Initiating Electric Vehicle Price Index and its Economic Factors: Evidence from the Stock Exchange of Thailand

Natdanai Aleenajitpong*, Karn Kaewpunpong

[1]Department of Finance, Kasetsart Business School, Faculty of Business Administration, Kasetsart University, Bangkok 10900, Thailand, [2]Kasetsart Business School, Kasetsart University, Bangkok 10900, Thailand. *Email: natdanai.al@ku.ac.th

ABSTRACT

The research aimed to develop a price index for electric vehicle companies listed on the Stock Exchange of Thailand and to examine the influence of macroeconomic factors on the Electric Vehicle Industry Index. The analysis employed both descriptive and inferential statistics, utilizing a multiple regression approach based on the least squares method. The study served as an example for constructing an index within the Thai stock market and provided insights into how macroeconomic factors influence the Electric Vehicle Industry Index. The findings indicated several factors affecting the stock price index of the electric vehicle industry. Notably, the exchange rate between the US dollar and the Thai baht, as well as the price of Dubai crude oil, showed a statistically significant inverse relationship with the electric vehicle index. Additionally, the total return index of the stock exchange of Thailand exhibited a statistically significant positive correlation with the electric vehicle index, while the consumer price index did not demonstrate any significant relationship with it. The results can assist investors and stakeholders in investment decisions in electric vehicle manufacturers by identifying key factors impacting the EV index and assessing the effects of macroeconomic conditions on their performance.

Keywords: Electric Vehicle, Price Index, Macroeconomic Factors, Stock Exchange of Thailand
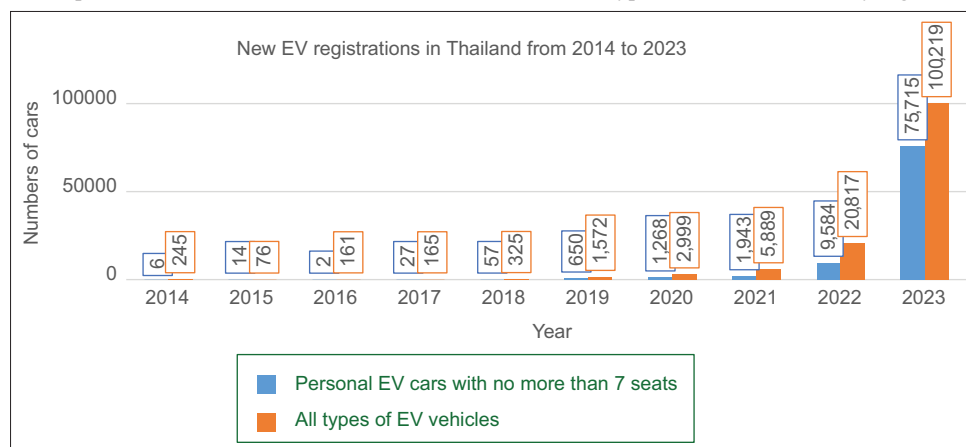**JEL Classifications:** G300, M200, O110, Q420

1. INTRODUCTION

At present, the Electric Vehicle (EV) industry has a greatly increased growth direction and there is a tendency for the industry to grow even further in the future, as Kanjanick (2020) has studied about an interesting industry group and the common mentioned one is EV industry. Because it is a new technology to clean energy. Therefore, it creates less impact on the environment compared to conventional gasoline or a so-called internal combustion car. In the near future EV industry will be an industrial group that can effectively benefit the Thai economic system. Since the electric vehicle industry is related to companies from many industries and business categories, such as the industrial products industry in the automotive business category, the resource industry in the energy and utilities business category, Technology in the electronic components business category and information and

communication technology, etc. Thai government and private sectors have been working together to push the framework of ESG being a national agenda through many projects. This on-going collaboration reflected its success by the numbers of new registration of electric vehicles including all types and personal electric cars with no more than seven seats in the past ten years, shown in Figure 1 below.

The number of newly registered electric vehicles on the Thai market in recent years has been mostly imported from large manufacturers such as those from China which is deemed as a leader in electric vehicle technology. Moreover, with a high production capacity, electric cars from China are affordable for consumers (He et al., 2022). As for the production of electric cars in Thailand, although the numbers were not very high, there has been significant growth. That is, in December 2023, a total of 652

Figure 1: The number of personal EV cars with no more than seven seats and all types of EV vehicles newly registered from 2014 to 2022

Source: Statistics team, Department of Land and Transport (2023), created by the authors

cars were produced, which dramatically increased from January 09, 2023 by 214.29% (the Federation of Thai Industries, 2023), projecting the future direction likely to increase continuously according to the expansion of electric cars around the world. In the next 20 years, there will be a high expansion of this industry in the range between 17% and 26% per year, with potentially 150-550 million electric cars on the road worldwide by 2040 or accounting for 31-55% of all car sales. Electric vehicle manufacturers will be able to generate profits from such expansion (Khantachavana, 2019).

