by using the monthly secondary data from January 2008 to December 2012, for 60 months, then analyzing with the hypothesis testing application package using Multiple Linear regression with

the Ordinary Least Square (OLS) method. The results of study were found that with the level of significance at 0.05, the factors that affected the security price index of the agro business group was the Dow Jones Industries Index and correlated in the same direction but the Thai Baht to U.S. Dollar exchange rate was reversely correlated with that security price index, while the crude oil price and the palm oil price did not affect the security price index of the agro business group.

Pongpan Danwattanakul (2013) studied the factors that affected the security price index of a services industry group by considering an inflation rate, a consumer price index, the Dow Jones Industries Index, the Thai Baht to U.S. Dollar exchange rate and a 12 months deposit interest rate by using the monthly secondary data from January 2008 to December 2012, for 60 months, then analyzing with the hypothesis testing application package using Multiple Linear regression with Ordinary Least Square (OLS) method. The results of study were found that with the level of significance at 0.05, the factors that affected the security price index of the services industry group were the Dow Jones Industries Index, which correlated in the same direction and the Thai Baht to U.S. Dollar exchange rate, which correlated in the reverse direction. The factors that did not affect the security price index of the services industry group were the inflation rate, the consumer price index and the 12 months deposit interest rate.

Sivarak Sangvirasiri (2015) studied the economic factors that affected security price indexes of industries groups in the Securities Exchange of Thailand (SET) by using the monthly secondary data of the independent variable factors and eight security price indexes of eight industries groups which were treated as dependent variables, from January 2011 to December 2013, for 36 months and analyzing by descriptive statistics, correlation analysis and multiple regression analysis. The results of study were found that at the confidence interval of 95%, the net quantity of securities investment of the foreign investors, the Thai Baht to U.S. Dollar exchange rate, the inflation rate, the prime interest rate and the consumer price index correlated to the security price index of the industries groups from the highest to the lowest levels respectively. Moreover, the economic confidence index did not correlate to the security price indexes of the industries groups.

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CHAPTER 3

Data and Methodology

3.2 Data

The study of the relationship between economic factors and the return of eight Industry Group Index in the Stock Exchange of Thailand using multivariate probit model. Researchers have collected secondary data monthly period from January 2006 to December 2018, total for 156 months or 13 years , Industry Group index , 10 Year Bond Yield, SET Index, Dow Jones Industrial Index, Currency Exchange Rate US Dollar to Thai Baht, Consumer Price Index, Business Sentiment Index and OPEC Oil Price Index. Data were collected from various sources following.

1. The Stock Exchange of Thailand: Industry Group Index and SET Index (SET)

2. Bank of Thailand: Business Sentiment Index (BSI), 10 Year Bond Yield (TH10Y), currency exchange rate US Dollar to Thai Baht (EXC) and Dow Jones Industrial Index (DJI)

3. Ministry of Commerce: Consumer Price Index (CPI

4. www.indexmundi.com: OPEC Oil Price Index (OIL)

3.1 Conceptual Framework

Independent research on the relationship between economic factors and rate of return of Industry Group Index in the Stock Exchange of Thailand using multivariate probit model, where the dependent (Industry Group Index) is binary data and would be to allow more than one equation. Determine that Industry Group Index = 1 if the Industry Group Index at time increase (t > t-1), 0 otherwise, due to focused on the change of the Industry Index that increase or decrease compare with time t-1.

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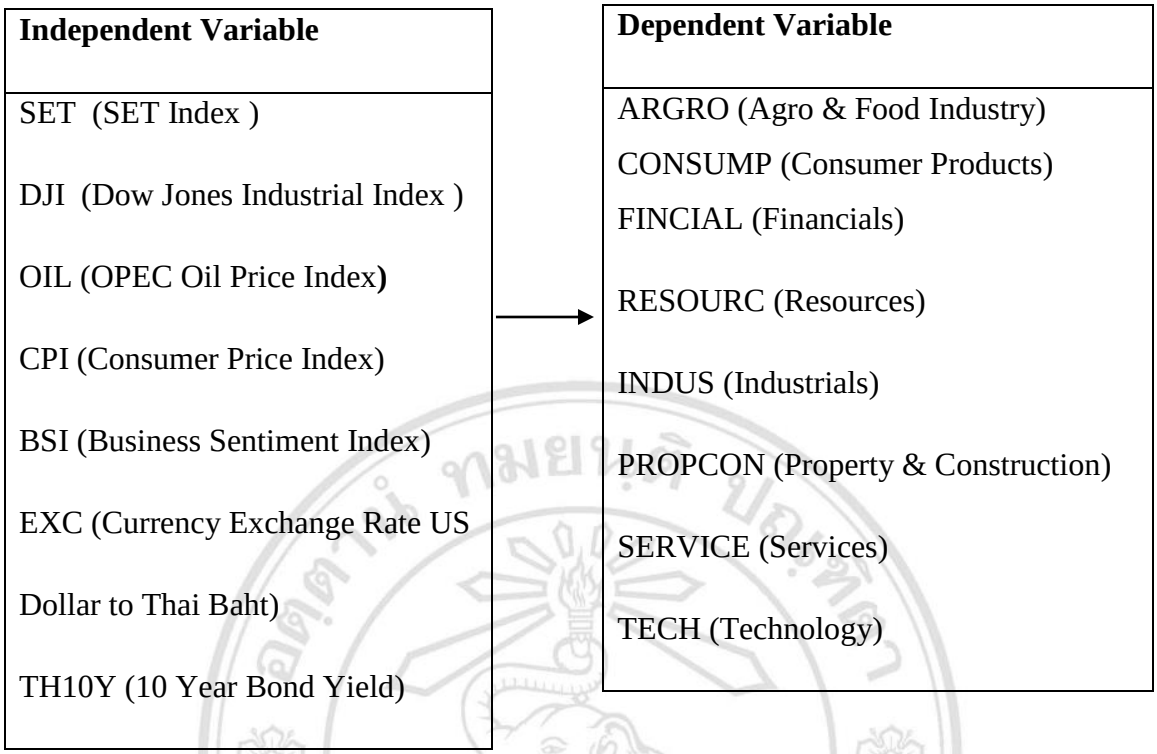

3.2 Research assumption

The period studies show the relationship between Economic Factors and the Rate of returns of eight Industry Group Index in the Stock Exchange of Thailand, their studies will be generate an assumption.

Agro & Food Industry (ARGRO) Krisakorn Tinwattnaporn , 2009 were found that the economic and financial factors that affected the security price index of the foods and beverages group were the percentage of change in the Securities Exchange of Thailand (SET) Index and the inflation rate. These two variables could significantly explain change in the security price index of the foods and beverages group. However, the variables of 12 months deposit interest rate, the private sector investment index and the foreign currency exchange rates did not significantly affect the security price index of the foods and beverages group .

Financials (FINCIAL)Suvapitch Banluerit ,2011 were found that the independent and dependent variables correlated with the level of significance at 0.05. The domestic consumer price index, the prime interest rate of fixed time loan, the minimum interest rate of overdraft and the Thai Baht to U.S. Dollar exchange rate reversely affected the

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security price index of the commercial banks group, but the 3 months deposit interest rate did not affect the security price index of the commercial banks group

Industrials (INDUS)Suvasi Suwannavej ,2009 were found that Securities Exchange of Thailand (SET) Index, the Thai Baht to U.S. Dollar exchange rate and the crude oil price statistical significantly correlated to the security price index of the industrials group in the same direction and the consumer price index statistical significantly correlated to the security price index of the industrials group in the same direction.