The Stock Exchange of Thailand has divided industries into eight industry groups and business categories into 28 businesses (Stock Exchange of Thailand, 2022). In each industry group or business category, there will be a separate index for every industry group and every business category, which are intentionally used as an indicator for a group performance of that category. In general, the index is based on changes in the prices of securities on the stock exchange. The index is therefore a measure of the economic condition and the situation of the stock market. In present, the Stock Exchange of Thailand has created many different index groups. However, they still lack of an index for the electric vehicle industry. The researcher realized this shortfall together with a forthcoming era of electric vehicle in Thai automotive industry. The Stock Exchange of Thailand does not classify companies involved in the electric vehicle industry into industry groups or business categories. As a result, there has not yet been an index for this industry group until the time of this research. The authors therefore initiated the electric vehicle group index according to the price index formulation from the Stock Exchange of Thailand.

Apart from the index construction, the researcher also investigated how several macroeconomic factors could be related or affect this EV industry index in Thailand. From the evidence in the past, macroeconomic factors could directly affect the analysis of various stock price indexes but could not directly control their fluctuations within the business itself (Sangveerasil, 2015; Nantharat, 2011; Permphongphan, 2010) because macroeconomic factors are something uncertain and can change instantly in every second. Macroeconomic factors are fundamental and essential

variables that impact the overall economic system of a country or the world on a broad scale. These factors are beyond the control of individual businesses or small private companies. They often arise from government policies and the actions of various national and international institutions under global economic conditions. Examples of common macroeconomic factors include interest rates, inflation rates, employment rates, national income, government fiscal and monetary policies, the economic conditions of trading partner countries, and the prices of key commodities like oil, minerals, and agricultural products. Changes in these factors directly affect the overall economy, prompting businesses to adjust their strategies to align with new economic conditions and mitigate potential risks. Generally, macroeconomic factors significantly influence consumer demand, business investment, and government policy decisions.

To illustrate the importance of macroeconomic factors, the researcher has considered factors affecting the national economy in various aspects. Domestically, the Consumer Price Index (CPI) of Thailand has been selected as a key indicator of inflation. A rising CPI indicates higher average prices for goods and services, signaling inflation within the economy. This also affects liquidity and consumer purchasing power. Businesses often use the CPI to analyze consumer purchasing power, informing marketing strategies, pricing decisions, sales forecasts, and government economic policies, such as setting economic growth targets and fiscal and budgetary policies. Additionally, the researcher has chosen the Total Return Index of the Stock Exchange of Thailand (SET) as another important domestic factor. This index reflects investor confidence, both domestic and international, in the economic and investment climate in Thailand. It provides an overview of the economy and business sector, indicating the health and growth prospects of industry and businesses as a whole. In investor side, an important indicator for investors investing in SET is SETTRI. It provides a clearer picture of all returns of both capital gains and dividends from investing in SET. The performance of listed companies in Thailand, as reflected in these indices, is a good indicator of domestic economic conditions. From an international perspective, the researcher uses the exchange rate between the US dollar and the Thai baht to gauge international

economic conditions. The electric vehicle (EV) industry includes many companies involved in importing raw materials and exporting products, which is evident from the five-year export value of automobiles. For instance, in 2019, the export value was $17.981 billion, in 2020 it was $13.586 billion, in 2021 it was $19.031 billion, in 2022 it was $21.564 billion, and in 2023 it was $23.339 billion. This data shows a growing trend despite the COVID-19 crisis, highlighting the significance of this factor for Thailand's automotive exports and its impact on the international economy. In the Industry side, Automotive industry involved in import and export affair also deals with the exchange rate risk. Lastly, crude oil prices in Dubai are used as a global economic indicator because oil is a primary energy source essential for production and transportation. Higher oil prices increase production and transportation costs and affect international trade. Oil-exporting countries benefit from higher prices, while oil-importing countries face increased expenses, impacting trade balances and economic stability. High or low oil prices can lead to inflation and interest rate fluctuations, affecting monetary policy and investment decisions.

Given these macroeconomic factors, it is crucial for investors to closely monitor and analyze them for optimal investment outcomes. With the importance of forthcoming EV era, but the Stock Exchange of Thailand does not have an index for the electric vehicle industry. The researcher therefore interested in initiating a price index of specific EV industry for the listed automotive companies in Thailand and further studying how economic factors influence the EV index. The objectives of this study are to construct a specific price index of EV industry in Thailand according to the stock exchange of Thailand's indices calculation and to examine the impact of macroeconomic factors on the Electric Vehicle Industry Index.

The study expects to contribute to both scholars and business sectors. In academic contribution, academia could consider our study as a simulation to construct index in Thai stock market. In managerial contribution, the research also benefits to understand the influence of the macroeconomic factors that affects Electric Vehicle Industry Index and the results from this study can be applied for the benefit of investors or stakeholders in using significant relationship to consider investing in Electric Vehicle manufacturers listed in the Stock Exchange of Thailand. In addition, the public companies in EV industry could focus on critical factors affecting the price of EV index.

2. LITERATURE REVIEW

Concepts of securities analysis using fundamental factors (Fundamental Analysis) is a concept that focuses on the analysis of determining factors affecting yield on investment and the value of securities. These basic factors include economic factors; related industry factors and such factors related to company operating performance. The main purpose of this concept is to use various fundamental factors as mentioned above to analyze or to find the securities that give the highest returns within the level of risk that investors can accept (Stock Exchange of Thailand, 2015). Therefore, fundamental analysis is an analysis of the economic situation, industry and company conditions used in determining the current true value of securities. Macroeconomic factors are variables or factors that impact the overall economic system of a country during a specific period. These factors influence economic stability and the quality of life of the population. They are often compiled and presented in the form of statistical figures and various indicators, such as the Consumer Price Index, exchange rates, total return indices, and crude oil prices, among others. These indicators are used as a representative to analyze and assess the overall economic conditions. The reasons why we selected these factors are their major relevance and involvement in Thai EV context. For example, in household side, CPI is a good indicator to examine the movement of people expenditure behavior towards purchasing power. In international trading, EV industry in Thailand has many things to do with the exchange rate. In investors' point of view, the return from the stock market reflects the country's economy, particularly returns from other sectors related to EV. In car buyers' perspective, oil prices are a sensitive factor for them to make a purchase decision.

2.1. Relevant Research on the Relationship between Macroeconomic Factors and Stock Price Index

2.1.1. Consumer price index (CPI) and stock price index
The Consumer Price Index (CPI) is a statistical tool used to measure changes in retail prices of goods and services, which reflects the cost of living and the country's inflation. An increase in the CPI signals relevant authorities to begin monitoring and tracking as it indicates a move towards inflation. This inflation may result in higher production costs for various industries, including the electric vehicle industry, due to rising labor costs, raw material costs, and energy costs, or reduced profits if prices cannot be adjusted promptly. This could also reduce competitiveness, especially in exports, leading to lower profitability for industries. This aligns with the economic and industry condition analysis based on fundamental analysis concepts (Rakaariyatham, 2011; Saeeng, 2016; Sae-Beh, 2018; Al-Sharkas, 2004; Chen et al., 1986; Mukherjee and Naka, 1995).

Hypothesis 1: The Consumer Price Index (CPI) affects the stock price index of the electric vehicle industry in the opposite direction.

2.2. Exchange Rate USD/THB and Stock Price Index
If the exchange rate between the U.S. dollar and the Thai baht decreases, it means the U.S. dollar has strengthened while the Thai baht has weakened. This impacts industries, particularly the electric vehicle industry, where many companies are exporters of vehicles and automotive parts. Consequently, export goods become cheaper in foreign currency terms, enhancing the competitiveness of Thai products and attracting international market interest. This leads to increased export revenue when converted back to Thai baht, expanding the export sector and supporting economic growth. This supports the theory of supply and demand for securities, with the exchange rate fluctuations affecting stock prices of exporting businesses in the opposite direction to the exchange rate of the U.S. dollar to the Thai baht (Tirapat and Chawakor, 2014; Watcharatthain and Usawadi, 2017; Cherdthamsathorn, 2008; Sae-Beh, 2018; Totrakulpitak, 2010).

Hypothesis 2: The exchange rate between the U.S. dollar and the Thai baht affects the stock price index of the electric vehicle industry in the opposite direction.

2.3. The Stock Exchange of Thailand Total Return Index (Total Return Index or TRI) and Stock Price Index

The Total Return Index of the Stock Exchange of Thailand (SETTRI) is calculated based on changes in stock prices plus dividends or interest earned from holding those securities. It reflects the actual return investors receive from investing in those securities. When this index rises, it indicates economic expansion, which positively impacts various industries, such as banking and financial institutions, where increased economic activity results in higher loan income and service fees. In the energy and petrochemical industries, economic growth leads to increase production and transportation activities, raising demand for energy and petrochemical products. Similarly, in manufacturing, economic growth boosts demand for consumer and capital goods, leading to increase production capacity. Thus, when the SETTRI rises, it indicates a healthy economy, benefiting industries related to consumption, investment, and production. Conversely, a decline in the SETTRI negatively impacts various industries, reducing returns or profits and leading to lower stock prices (Meunkhaw and Rujitarmongkul, 2013; Wipha, 2022).

Hypothesis 3: The Total Return Index of the Stock Exchange of Thailand affects the stock price index of the electric vehicle industry in the same direction.