Property & Construction (PROPCON)Satirat Choensombat, 2013 were found that with the level of significanceat 0.05, the independent variable or the factor that affected the security price index of the real estate & construction industries group was the Securities Exchange of Thailand (SET) Index, which statistical significantly correlated in the same direction. The factors that did not affect the security price index of the real estate &construction industries group were the economic confidence index, the Dow Jones Index, the prime interest rate and the inflation rate.

Services (SERVICE)Chaiphat Lertjaruchokekhajorn ,2008 were found that factors that could significantly explain changing of the security price index of the services group were the Securities Exchange of Thailand (SET) Index, the Thai Baht to U.S. Dollar exchange rate and the Dow Jones Index.

Table 3: Research Assumption

Variables	TH10Y	SET	DJIA	EXC	CPI	BSI	OIL
ARGRO	-	+	+	-	+	-	+
CONSUMP	-	+	-	-	+	-	+
FINCIAL	+	+	-	+	-	+	-
INDUS	-	+	-	+	+	-	+
PROPCON	+	+	-	+	+	+	-
RESOURC	-	+	-	+	+	+	+
SERVICE	-	+	+	+	+	+	-
TECH	-	+	+	+	+	+	-

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Table 3: Variables detail

Notation	**Variables name**	**Definition**	**Data Source**
AGRO	Agro & Food Industry	Businesses relating to farming, forestation, livestock, processing agricultural products, and food and beverage production	Stock Exchange of Thailand
CONSUMP	Consumer Products	Businesses relating to the production and distribution of consumer products, both necessity and luxury goods.	Stock Exchange of Thailand
FINCIAL	Financials	Industries relating to different types of financial service providers	Stock Exchange of Thailand
INDUS	Industrials	Business relating to the production and distribution of general raw materials used in various industries, primary and intermediate products, machines and equipment used in production industry and the automotive industry.	Stock Exchange of Thailand
PROPCON	Property & Construction	Industries relating to the producers of construction material, the developers and managers of real estates, as well as the construction and engineering services.	Stock Exchange of Thailand
RESOURC	Resources	Businesses relating sourcing and managing the resources such as production and allocation of energy and mining.	Stock Exchange of Thailand

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Table 3: Variables detail (continued)

Notation	Variables name	Definition	Data Source
SERVICE	Services	Businesses in the service industry, except financial service and IT as they are classified in different groups.	Stock Exchange of Thailand
TECH	Technology	Businesses relating to IT products, including all primary, intermediate and final products, and the providers of IT and telecommunication services.	Stock Exchange of Thailand
TH10Y	10 year Bond Yield	The returns that investors will receive from the government when holding the bonds until the maturity of 10 years	Stock Exchange of Thailand
SET	SET Index	Thai composite stock market index which is calculated from the prices of all common stocks of the Stock Exchange of Thailand	Stock Exchange of Thailand
DJI	Dow Jones Industrial	a price-weighted average of 30 significant stocks traded on the New York Stock Exchange	Stock Exchange of Thailand
EXC	Exchange Rate USD to THAI	Exchange Rate US Dollar to Thai Baht	Bank of Thailand
CPI	Consumer Price Index	a measure that examines the weighted average of prices of a basket of consumer goods and services	Bank of Thailand

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Table 3 : Variables detail(continued)

Notation	Variables name	Definition	Data Source
BSI	Business Sentiment Index	The numbers reflect business sentiment over a period of time.	Bank of Thailand
OIL	OPEC Oil Price Index	The average crude oil price index, Brent, West Texas Inter and Dudai Fatheh	www.indexmundi .com

Source:www.settrade.com(2018)

3.3 Model Specification

The multivariate probit model to an analysis of the rate of returns of eight Industry Group Index in the Stock Exchange of Thailand 13 years, 2006-2018, in response to economic factors.

$$Prob(Y_{i1} = 1, Y_{i2} = 1, \dots, Y_{i8} = 1 | \boldsymbol{x}_1, \boldsymbol{x}_2, \dots, \boldsymbol{x}_7) = \Phi_8(w_{i1}, w_{i2}, .. w_{i8}, \rho_{i^*}) \quad (3.1)$$

which accounts for all the necessary sign changes needed to compute probabilities for y equal to zero and one. Thus,

$$\ln L = \sum_{i=1}^{n} ln\ \Phi_8(w_{i1}, w_{i2}, .. w_{i8}, \rho_{i^*}) \quad (3.2)$$

where, Φ_8 is The cdf $\Phi_8 = \Phi_2(w_{i1})\ \Phi_2(w_{i2}),\dots,\ \Phi_8(w_{i8})$

$w_{ij} = q_{ij} z_{ij}$, and $\rho_{i^*} = q_{i1} q_{i2}, .., q_{i8}\rho$

let $q_{ij} = 2y_{ij} - 1$ and Thus, $q_{ij} = 1$ if $y_{ij} = 1$ and -1 if $y_{ij} = 0$ for j =1,2,..,8 and $z_{ij} = x'_{ij}\beta_i$

$y_{ij} =$ 1 if the Industry Group Index at time t > t-1 , 0 otherwise,

y_{i1} = Agro & Food Industry (ARGRO)

y_{i2} = Consumer Products (CONSUMP)

y_{i3} = Financials (FINCIAL)

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y_{i4} = Resources (RESOURC)

y_{i5} = Industrials (INDUS)

y_{i6} = Property & Construction (PROPCON)

y_{i7} = Services (SERVICE)

y_{i8} = Technology (TECH)

x_i is independent variable that can affect the Industrial Group Index.

x_1 = SET Index (SET)

x_2 = Dow Jones Industrial Index (DJI)

x_3 = OPEC Oil price Index (OIL)

x_4 = Consumer Price Index (CPI)

x_5 = Business Sentiment Index (BSI)

x_6 = Currency Exchange Rate US Dollar to Thai Baht (EXC)

x_7 = 10 Year Bond Yield (TH10Y)

3.4 Methodologies

Estimation and Inference in Probit Models

So far nothing has been said about how Probit models are estimated by statistical software. The reason why this is interesting is that models is nonlinear in the parameters and thus cannot be estimated using OLS. Instead one relies on maximum likelihood estimation (MLE). Another approach is estimation by nonlinear least squares (NLS).

1. Nonlinear Least Squares (NLS)

Consider the multiple regression Probit model

$$E(y_i|x_{1i}, \dots, x_{ki}) = P((y_i = 1|x_{1i}, \dots, x_{ki}) = \Phi(\beta_0 + \beta_1 x_1 + \cdots + \beta_k x_{ki}) \quad (3.3)$$

Similarly to OLS, NLS estimates the parameters $\beta 0, \beta 1, \dots, \beta k$ by minimizing the sum of squared mistakes

$$\sum_{i=1}^{n}[y_i - \Phi(\beta_0 + \beta_1 x_1 + \cdots + \beta_k x_{ki})]^2. \quad (3.4)$$

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NLS estimation is a consistent approach that produces estimates which are normally distributed in large samples. In R there are functions like nls() from package stats which provide algorithms for solving nonlinear least squares problems.