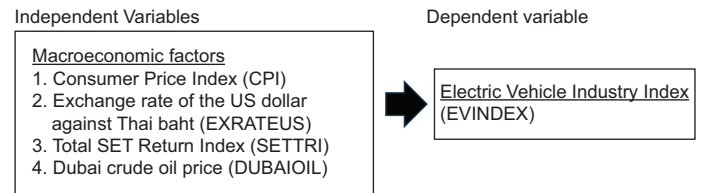## 2.4. Dubai Crude Oil Price and Stock Price Index

The price of Dubai crude oil is an important benchmark for the Asia region, being the closest oil source to Thailand and significantly affecting oil prices in Thailand. As a standard price used by oil companies to adjust retail fuel prices, Dubai crude oil prices are crucial for the region and directly impact oil prices and energy costs in oil-importing countries like Thailand. When Dubai crude oil prices rise, the cost of fuel for gasoline-powered vehicles also increases, leading consumers to consider electric vehicles due to lower fuel costs. This results in higher sales of electric vehicles and a corresponding increase in the stock prices of electric vehicle manufacturers moving in the same direction as Dubai crude oil prices. In summary, an increase in Dubai crude oil prices positively affects the stock price index of the electric vehicle industry, while a decrease in oil prices could exert downward pressure on stock prices of this industry. However, other factors must also be considered, in line with fundamental analysis and macroeconomic concepts (Promsaphet, 2021; Klinphayom, 2016; Paisalnikit, 2005; Abdullah et al., 2016).

Hypothesis 4: The price of Dubai crude oil affects the stock price index of the electric vehicle industry in the same direction.

2.5. Research Hypothesis Development

From literature review and related studies, the interesting macroeconomic factors are Consumer Price Index, Exchange rate of the US dollar against Thai baht, Total Return Index, and Dubai crude oil price. The conceptual framework represented, and research questions are hypothesized as shown in Figure 2.

Figure 2: Research conceptual framework

Source: Authors' own creation

3. RESEARCH METHODOLOGIES

Population characteristics can be classified by companies on the Stock Exchange of Thailand that are related to the personal electric vehicle industry with no more than seven seats and a purely electric vehicle system (Battery Electric Vehicle - BEV), excluding other electric vehicle systems such as Hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV) or hydrogen powered vehicle or Fuel Cell Electric Vehicle (FCEV). A total of 30 companies out of the EV Stocks in the Thai stock market (Stock Exchange of Thailand, 2023) were finalized.

3.1. Data Collection

This study used secondary data in time series of monthly basis. We collected information, starting from January 2018 to February 2024 for a total of 74 months. The researcher collected data on both the independent variables, which are macroeconomic variables, and the dependent variable, which is the electric vehicle industry group index listed on the Stock Exchange of Thailand. The data were sourced from Bloomberg Terminal (BloombergNEF, 2023) and Federal Reserve Economic Data (FRED). Particularly for the electric vehicle industry group index, it was constructed by using the data of market capitalization of all 30 companies, according to the stock index calculation from the Stock Exchange of Thailand. The calculations are demonstrated in the next section.

3.2. The Stock Index Calculation Method

Index groups of the Stock Exchange of Thailand were used as a tool to reference the direction of a price movement of securities that are traded on the stock exchange or used to compare returns on investment as well as being used as a reference in issuing various financial instruments. The preparation of the index group will be in line with the development of the capital market and meet the needs of investors (Stock Exchange of Thailand, 2022) according to the equation (1)-(6).

Index calculation method according to the rules of the Stock Exchange of Thailand

First day, base day

$$Base\ Index = \frac{Current\ Market\ Value}{Base\ Market\ Value} \times 100 \tag{1}$$

$$\frac{\sum_{i=1}^{n} P_{it} Q_{it}}{\sum P_{io} Q_{io}} \times 100 \tag{2}$$

Where P is a price, Q is a unit quantity, CMV is current market value, BMV is base market value, i is number of companies, t is current time period, o is base time period.

Where

Current Market Value (CMV) = The total market value of all securities that are constituents of the index on the calculation date.

Base Market Value (BMV) = The total market value of all securities that are constituents of the index on the base date.

Base Value = Base value of the index

2nd day, suppose the security price changed but used the same base for calculation.

Stock price index day 2

$$\text{Index Day } (2) = \frac{CMV_n}{BMV_n} \times 100 \qquad (3)$$

3rd day, suppose there were new securities listed but not yet included in today's index calculation.

Stock Price Index Day 3

$$\text{Index Day } (3) = \frac{CMV_n}{BMV_n} \times 100 \qquad (4)$$

Index calculation base for day 4

$$BMV_n = BMV_0 \times \frac{CMV_n}{CMV_0} \qquad (5)$$

4th day, suppose the security price changes and additional listed securities are added. Today a new base will be used for calculations.

Note: Every time there are new listed securities, the base must be recalculated and the new base will be used in the calculation for the next day.

Stock price index day 4

$$\text{Index Day } (4) = \frac{CMV_n}{BMV_n} \times 100 \qquad (6)$$

Source: Stock Exchange of Thailand. (2022). Guidelines for index construction of the Stock Exchange of Thailand.

3.3. Data Analysis

This research deployed both descriptive and inferential statistical analysis. The analysis model employs multiple regression analysis to construct the equation and then estimates the coefficients of the equation using the Ordinary Least Squares (OLS) method. Descriptive statistics is a preliminary analysis of data used to describe the characteristics of variables used in the study which consist of Electric Vehicle Industry Index (SETEV), Consumer Price Index (THCPI), US Dollar to Baht exchange rate

(EXRATEUS), Stock Exchange of Thailand Total Return Index (SETTRI), and Dubai crude oil price (DUBAIOIL). Regarding Inferential Statistics Analysis, this study explores the relationship of the electric vehicle industry index in the Stock Exchange of Thailand and macroeconomic factors by creating a data analysis format with a multiple regression analysis and then estimating the coefficient of the equation using the Ordinary Least Squares (OLS).

3.3.1. Regression model and abbreviations

This research conducted inferential statistical analysis from multiple regression equations and then estimated the coefficients of the equation using the OLS method of all four independent variables. It can display the relationship function between various variables according to the economic model as the following equation (Equation 7).

$$EVINDEX_t = \beta_1 THCPI_t + \beta_2 EXRATEUS_t + \beta_3 SETTRI_t + \beta_4 DUBAIOIL_t + \varepsilon \qquad (7)$$

The terms are defined as:

EVINDEX$_t$: The stock price index for the electric vehicle industry on the Stock Exchange of Thailand in month t (unit: points)

THCPI$_t$: The Consumer Price Index (CPI) in month t (unit: points)

EXRATEUS$_t$: The exchange rate between the U.S. dollar and the Thai baht in month t (unit: dollars per baht)

SETTRI$_t$: The Total Return Index of the Stock Exchange of Thailand in month t (unit: points)

DUBAIOIL$_t$: The price of Dubai crude oil in month t (unit: dollars per barrel)

β$_i$: The coefficient of the independent variable

t: A specific time period

ε: The error term.

3.3.2. Model validation and correctness. Data validity and robustness check

Validity of variables were tested by unit root test, Dubin Watson, the Variance Inflation Factor, and the Breusch-Pagan-Godfrey test to make sure that there is no multicollinearity, autocorrelation and heteroskedasticity problem.

4. RESULTS OF DESCRIPTIVE STATISTICAL ANALYSIS

Descriptive statistical analysis will consist of basic information on the dependent and independent variables with details shown in Table 1.

Table 1: The results of descriptive statistical analysis of independent and dependent variables after seasonal adjustment

Variable	Maximum value	Lowest value	Average	Standard deviation
EVINDEX_SA	118.1082	63.9262	95.5083	11.32508
THCPI_SA	108.26	97.22	102.3149	3.719552
EXRATEUS_SA	37.5331	29.8865	32.84935	1.944725
SETTRI_SA	11691.67	7335.007	10461.11	949.6326
DUBAIOIL_SA	108.0683	26.4761	70.5266	17.77055

From Table 1, the table shows the results of descriptive statistical analysis of various independent and dependent variables after seasonal adjustment process consisting of Consumer Price Index (THCPI), Exchange rate of the US dollar to the baht (EXRATEUS), total return index (SETTRI), Dubai crude oil prices (DUBAIOIL), and the Electric Vehicle Industry Index (EVINDEX) as dependent variable. The results of the descriptive statistical analysis of each variable can be explained as follows.

The Electric Vehicle Index (EVINDEX) has an average value of 95.5083, with a standard deviation of 11.32508. The highest value recorded is 118.1082, and the lowest value is 63.9262. The Consumer Price Index (THCPI) has an average value of 102.3149, with a standard deviation of 3.719552. The highest value recorded is 108.26, and the lowest value is 97.22. The Exchange Rate of the US Dollar to Thai Baht (EXRATEUS) has an average value of 32.84935, with a standard deviation of 1.944725. The highest value recorded is 37.5331, and the lowest value is 29.8865. The Total Return Index of the Stock Exchange of Thailand (SET TRI) has an average value of 10,461.11, with a standard deviation of 949.6326. The highest value recorded is 11,691.67, and the lowest value is 7,335.007. The Dubai Crude Oil Price (DUBAIOIL) has an average value of 70.5266, with a standard deviation of 17.77055. The highest value recorded is 108.0683, and the lowest value is 26.4761.

From the results of the descriptive statistical analysis, it can be summarized that the Electric Vehicle Index (EVINDEX) and the Total Return Index of the Stock Exchange of Thailand (SET TRI) had their lowest values in March 2020. The Consumer Price Index (THCPI) and Dubai Crude Oil Price (DUBAIOIL) reached their lowest values in April 2020, while the Exchange Rate of the US Dollar to Thai Baht (EXRATEUS) hit its lowest in January 2022. All these independent and dependent variables had their lowest values during the COVID-19 crisis due to the economic downturn caused by the pandemic. After the COVID-19 crisis, these variables significantly increased starting from February 2022. The researcher will now discuss the highest values of both independent and dependent variables. The Electric Vehicle Index (EVINDEX) had its highest value in March 2023. The Consumer Price Index (THCPI) peaked in August 2023, the Total Return Index of the Stock Exchange of Thailand (SET TRI) reached its highest in January 2023, and the Dubai Crude Oil Price (DUBAIOIL) was highest in June 2022. This indicates that both independent and dependent variables were at their highest levels after the COVID-19 crisis, reflecting a period of full economic recovery in Thailand and globally.