2. Maximum Likelihood Estimation (MLE)

In MLE we seek to estimate the unknown parameters choosing them such that the likelihood of drawing the sample observed is maximized. This probability is measured by means of the likelihood function, the joint probability distribution of the data treated as a function of the unknown parameters. Put differently, the maximum likelihood estimates of the unknown parameters are the values that result in a model which is most likely to produce the data observed. It turns out that MLE is more efficient than NLS.

As maximum likelihood estimates are normally distributed in large samples, statistical inference for coefficients in nonlinear models like Logit and Probit regression can be made using the same tools that are used for linear regression models, we can compute t-statistics and confidence intervals.

The Multivariate Probit Model

In principle, a Multivariate Probit Model would simply extend Bivariate Probit Model to more than two outcome variables just by adding equations. Therefore this thesis will explain the research methodologies in the form of the Bivariate Probit Model to understand more easily and simplify equation.

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A natural extension of the probit model would be to allow more than one equation, with correlated disturbances, in the same spirit as the seemingly unrelated regressions model. The general specification for a two-equation model would be

$$
\begin{aligned}
y_1^* &= x_1'\beta_1 + \varepsilon_1, \qquad y_1 = 1 \quad if \;\; y_1^* > 0, 0 \; otherwise, \\
y_1^* &= x_2'\beta_2 + \varepsilon_2, \qquad y_2 = 1 \quad if \;\; y_2^* > 0, 0 \; otherwise, \\
E[\varepsilon_1 | x_1 x_2] &= E[\varepsilon_2 | x_1 x_2] = 0, \\
Var[\varepsilon_1 | x_1 x_2] &= Var[\varepsilon_2 | x_1 x_2] = 1,
\end{aligned}
\tag{3.5}
$$

$$Cov[\varepsilon_1, \varepsilon_2 | x_1 x_2] = \rho.$$

Maximum likelihood Estimation

The bivariate normal cdf is

$$Prob(X_1 < x_1, X_2 < x_2) = \int_{-\infty}^{x_2} \int_{-\infty}^{x_1} \phi_2(z_1, z_2, \rho) dz_1 d\, z_2, \tag{3.6}$$

which denote $\Phi_2(z_1, z_2, \rho)$ the density is

$$\phi_2(z_1, z_2, \rho) = \frac{e^{-(1/2)(x_1^2 + x_2^2 - 2\rho x_1 x_2)/(1-\rho^2)}}{2\pi(1-\rho^2)^{1/2}} \tag{3.7}$$

To construct the log-likelihood, let $q_{i1} = 2y_{i1} - 1$ and $q_{i2} = 2y_{i2} - 1$. Thus,$q_{ij} = 1$ if $y_{ij} = 1$ and-1 if $y_{ij} = 0$ for j =1 and 2. Now let $z_{ij} = x'_{ij}\beta_i$ and $w_{ij} = q_{ij} z_{ij}$, $j = 1,2,$ and $\rho_{i^*} = q_i 1 q_{i2} \rho$.

Note the notational convention. The subscript 2 is used to indicate the bivariate normal distribution in the density ϕ_2 and cdf Φ_2. In all other cases, the subscript 2 indicates the variables in the second equation. As before, ø (.)and Φ(.)without subscripts denote the univariate standard normal density and cdf.

The probabilities that enter the likelihood function are

$$Prob(Y_1 = y_{i1}, Y_2 = y_{i2} | x_1, x_2) = \Phi_2(w_{i1}, w_{i2}, \rho_{1^*}), \tag{3.8}$$

which accounts for all the necessary sign changes needed to compute probabilities for y's equal to zero and one. Thus,

$$\ln L = \sum_{i=1}^{n} ln\ \Phi_2(w_{i1}, w_{i2}, \rho_{i^*}). \tag{3.9}$$

The derivatives of the log-likelihood then reduce to

$$\frac{\partial ln\, L}{\partial \beta_j} = \sum_{i=1}^{n} \left(\frac{q_{ij} g_{ij}}{\Phi_2}\right) x_{ij} \quad j = 1,2, \tag{3.10}$$

$$\frac{\partial ln\, L}{\partial \rho} = \sum_{i=1}^{n} \frac{q_{i1} q_{i2} \phi_2}{\Phi_2}, \tag{3.11}$$

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$$g_{i1} = \phi(w_{i1})\Phi\left[\frac{w_{i2}-\rho_{i^*}w_{i1}}{\sqrt{1-\rho_{i^*}^2}}\right] \tag{3.12}$$

and the subscripts 1 and 2 in g_{i1} are reversed to obtain g_{i2}. Before considering the Hessian, it is useful to note what becomes of the preceding if $\rho = 0$. For $\partial lnL/\partial\beta_1, if\rho = \rho_{i^*} = 0$, thengi1reduces $\phi(w_{i1})\Phi(w_{i2})$, ϕ_2Some simplifications are useful. Letand $\Phi_2$is $\Phi_2(w_{i1})\,\Phi_2(w_{i2})$. Because both func-tions in $\partial lnL/\partial\rho$ factor into the product of the univariate functions, $\partial lnL/\partial\rho$ ρreduces to $\sum_{i=1}^{n}\lambda_{i1}\lambda_{i2}$ where λ_{ij} j =1,2,

The maximum likelihood estimates are obtained by simultaneously setting the three derivatives to zero. The second derivatives are relatively straightforward but tedious.Some simplifications are useful. Let

$$\delta_i = \frac{1}{\sqrt{1-\rho_{i^*}^2}},$$

$$v_{i1} = \delta_i(w_{i2} - \rho_{i^*}w_{i1}), \qquad so\ g_{i1} = \phi(w_{i1})\Phi(v_{i1}),$$

$$v_{i2} = \delta_i(w_{i2} - \rho_{i^*}w_{i2}), \qquad so\ g_{i2} = \phi(w_{i2})\Phi(v_{i2}).$$

By multiplying it out, you can show that

$$\delta_i\phi(w_{i1})\phi(v_{i1}) = \delta_i\phi(w_{i2})\phi(v_{i2}) = \phi_2.$$

$$\frac{\partial^2 logL}{\partial\beta_1\partial\beta_1'} = \sum_{i-1}^{n} x_{i1}x_{i1}'\left[\frac{-w_{i1}g_{i1}'}{\Phi_2} - \frac{\rho_{i^*}\phi_2}{\Phi_2} - \frac{g_{i1}^2}{\Phi_2^2}\right]$$

$$\frac{\partial^2 logL}{\partial\beta_1\partial\beta_2'} = \sum_{i-1}^{n} q_{i1}q_{i2}x_{i1}x_{i2}'\left[\frac{\phi_2}{\Phi_2} - \frac{g_{i1}g_{i2}}{\Phi_2^2}\right], \tag{3.13}$$

$$\frac{\partial^2 logL}{\partial\beta_1\partial\rho} = \sum_{i-1}^{n} q_{i2}x_{i1}\frac{\phi_2}{\Phi_2}\left[\rho_{i^*}\delta_i v_{i1} - w_{i1} - \frac{g_{i1}}{\Phi_2}\right],$$

$$\frac{\partial^2 logL}{\partial\rho^2} = \sum_{i-1}^{n}\frac{\phi_2}{\Phi_2}\left[\delta_i^2\rho_{i^*}(1 - w_i'R_i^{-1}w_i) + \delta_i^2 w_{i1}w_{i2} - \frac{\phi_2}{\Phi_2}\right],$$

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where $w_i' R_i^{-1} w_i = \delta_i^2 (w_{i1}^2 + w_{i2}^2 - 2\rho_{i^*} w_{i1} w_{i2})$. (For β_2, change the subscripts in $\partial^2 lnL / \partial\beta_1 \partial\beta_1'$ and $\partial^2 lnL / \partial\beta_1 \partial\rho$ accordingly.) The complexity of the second derivatives for this model makes it an excellent candidate for the Berndt et al. estimator of the variance matrix of the maximum likelihood estimator.