4.1. Results of Multiple Linear Regression analysis

Inferential statistical analysis was performed on the data sets by using the econometric method in a Multiple Linear Regression equation which has the results shown in Table 2.

Exchange the US dollar against the baht (EXRATEUS) has a significant relationship in the opposite direction with the Electric Vehicle Industry Index (EVINDEX) at the 95% confidence level. An increase in the US dollar to baht exchange rate by 1 unit will cause the Electric Vehicle Industry Index (EVINDEX) to decrease by 1.126996 units. Total Return Index of the stock exchange of Thailand (SETTRI) has a relationship in the same direction with Electric Vehicle Industry Index (EVINDEX) significantly at the 95 percent confidence level. Total Return Index of The Stock Exchange of Thailand increased by 1 unit will cause the Electric Vehicle Industry Index (EVINDEX) to decrease by 0.009668 units. Dubai Crude oil price (DUBAIOIL) has a significant relationship in the opposite direction with the Electric Vehicle Industry Index (EVINDEX) at the 95% confidence level. An increase of 1 unit of the price of Dubai crude oil will cause the Electric Vehicle Industry Index (EVINDEX) to decrease by 0.193371 units. Consumer Price Index (THCPI) has no statistically significant relationship with the Electric Vehicle Industry Index (EVINDEX).

Table 2: The results of testing the relationship of independent variables to the Electric Vehicle Industry Index (EVINDEX)

Variable	Coefficient	Standard error	t- statistic	Probability value
D (THCPI_SA)	0.367795	0.770831	0.477141	0.6348
D (EXRATEUS_SA)	−1.126996	0.543636	−2.073070	0.0420**
D (SETTRI_SA)	0.009668	0.000965	10.01994	0.0000**
D (DUBAIOIL_SA)	−0.193371	0.076087	−2.541439	0.0133**
C (CONSTANT)	0.170805	0.383643	0.445219	0.6576
R-Squared	0.697358	Adjusted R-Squared	0.679556	
Prob (F-Statistic)	0.000000	Durbin-Watson stat	2.261169	

**Displays P value at a static significance level of 0.05. *Displays P value at a static significance level of 0.1 D (….SA) The data is stationary at a certain level and has undergone seasonal adjustment

Table 3: Summary results of testing the assumptions of independent variables on the electric vehicle industry index

Variable	Hypothesis		Test results	
	Relationship direction	Relationship	Relationship direction	Coefficient
D (THCPI_SA)	Opposite direction	No relationship		0.367795
D (EXRATEUS_SA)	Opposite direction	Have a relationship**	Opposite direction	−1.126996
D (SETTRI_SA)	Same direction	Have a relationship**	Same direction	0.009668
D (DUBAIOIL_SA)	Same direction	Have a relationship**	Opposite direction	−0.193371

**Means that it is statistically significant at the 95% confidence level. *Means that it is statistically significant at the 90% confidence level. D(….SA) The data is stationary at a certain level and has undergone seasonal adjustment

4.1.1. Hypothesis testing results

The results from hypothesis testing are summarized in Table 3.

The hypothesis testing results for the independent variables affecting the Electric Vehicle Index (EVINDEX) in the Stock Exchange of Thailand can be explained as follows. Exchange Rate of the US Dollar to Thai Baht (EXRATEUS): The data is stable at the first level, having been transformed into natural logarithms and seasonally adjusted (D(EXRATEUS_SA)). It has a significant inverse effect on the Electric Vehicle Index (EVINDEX) at a 95% confidence level. Specifically, a 1-unit increase in the exchange rate of the US dollar to the Thai baht results in a decrease of 1.126996 units in the EVINDEX. This means that as the exchange rate increases, the EVINDEX moves in the opposite direction, aligning with the theory of demand and supply as hypothesized by the researcher. Total Return Index of the Stock Exchange of Thailand (SET TRI): The data is stable at the first level, having been transformed into natural logarithms and seasonally adjusted (D(SETTRI_SA)). It has a significant positive effect on the Electric Vehicle Index (EVINDEX) at a 95% confidence level. Specifically, a 1-unit increase in the SET TRI results in an increase of 0.009668 units in the EVINDEX. This means that as the SET TRI increases, the EVINDEX also moves in the same direction, reflecting the overall investment returns and economic conditions, consistent with fundamental analysis theory and the researcher's hypothesis. Dubai Crude Oil Price (DUBAIOIL): The data is stable at the first level, having been transformed into natural logarithms and seasonally adjusted (D(DUBAIOIL_SA)). It has a significant inverse effect on the Electric Vehicle Index (EVINDEX) at a 95% confidence level. Specifically, a 1-unit increase in the Dubai crude oil price resulted in a decrease of 0.193371 units in the EVINDEX. This means that as the Dubai crude oil price increases, the EVINDEX moves in the opposite direction, consistent with macroeconomic factors and fundamental analysis theory, though not in line with the researcher's hypothesis. Consumer Price Index (THCPI): The data is stable at the first level, having been transformed into natural logarithms and seasonally adjusted (D(THCPI_SA)). It shows no significant relationship with the Electric Vehicle Index (EVINDEX) at a 95% confidence level. This implies that the Consumer Price Index may not affect EVINDEX.

4.2. Testing the Stability of Variables (Unit Root Test)

We tested the stability of various variable data (Stationary) by using the method called Augmented Dickey – Fuller (ADF) because most of the data in the time series format is non - stationary, which if the data is used to forecast the dependent variable using multiple linear regression method, it will lack reliability. Although the variable is statistically significant, the researcher therefore tested the assumption of stationarity of the variables at the statistical significance level of 0.05 as follows.

H_0: The data is not stationary (has a unit root)
H_1: Data is stable (Stationary)

Table 4 presents the results of the data stationarity test using the Augmented Dickey-Fuller (ADF) Test. The test was conducted for data at the Order of Integration equal to zero, or I(0), which is at the level. The stationarity of the data was then assessed at a significant level of 0.05. The results indicate that all variables namely the Electric Vehicle Index (EVINDEX), the Consumer Price Index (THCPI), the Exchange Rate of the US Dollar to Thai Baht (EXRATEUS), the Total Return Index of the Stock Exchange of Thailand (SET TRI), and the Dubai Crude Oil Price (DUBAIOIL) showed stationarity at the first difference level, with all statistical probability values (Prob) being <0.05.

4.3. Examining the Problem of Correlation between Variables (Multicollinearity)

We analyzed the relationship of the independent variables used in the study to prevent problems with variables having relationships among themselves. If the variables are related to each other, it will cause an error on the model used in forecasting the dependent variable. The method used to examine multicollinearity problems are Correlation Coefficients and Variance Inflation Factor (VIF), as shown in Tables 5 and 6 below.

From the Table 5 Found that the correlation coefficient between every pair of independent variables is <0.8 It shows that all independent variables do not have a relationship with each other. That is, it does not cause correlation problems between variables (Multicollinearity).

From the Table 6 Found that the value Variance Inflation Factor (VIF) has a value not exceeding 10 showed that all variables are not related to each other. In other words, it does not cause problems of correlation between variables (Multicollinearity).

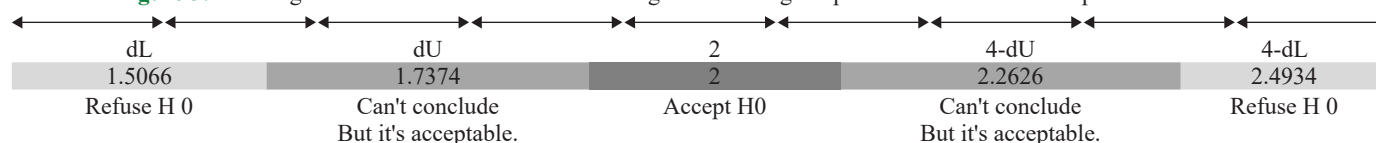### 4.4. Examining the Problem of the Relationship between Tolerances (Autocorrelation)

This analysis was performed to check whether the error values of the variables were related to their counterparts or not by testing with the indicator called the Durbin-Watson (DW).

Table 4: Results of testing the stability of the data using the augmented Dickey-Fuller test (ADF)

Variable	At level	At 1st difference	Order of Integration
EVINDEX	0.3692	0.0000**	I (1)
THCPI	0.8450	0.0000**	I (1)
EXRATEUS	0.3251	0.0000**	I (1)
SETTRI	0.5067	0.0000**	I (1)
DUBAIOIL	0.4836	0.0000**	I (1)

**Statistically significant at the 95% confidence level

Table 5: The correlation coefficient between independent variables with the correlation coefficients method

Variable	THCPI	EXRATEUS	SETTRI	DUBAIOIL
THCPI	1.0000			
EXRATEUS	0.744343	1.0000		
SETTRI	0.258401	0.169920	1.0000	
DUBAIOIL	0.568227	0.517358	0.607246	1.0000

Table 6: The correlation coefficient between independent variables with variance inflation factor (VIF)

Variable	THCPI	EXRATEUS	SETTRI	DUBAIOIL
THCPI	1.0000			
EXRATEUS	2.242386	1.0000		
SETTRI	1.071548	1.029731	1.0000	
DUBAIOIL	1.476847	1.365485	1.584153	1.0000

Figure 3: The range of criteria used for decision making in examining the problem of the relationship between tolerances

dL	dU	2	4-dU	4-dL
1.5066	1.7374	2	2.2626	2.4934
Refuse H 0	Can't conclude But it's acceptable.	Accept H0	Can't conclude But it's acceptable.	Refuse H 0

From the Table 7 displays information that is used as a basis for decision making in investigating problems of relationships between tolerance values. The information was obtained from the beginning where Durbin-Watson Statistics was at a significance level of 0.05 with four independent variables (K) and 73 number of data (n). The decision period for investigating the problem of the relationship between the moving values using the Durbin-Watson (DW) value is stated in Figure 3 and used as a basis for testing statistical assumptions with the hypothesis below.