Testing correlation

The Lagrange multiplier statistic is a convenient device for testing for the absence of correlation in this model. Under the null hypothesis that ρ equals zero, the model consists of independent probit equations, which can be estimated separately. Moreover, in the multivariate model, all the bivariate (or multivariate) densities and probabilities factor into the products of the marginals if the correlations are zero, which makes construction of the test statistic a simple matter of manipulating the results of the

Independent probits. The Lagrange multiplier statistic for testing $H_0: \rho = 0$ in a bivariate probit model is

$$LM = \frac{\left[\sum_{i=1}^{n} q_{i1} q_{i2} \frac{\phi(w_{i1})\phi(w_{i2})}{\Phi(w_{i1})(\Phi w_{i2})}\right]^2}{\sum_{i-1}^{n} \frac{[\phi(w_{i1})\phi(w_{i2})]^2}{\Phi(w_{i1})\Phi(-w_{i1})\Phi(w_{i2})\Phi(-w_{i2})}}. \quad (3.14)$$

As usual, the advantage of the LM statistic is that it obviates computing the bivariateprobit model. But the full unrestricted model is now fairly common in commercial soft-ware, so that advantage is minor. The likelihood ratio or Wald test can often be used with equal ease. To carry out the likelihood ratio test, we note first that if ρ equals zero, then the bivariate probit model becomes two independent univariate probits models. The log-likelihood in that case would simply be the sum of the two separate log-likelihoods. The test statistic would be

$$\lambda_{LR} = 2[\ln L_{BIVARIATE} - (ln\, L_1 + \ln L_2)].$$

This would converge to a chi-squared variable with one degree of freedom. The Wald test is carried out by referring

$$\lambda_{WARLD} = \left[\frac{\hat{\rho}_{MLE}}{\sqrt{Est.Asy.\ Var[\hat{\rho}_{MLE}]}}\right]^2 \quad (3.15)$$

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Estimate Marginal effects

There are several "marginal effects" one might want to evaluate in a bivariate probit model. A natural first step would be the derivatives of $Prob[y_1 = 1, y_2 = 1|x_1, x_2]$. These can be deduced from (17) by multiplying by Φ_2, removing the sign carrier, $q_{ij}$and differentiating with respect to x_j rather than β_j. The result is

$$\frac{\partial\, \Phi_2(x_1'\beta_1, x_2'\beta_2, \rho)}{\partial x_1} = \phi\left(x_1'\beta_1\right)\Phi\left(\frac{x_2'\beta_2 - \rho x_1'\beta_1}{\sqrt{1-\rho^2}}\right)\beta_1 \tag{3.16}$$

Note, however, the bivariate probability, albeit possibly of interest in its own right, is not a conditional mean function. As such, the preceding does not correspond to a regression coefficient or a slope of a conditional expectation.

For convenience in evaluating the conditional mean and its partial effects, we will define a vector $x = x_1 \cup x_2$ and let $x_1'\beta_1 = x_1'\gamma_1$. Thus, γ_1 contains all the nonzero elements of β_1 and possibly some zeros in the positions of variables in x that appear only in the other equation; γ_2 is defined likewise. The bivariate probability is

$$Prob[y_1 = 1, y_2 = 1|x] = \Phi_2[x'\gamma_1, x'\gamma_2, \rho] \tag{3.17}$$

Signs are changed appropriately if the probability of the zero outcome is desired in either case. (See 12.) The marginal effects of changes in x on this probability are given by

$$\frac{\partial\, \Phi_2}{\partial x} = g_1\gamma_1 + g_2\gamma_2 \tag{3.18}$$

where $g_1$and g_2 are defined in (19). The familiar univariate cases will arise if $\rho = 0$, and effects specific to one equation or the other will be produced by zeros in the corre-sponding position in one or the other parameter vector. There are also some conditional mean functions to consider. The unconditional mean functions are given by the univari-ate probabilities:

$$E[y_i|x] = \Phi\left(x'\gamma_j\right), \quad j = 1,2, \tag{3.19}$$

so the analysis one pair of conditional mean functions that might be of interest are

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$$E[y_1|y_2 = 1, x] = Prob[y_1 = 1|y_2 = 1, x] = \frac{Prob[y_1 = 1.\, y_2 = 1|x]}{Prob[y_2 = 1|x]}$$

$$= \frac{\Phi_2(x'\gamma_1, x'\gamma_2, \rho)}{\Phi(x'\gamma_2)} \tag{3.20}$$

and similarly for $E[y_1|y_2 = 1, x]$. The marginal effects for this function are given by

$$\frac{\partial E[y_1|y_2=1,x]}{\partial x} = \left(\frac{1}{\Phi(x'\gamma_2)}\right)\left[g_1\gamma_1 + (g_2 - \Phi_2 \frac{\phi(x'\gamma_2)}{\Phi(x'\gamma_2)}\gamma_2\right] \tag{3.21}$$

Finally, one might construct the nonlinear conditional mean function

$$E[y_1|y_2, x] = \frac{\Phi_2[x'\gamma_1, (2y_2-1)x'\gamma_2, (2y_2-1)\rho]}{\Phi[(2y_2-1)x'\gamma_2]} \tag{3.22}$$

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CHAPTER 4

Result

In this study, I would like to examine the Impact of Economic Factors on the Return of Eight Industry Group Index in the Stock Exchange of Thailand by using Mmultivariate probit model. This data contains 15 variables which are the monthly secondary data from January 2006 to December 2018, total for 156 months follows

x_1 = SET Index (SET)
x_2 = Dow Jones Industrial Index (DJI)
x_3 = OPEC Oil price Index (OIL)
x_4 = Consumer Price Index (CPI)
x_5 = Business Sentiment Index (BSI)
x_6 = Currency Exchange Rate US Dollar to Thai Baht (EXC)
x_7 = 10 Year Bond Yield (TH10Y)
y_1 = Agro& Food Industry Index (ARGRO)
y_2 = Consumer Products Industry Index (CONSUMP)
y_3 = Financials Industry Index (FINCIAL)
y_4 = Resources Industry Index (RESOURC)
y_5 = Industrials Industry Index (INDUS)
y_6 = Property & Construction Industry Index (PROPCON)
y_7 = Services Industry Index (SERVICE)
y_8 = Technology Industry Index (TECH)

Multivariate probit model describes the relationship between the independent variables and the dependent variables divided into 3parts by following:

Part 1: Estimation of Mmultivariate probit Model
Part 2: Correlation matrix
Part 3: Marginal effect

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4.1 Estimation of Multivariate probit Model

Estimate from Maximum likelihood Estimation to find the relationship between economic factors and Industry Group Index in the Stock Exchange of Thailand**.**

Table 4.1: Estimates of Multivariate probit Model of Agro& Food Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0019	0.0012	1.5600	0.1190
DOWJ	-0.0001	0.0001	-2.0100	0.0450
OIL	0.0260	0.0133	1.9500	0.0510
CPI	-0.1718	0.0684	-2.5100	0.0120
BSI	0.0912	0.0370	2.4700	0.0140
EXC	0.2134	0.1219	1.7500	0.0800
TH10Y	-1.0603	0.4094	-2.5900	0.0101

Source: calculation

The results in table 4.1 show the economic factors that were negative correlation and statistically significant impact on Agro& Food Industry index include Dow Jones index, Consumer Price Index and 10 Year Bond Yield were statistically significant at 5% level that means when Dow Jones index, Consumer Price Index and 10 Year Bond Yield increases, will result in Agro& Food Industry index decreases. However the economic factors were positive correlation and statistically impact on Agro& Food Industry index include OPEC Oil Price Index, Currency Exchange Rate US Dollar to Thai Baht and Business Sentiment Index were statistically significant at 10%, 10%, 5% level respectively that means when OPEC Oil Price Index, Currency Exchange Rate US Dollar to Thai Baht and Business Sentiment Index increases, will result in Agro& Food Industry index increases. But SET Index was not statistically significant impact on Agro& Food Industry index.

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Table 4.2: Estimates of Multivariate probit Model of Consumer Products Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0036	0.0012	2.9400	0.0030
DOWJ	-0.0001	0.0001	-2.3000	0.0220
OIL	0.0267	0.0127	2.1000	0.0360
CPI	-0.2162	0.0682	-3.1700	0.0020
BSI	0.0521	0.0359	1.4500	0.1480
EXC	0.1521	0.1155	1.3200	0.1880
TH10Y	-0.9058	0.3967	-2.2800	0.0220

Source: calculation

In table 4.2 show the economic factors that were negative correlation and statistically significant impact on Consumer Products Industry index include Dow Jones index, 10 Year Bond Yield and Consumer Price Index were statistically significant at 5%, 5%, 1% level respectively that means when Dow Jones index, Consumer Price Index and 10 Year Bond Yield increases, will result in Consumer Products Industry index decreases. However the economic factors were positive correlation and statistically impact on Consumer Products Industry index include SET Index and OPEC Oil Price Index were statistically significant at 5% level that means when SET Index and OPEC Oil Price Index increases, will result in Consumer Products Industry index increases. But Business Sentiment Index and Currency Exchange Rate US Dollar to Thai Baht were not statistically significant impact on Consumer Products index.

Table 4.3: Estimates of Multivariate probit Model of Financials Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0017	0.0012	1.4900	0.1360
DOWJ	-0.0001	0.0001	-1.0600	0.2890
OIL	0.0200	0.0119	1.6800	0.0930
CPI	-0.1342	0.0631	-2.1300	0.0330
BSI	0.0569	0.0342	1.6600	0.0960
EXC	0.1287	0.1090	1.1800	0.2370
TH10Y	-0.7246	0.3644	-1.9900	0.0470

Source: calculation

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In table 4.3 show the economic factors that were negative correlation and statistically significant impact on Financials Industry index include Consumer Price Index and 10 Year Bond Yield were statistically significant at 5% level that means when Consumer Price Index and 10 Year Bond Yield increases, will result in Financials Industry index decreases. However the economic factors were positive correlation and statistically impact on Financials Industry index include OPEC Oil Price Index and Business Sentiment Index were statistically significant at 5% level that means when OPEC Oil Price Index and Business Sentiment Index increases, will result in Financials Industry index increases. But SET Index, Dow Jones index and Currency Exchange Rate US Dollar to Thai Baht were not statistically significant impact on Financials Industry index.

Table 4.4: Estimates of Multivariate probit Model of Resources Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0049	0.0012	4.2100	0.0000
DOWJ	-0.0001	0.0001	-1.7700	0.0760
OIL	0.0391	0.0123	3.1900	0.0010
CPI	-0.3655	0.0675	-5.4100	0.0000
BSI	-0.0018	0.0315	-0.0600	0.9550
EXC	0.2717	0.1132	2.4000	0.0160
TH10Y	-1.7767	0.3809	-4.6600	0.0000

Source: calculation

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In table 4.4 show the economic factors that were negative correlation and statistically significant impact on Resources Industry index include Dow Jones index, Consumer Price Index and 10 Year Bond Yield were statistically significant at 10%, 1%, 1% level respectively that means when Dow Jones index, Consumer Price Index and 10 Year Bond Yield increases, will result in Resources Industry index decreases. However the economic factors were positive correlation and statistically impact on Resources Industry index include SET index, OPEC Oil Price Index and Currency Exchange Rate US Dollar to Thai Baht were statistically significant at 1%, 1%, 5% level respectively that means when SET index, OPEC Oil Price Index and Currency Exchange Rate US Dollar to Thai Baht increases, will result in Resources Industry

index increases. But Business Sentiment Index was not statistically significant impact on Resources index.

Table 4.5: Estimates of Multivariate probit Model of Industrials Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0037	0.0011	3.2400	0.0010
DOWJ	-0.0001	0.0001	-1.0500	0.2960
OIL	0.0177	0.0118	1.5000	0.1340
CPI	-0.2634	0.0644	-4.0900	0.0000
BSI	0.0059	0.0323	0.1800	0.8550
EXC	0.0906	0.1094	0.8300	0.4080
TH10Y	-0.9945	0.3639	-2.7300	0.0060

Source: calculation

In table 4.5 show the economic factors that were negative correlation and statistically significant impact on Industrials index include Consumer Price Index and 10 Year Bond Yield were statistically significant at 1% level that means when Consumer Price Index and 10 Year Bond Yield increases, will result in Industrials index decreases. However the economic factor was positive correlation and statistically impact on Industrials index is SET index were statistically significant at 1% level r that means when SET index increases, will result in Industrials index increases. But Dow Jones, Oil Price Index, Business Sentiment Index and Currency Exchange Rate US Dollar to Thai Baht were not statistically significant impact on Industrials index

Table 4.6: Estimates of Multivariate probit Model of Property & Construction Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0046	0.0012	3.7600	0.0000
DOWJ	-0.0002	0.0001	-2.8100	0.0050
OIL	0.0477	0.0132	3.6200	0.0000
CPI	-0.3315	0.0693	-4.7800	0.0000
BSI	0.0417	0.0342	1.2200	0.2220
EXC	0.3577	0.1190	3.0100	0.0030
TH10Y	-1.9498	0.4135	-4.7200	0.00008

Source: calculation

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In table 4.6 show the economic factors that were negative correlation and statistically significant impact on Property & Construction Industry Index include Dow Jones index, Consumer Price Index and 10 Year Bond Yield were statistically significant at 1% level that means when Dow Jones index, Consumer Price Index and 10 Year Bond Yield increases, will result in Property & Construction Industry Index decreases. However the economic factors were positive correlation and statistically impact on Property & Construction Industry Index include SET index, OPEC Oil Price Index and Currency Exchange Rate US Dollar to Thai Baht were statistically significant at 1% level that means when SET index, OPEC Oil Price Index and Currency Exchange Rate US Dollar to Thai Baht increases, will result in Property & Construction Industry Index increases. But Business Sentiment Index was not statistically significant impact on Property & Construction Industry index.

Table 4.7: Estimates of Multivariate probit Model of Service Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0040	0.0012	3.4800	0.00008
DOWJ	-0.0001	0.0001	-2.5000	0.01208
OIL	0.0210	0.0127	1.6500	0.0990
CPI	-0.2545	0.0668	-3.8100	0.00008
BSI	0.0673	0.0334	2.0200	0.0440
EXC	0.2069	0.1151	1.8000	0.0720
TH10Y	-1.1568	0.4008	-2.8900	0.0040

Source: calculation

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In table 4.7 In table 4.4 show the economic factors that were negative correlation and statistically significant impact on Service Industry index include Dow Jones index, Consumer Price Index and 10 Year Bond Yield were statistically significant at 5%, 1%, 1% level respectively that means when Dow Jones index, Consumer Price Index and 10 Year Bond Yield increases, will result in Service Industry index decreases. However the economic factors were positive correlation and statistically impact on Service Industry index include SET index, OPEC Oil Price Index, Business Sentiment Index and Currency Exchange Rate US Dollar to Thai Baht were statistically significant at 1%, 1%, 10%, 5% level respectively that means when SET index, OPEC Oil Price Index,

Business Sentiment Index and Currency Exchange Rate US Dollar to Thai Baht increases, will result in Service Industry index increases.

Table 4.8: Estimates of Multivariate probit Model of Technology Industry

variables	Coef.	Std. Err.	z	P>|z|
SET	0.0043	0.0012	3.6000	0.0000
DOWJ	-0.0002	0.0001	-3.0300	0.0020
OIL	0.0267	0.0126	2.1200	0.0340
CPI	-0.2361	0.0650	-3.6300	0.0000
BSI	-0.0563	0.0331	-1.7000	0.0880
EXC	0.1367	0.1148	1.1900	0.2340
TH10Y	-1.4384	0.3762	-3.8200	0.0000

Source: calculation

In table 4.8 show the economic factors that were negative correlation and statistically significant impact on Technology Industry Index include Dow Jones index, Consumer Price Index, 10 Year Bond Yield and Business Sentiment Index were statistically significant at 1%, 1%, 1%, 10% level respectively that means when Dow Jones index, Consumer Price Index, 10 Year Bond Yield and Business Sentiment Index increases, will result in Technology Industry Index decreases. However the economic factors were positive correlation and statistically impact on Technology Industry Index include SET index and OPEC Oil Price Index were statistically significant at 1%, 5% level respectively that means when SET index and OPEC Oil Price Index increases, will result in Technology Industry Index increases. But Currency Exchange Rate US Dollar to Thai Baht was not statistically significant impact on Technology Industry index.

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4.2 Correlation matrix

Correlation matrix shows the correlation between dependent variables (eight Industry Group Index in the Stock Exchange of Thailand) in the form of rho values**.** Rho number in both the vertical and horizontal lines of the correlation matrix are 1, 2,.., 8 mean The correlation of each industry index : Agro& Food Industry Index, Consumer Products Industry Index, Financials Industry Index, Resources Industry Index, Industrials Industry Index, Property & Construction Industry Index, Services Industry Index and Technology Industry Index respectively.

Table 4.9: Correlation matrix

rho	rho1 (AGRO)	rho2 (CONSUMP)	rho3 (FINCIAL)	rho4 (RESOURC)	rho5 (INDUS)	rho6 (PROPCON)	rho7 (SERVICE)	rho8 (TECH)
rho1 (AGRO)	1.000	0.567	0.531	0.677	0.723	0.770	0.765	0.601
rho2 (CONSUMP)		1.000	0.528	0.489	0.455	0.589	0.446	0.550
rho3 (FINCIAL)			1.000	0.803	0.746	0.768	0.749	0.641
rho4 (RESOURC)				1.000	0.761	0.694	0.710	0.485
rho5 (INDUS)					1.000	0.718	0.577	0.654
rho6 (PROPCON)						1.000	0.830	0.634
rho7 (SERVICE)							1.000	0.671
rho8 (TECH)								1.000

Source: calculation

In table 4.9 rho value shows the correlation between each industry. The highest rho value is rho67 (0.830) show the correlation between Property & Construction index and Service index. This means that when Property & Construction index has changed, it will result in opportunities of Service index to change more than other industry group index. The second highest rho value is rho34 (0.803) show the correlation between Financials index and Resources index. This means that when Financials index has changed, it will result in opportunities of Resources index to change more than other industry group index.

The correlation of Agro& Food Industry index with other industry group index are quite large rho values in rho values in rho15 (0.723), rho16 (0.770) and rho17 (0.770), show the correlation of Agro& Food Industry index with Industrials index, Property & Construction index and Service index, That mean when Agro& Food Industry index changes, it will affect Industrials index, Property & Construction index and Service index more than other group industry index.

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The correlation of Financials index with other industry group index are quite large rho values in rho34 (0.803), rho35 (0.746), rho36 (0.768) and rho37 (0.749) show the correlation of Financials index with Resources index, Industrials index, Property & Construction index and Service index. That mean when Financials index changes, it will affect Resources index, Industrials index, Property & Construction index and Service index more than other industry group index.

The correlation of Industrials index with other industry group index are quite large rho values in rho15 (0.723), rho35 (0.746), rho45 (0.746) and rho56 (0.718) show the correlation of Industrials index with Agro& Food Industry index, Financials index, Resources index and Property & Construction index. That mean when Industrials index changes, it will affect Agro& Food Industry index, Financials index, Resources index and Property & Construction index more than other industry group index.

The correlation of Property & Construction index with other industry group index are quite large rho values in rho16 (0.770), rho36 (0.768), rho56 (0.718), and rho67 (0.830) show the correlation of Property & Construction index with Agro& Food Industry index, Financials index, Industrials index and Service index. That mean when Property & Construction index changes, it will affect Agro& Food Industry index, Financials index, Industrials index and Service index more than other industry group index.

The correlation of Resources index with other industry group index are quite large rho values in rho45 (0.761), rho47 (0.710) and rho34 (0.803) show the correlation of Resources index with Industrials index, Service index and Financials index. That mean when Resources index changes, it will affect Industrials index, Service index and Financials index more than other industry group index.

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The correlation of Service index with other industry group index are quite large rho values in rho17, rho37, rho47and rho67 show the correlation of Service index with Agro& Food Industry index, Financials index, Resources index changes and Property & Construction index. That mean when Service index changes, it will affect Agro& Food Industry index, Financials index, Resources index changes and Property & Construction index than other industry group index.

On the other hand the correlation of Consumer Products index and Technology index with other industry group index are quite low that mean when Consumer Products index and Technology index changes it will not affect or have a slight effect to other industry group index

4.3 Marginal effect

Marginal effect shows the probability of dependent variable changing when independent variables change. The marginal effect in this study will show the value of the probability that the industry group index will change when each economic factor has changed.

Table 4.10: Result of marginal effect in Agro& Food Industry

Variables	Marginal Effect
DOWJ	-0.00004
OIL	0.00905
CPI	-0.05983
BSI	0.03177
EXC	0.07429
TH10Y	-0.36917

Source: calculation

The result in table 4.10 shows the marginal effect of Dow Jones index with Agro& Food Industry index is -0.00004 that means, when Dow Jones index increased by 1 unit the probability that Agro& Food Industry index will decrease is 0.004 %.

The marginal effect of OPEC Oil Price Index with Agro& Food Industry index is 0.00905 that means when OPEC Oil Price Index increased by 1 unit the probability of Agro& Food Industry index will increase is 0.95 %.

The marginal effect of Consumer Price Index with Agro& Food Industry index is -0.05983 that means when Consumer Price Index increased by 1 unit the probability of Agro& Food Industry index will decrease is 5.98 %.

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The marginal effect of Business Sentiment Index with Agro& Food Industry index is 0.03177 that means when Business Sentiment Index increased by 1 unit the probability of Agro& Food Industry index will increase is 3.17 %.

The marginal effect of Currency Exchange Rate US Dollar to Thai Baht with Agro& Food Industry index is 0.07429 that means when Currency Exchange Rate US Dollar to Thai Baht increased by 1 unit the probability of Agro& Food Industry index will increase is 7.42 %.

The marginal effect of 10 Year Bond Yield with Agro& Food Industry index is -0.36917 that means when 10 Year Bond Yield increased by 1 unit the probability of Agro& Food Industry index will decrease is 36.91 %.

Table 4.11: Result of marginal effect in Consumer Products Industry

Variables	**Marginal Effect**
SET	0.00129
DOWJ	-0.00005
OIL	0.00945
CPI	-0.07654
TH10Y	-0.32062

Source: calculation

The result in table 4.11 shows the marginal effect of SET index with Consumer Products Industry index is 0.00129 that means when SET index increased by 1 unit the probability of Consumer Products Industry index will increase is 0.12 %.

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The marginal effect of Dow Jones Industrial Index with Consumer Products Industry index is -0.00005 that means when Dow Jones Industrial Index increased by 1 unit the probability of Consumer Products Industry index will decrease is 0.005 %.

The marginal effect of OPEC Oil Price Index with Consumer Products Industry index is 0.00945 that means when OPEC Oil Price Index increased by 1 unit the probability of Consumer Products Industry index will increase is 0.945 %.

The marginal effect of Consumer Price Index with Consumer Products Industry index is -0.07654 that means when Consumer Price Index increased by 1 unit the probability of Consumer Products Industry index will decrease is 7.65%.

The marginal effect of 10 Year Bond Yield with Consumer Products Industry index is -0.32062 that means when 10 Year Bond Yield increased by 1 unit the probability that Consumer Products Industry index will decrease is 32.06 %.

Table 4.12: Result of marginal effect in Financials Industry

Variables	Marginal Effect
OIL	0.00746
CPI	-0.05011
BSI	0.02126
TH10Y	-0.27047

Source: calculation

The result in table 4.12 shows the marginal effect of OPEC Oil Price Index with Financials Industry index is 0.00746 that means when OPEC Oil Price Index increased by 1 unit the probability of Financials Industry index will increase is 0.74 %.

The marginal effect of Consumer Price Index with Financials Industry index is -0.05011 that means when Consumer Price Index increased by 1 unit the probability of Financials Industry index will decrease is 5.0 %.

The marginal effect of Business Sentiment Index with Financials Industry index is 0.02126that means when Business Sentiment Index increased by 1 unit the probability of Financials Industry index will increase is 2.126 %.

The marginal effect of 10 Year Bond Yield with Financials Industry index is -0.27047 that means when 10 Year Bond Yield increased by 1 unit the probability of Financials Industry index will decrease is 27.047 %.

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Table 4.13: Result of marginal effect in Resources Industry

Variables	Marginal Effect
SET	0.00164
DOWJ	-0.00003
OIL	0.01307
CPI	-0.12220
EXC	0.09082
TH10Y	-0.59398

Source: calculation

The result in table 4.13 shows the marginal effect of SET index with Resources Industry index is 0.00164 that means when SET index increased by 1 unit the probability of Resources Industry index will increase is 0.164 %.

The marginal effect of Dow Jones Industrial Index with Resources Industry index is -0.00003that means when Dow Jones Industrial Index increased by 1 unit the probability of Resources Industry index will decrease is 0.003 %.

The marginal effect of OPEC Oil Price Index with Resources Industry index is 0.01307 that means when OPEC Oil Price Index increased by 1 unit the probability of Resources Industry index will increase is 1.307 %.

The marginal effect of Consumer Price Index with Resources Industry index is -0.12220 that means when Consumer Price Index increase the probability that Resources Industry index decrease will be 12.22 %.

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The marginal effect of Currency Exchange Rate US Dollar to Thai Baht with Resources Industry index is 0.09082 that means when Currency Exchange Rate US Dollar to Thai Baht increased by 1 unit the probability of Resources Industry index will increase is 9.082 %.

The marginal effect of 10 Year Bond Yield with Resources Industry index is -0.59398 that means when 10 Year Bond Yield increased by 1 unit the probability of Resources Industry index will decrease is 59.398%.

Table 4.14: Result of marginal effect in Industrials Industry

Variables	Marginal Effect
SET	0.00130
CPI	-0.09315
TH10Y	-0.3517

Source: calculation

The result in table 4.14 shows the marginal effect of SET index with Industrials index is 0.00130 that means when SET index increased by 1 unit the probability of Industrials index will increase is 0.130 %.

The marginal effect of Consumer Price Index with Industrials index is -0.09315 that means when Consumer Price Index increased by 1 unit the probability of Industrials index will decrease is 9.315 %.

The marginal effect of 10 Year Bond Yield with Industrials index is -0.3517 that means when 10 Year Bond Yield increased by 1 unit the probability of Industrials index will decrease is 35.17 %.

Table 4.15: Result of marginal effect in Property & Construction Industry

Variables	Marginal Effect
SET	0.00151
DOWJ	-0.00006
OIL	0.01582
CPI	-0.10992
EXC	0.11862
TH10Y	-0.64652

Source: calculation

The result in table 4.15 shows the marginal effect of SET index with Property & Construction Industry index is 0.00151 that means when SET index increased by 1 unit the probability of Property & Construction Industry index will increase is 0.151 %.

The marginal effect of Dow Jones Industrial Index with Property & Construction Industry index is -0.00006 that means when Dow Jones Industrial Index increased by 1 unit the probability of Property & Construction Industry index will decrease is 0.006 %.

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The marginal effect of OPEC Oil Price Index with Property & Construction Industry index is 0.01582 that means when OPEC Oil Price Index increased by 1 unit the probability of Property & Construction Industry index will increase is 1.582 %.

The marginal effect of Consumer Price Index with Property & Construction Industry index is -0.10992 that means when Consumer Price Index increased by 1 unit the probability of Property & Construction Industry index will decrease is 10.992 %.

The marginal effect of Currency Exchange Rate US Dollar to Thai Baht with Property & Construction Industry index is 0.11862 that means when Currency Exchange Rate US Dollar to Thai increased by 1 unit the probability of Property & Construction Industry index will increase is 11.862 %.

The marginal effect of 10 Year Bond Yield with Property & Construction Industry index is -0.64652 that means when 10 Year Bond Yield increased by 1 unit the probability of Property & Construction Industry index will decrease is 64.652 %.

Table 4.16: Result of marginal effect in Service Industry

Variables	Marginal Effect
SET	0.00128
DOWJ	-0.00004
OIL	0.00668
CPI	-0.08111
BSI	0.02144
EXC	0.06594
TH10Y	-0.36863

Source: calculation

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The result in table 4.16 shows the marginal effect of SET index with Service Industry index is 0.00128 that means when SET index increased by 1 unit the probability of Service Industry index will increase is 0.128 %.

The marginal effect of Dow Jones Industrial Index with Service Industry index is -0.00004 that means when Dow Jones Industrial Index increased by 1 unit the probability of Service Industry index will decrease is 0.004 %.

The marginal effect of OPEC Oil Price Index with Service Industry index is 0.00668 that means when OPEC Oil Price Index increased by 1 unit the probability of Service Industry index will increase is 0.668 %.

The marginal effect of Consumer Price Index with Service Industry index is -0.08111 that means when OPEC Consumer Price Index increased by 1 unit the probability of Service Industry index will decrease is 8.11%.

The marginal effect of Business Sentiment Index with Service Industry index is -0.02144 that means when Business Sentiment Index increased by 1 unit the probability of Service Industry index will increase is 2.144 %.

The marginal effect of Currency Exchange Rate US Dollar to Thai Baht with Service Industry index is 0.06594 that means when Currency Exchange Rate US Dollar to Thai Baht increased by 1 unit the probability of Service Industry index will increase is 6.594 %.

The marginal effect of 10 Year Bond Yield with Service Industry index is -0.36863that means when 10 Year Bond Yield increased by 1 unit the probability of Service Industry index will decrease is 36.863 %.

Table 4.17: Result of marginal effect of Multivariate probit in Technology Industry

Variables	Marginal Effect
SET	0.00147
DOWJ	-0.00006
OIL	0.00916
CPI	-0.08108
BSI	-0.01935
TH10Y	-0.49405

Source: calculation

The result in table 4.16 shows the marginal effect of SET index with Technology Industry index is 0.00147 that means when SET index increased by 1 unit the probability of Technology Industry index will increase is 0.147 %.

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The marginal effect of Dow Jones Industrial Index with Technology Industry index is -0.00006 that means when Dow Jones Industrial Index increased by 1 unit the probability of Technology Industry index will decrease is 0.006 %.

The marginal effect of OPEC Oil Price Index with Technology Industry index is 0.00916 that means when OPEC Oil Price Index increased by 1 unit the Technology of Industry index will increase is 0.916 %.

The marginal effect of Consumer Price Index with Technology Industry index is -0.08108 that means when OPEC Consumer Price Index increased by 1 unit the probability of Technology Industry index will decrease is 8.108%.

The marginal effect of Business Sentiment Index with Technology Industry index is -0.01935 that means when Business Sentiment Index increased by 1 unit the probability of Technology Industry index will decrease is 1.935 %.

The marginal effect of 10 Year Bond Yield with Technology Industry index is -0.49405 that means when 10 Year Bond Yield increased by 1 unit the probability of Technology Industry index will decrease is 49.504 %.

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CHAPTER 5

Conclusion

5.1 Conclusion

The study of relationship between economic factors and the return of eight Industry group Index in the Stock Exchange of Thailand, the method in this study used the Multivariate probit model. This data contains 15 variables which are the monthly secondary data from the period January 2006 to December 2018 total for 156 months or 13 years. This thesis has the objectives to study the relationship between economic factors and Eight Industry Group Index include relationship between each eight Industry Group Index in the Stock Exchange of Thailand and examine on impacts of the economic factors on probability of returns of Eight Industry Group Index in the Stock Exchange of Thailand.

The results of Multivariate probit model in this study will show the value of the probability that the industry group index will change when each economic factor has changed. The study found that, 10 Year Bond Yield is the economic factor that has the most affects to probability of every Industry Group Index in the Stock Exchange of Thailand to decrease. The industry group index that has the most probability to decrease is the Property & Construction Industry index following by Resources Industry index and Technology Industry index respectively, because when Bond Yield increase investors will move capital from the stock market to buy bonds that are more profitable and more secure than stocks. And the reason why the Property & Construction Industry index is the index that has the most probability to decrease because the real estate sector is a big part of the economy and is the sector that have borrowed the most from Bank. When the government raises bond yield, banks will increase interest rates as well as based on increased of bond yield a result, the real estate sector has been affected more than other sectors due to higher borrowing costs and resulting in lower profit.

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In addition, the Consumer Price Index is the second economic factor that affects the probability of every Industry Group Index in the Stock Exchange of Thailand to decrease. The industry group index that has the most probability to decrease is the Resources Industry index following by Property & Construction Industry index and Industrials Industry respectively, season from Consumer Price Index is a variable used to measure the inflation rate of the country. When the Consumer Price Index increases, it means that the country has a higher inflation rate, resulting in a stock market full of volatility so most investors move capital to other assets such as gold because they are assets that are worth themselves and protect against inflation.

The Currency Exchange Rate US Dollar to Thai Baht is the economic factor that has the most affects to probability of every Industry Group Index in the Stock Exchange of Thailand to increase. The industry group index that has the most probability to increase is the Property & Construction Industry index following by Resources Industry index and Agro& Food Industry index respectively, season from the exchange rate is a variable that measures appreciate and depreciate of Thai currency (Baht), if the exchange rate increases, it means the Thai baht is depreciate causing foreign investors to move capital into Thailand because they gain more profit from higher exchange rate in the stock market also rising as well.

In addition, Business Sentiment Index is the second economic factors that affect the probability of every Industry Group Index in the Stock Exchange of Thailand to increase. The industry group index that has the most probability to increase is The Agro& Food Industry index following by Service Industry index and Financials Industry index respectively, season from Business Sentiment Index is a number reflecting business confidence over a period of time as a tool for both the public and private sectors to monitor, analyze business conditions and the overall economy to find strategies for economic policy making, when Business Sentiment Index increases means the economy will grow and the stock market will also increase. Therefore, if Business Sentiment Index increases will cause every industry group index to increase investors should buy before the index is up to sell to make profit in the future especially in Agro& Food Industry index , Service Industry index and Financials Industry index. And the reason of the Agro& Food Industry has the most probability to increase because Agro&

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Food Industry index is the largest industry in the economy when Business Sentiment Index increases causing Agro& Food Industry to increase more than other industries

SET index, Dow Jones Industrial Index and OPEC Oil Price Index is the economics factor that has the least affects to probability of every Industry Group Index in the Stock Exchange of Thailand.

5.2 Recommendation

Based on these results, I suggest for investors if the 10 Year Bond Yield increases will cause every industry group index to decrease investors should sell stocks to make profit before the Industry index drops especially in Property & Construction Industry index, Resources Industry index and Technology Industry index. Moreover, if the Consumer Price Index increases will cause every industry group index to decrease investors should sell stocks to make profit before the Industry index drops especially in Resources Industry index, Property & Construction Industry index and Industrials index. On the other hand, if Currency Exchange Rate US Dollar to Thai Baht increases will cause every industry group index to increase investors should buy before the index is up to sell to make profit in the future especially in Property & Construction Industry index, Resources Industry index and Agro& Food Industry index. By the way, if Business Sentiment Index increases will cause every industry group index to increase investors should buy before the index is up to sell to make profit in the future especially in Agro& Food Industry index , Service Industry index and Financials Industry index.

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5.3 Further study

Future research in this field can expand the scope of other economic factors to study the relationship with the return of Eight Industry Group Index in the Stock Exchange of Thailand and should bring other factors to be used in analysis, such as political factors because political factors are important factors that impact on The change of the stock market. Moreover, Stock indexes are daily, in the next study, the daily data variables should be used in the analysis to get more accurate and accurate results.

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