H_0: 1.5066 < value DW < 2.4934; The data does not have a relationship between the error values.

H_1: Value DW is in other ranges; The data has a relationship between the tolerance values.

From the Durbin-Watson Statistic (D.W.) value in Table 8, it is observed that the Durbin-Watson (D.W.) value for the multiple linear regression model predicting the Electric Vehicle Index (EVINDEX) in the Stock Exchange of Thailand is 2.261169. This value falls within the range that accepts the null hypothesis at a 0.05 statistical significance level, indicating that the multiple linear regression model for predicting the EVINDEX does not have issues with autocorrelation of residuals.

4.5. Testing for Heteroskedasticity Problem

We performed a relationship analysis to check whether the variance of the error is constant by using the Breusch-Pagan-Godfrey test. The test sets the assumption at a statistical significance level of 0.05 if the statistical probability values, Prob. F and Prob. Chi Square of the linear multiple regression model, are >0.05. That is, the error variance of the model is constant or there is no problem of Heteroskedasticity, as shown in Table 9.

The test results indicate that the P-values, including Prob. F and Prob. Chi-Square, for the multiple linear regression model predicting the Electric Vehicle Index (EVINDEX) in the Stock Exchange of Thailand are >0.05. This exceeds the statistical significance level, meaning that the variance of the residuals for the model predicting the EVINDEX is constant or does not exhibit issues with heteroskedasticity.

5. DISCUSSION

Exchange rate of the US dollar against Thai baht which is related to the electric vehicle industry index (EVINDEX) in the opposite direction at the 95% confidence level. If the exchange rate of the US dollar to the baht decreases, it will affect the electric vehicle industry index (EVINDEX) will adjust in the opposite direction significantly. The electric vehicle industry index that the researcher constructed is engaged in the production and an export of automobiles and automotive spare parts. That is mainly because Thailand is considered one of the most important automobile production bases

Table 7: The data is used as a basis for decision making in examining the problem of the relationship between tolerance values using the method Durbin-Watson (DW)

K	n	dL	dU	4-dU	4-dL
4	73	1.5066	1.7374	2.2626	2.4934

K means number of independent, n means number of observations

Table 8: The Durbin-Watson Statistic (D.W.) value for the electric vehicle index (EVINDEX) in the stock exchange of Thailand

Stock exchange price index	Durbin-Watson Statistics (DW)
EVINDEX	2.261169

Table 9: The P-values for testing heteroskedasticity of the residuals for the Electric Vehicle Index (EVINDEX) in the Stock Exchange of Thailand

Stock exchange price index	Prob. F	Prob. Chi-square
EVINDEX	0.2298	0.2222

in the world. From the exporter's point of view, Exchange rate of the US dollar to the baht has the opposite direction of relationship with Electric Vehicle Industry Index (EVINDEX) is originally based on the theory of demand and supply. That is, exporters can profit from the weakening of the baht and the strengthening of the US dollar and it is consistent with the research of Tirapat and Chawakor (2014) who found that the exchange rate of the baht to the US dollar has a relationship in the opposite direction with the stock price index of the banking and commercial groups.

Total Return Index Stock Exchange of Thailand can affect Electric Vehicle Industry Index (EVINDEX) in the same direction. If the total return index of the Stock Exchange of Thailand increases, Electric Vehicle Industry Index (EVINDEX) will adjust in the same direction significantly at the 95% confidence level. Because the Total Return Index, in addition to reflecting the price movements of the Stock Exchange of Thailand, also reflects other types of returns obtained from all investments. From the concept of fundamental analysis, if the total returns of the Stock Exchange of Thailand increase both the level of stock prices and the trading value, various stock price indexes will move in the same direction according to the total return on investment and the overall trend of the economic situation both domestically and internationally, which is in line with the research of Meunkhaw and Rujitarmongkul (2013).

Dubai Crude oil price which is significantly related to the Electric Vehicle Industry Index (EVINDEX) in the opposite direction at the 95% confidence level. If the price of crude oil increases, the Electric Vehicle Industry Index (EVINDEX) will adapt in the opposite direction. That is, normally if the price of oil increases, the behavior of using internal combustion cars or the desire to buy cars will tend

to be lower, which is the result in the opposite direction. The industry group that the researcher brought to study is the electric vehicle industry group. The researcher reckons that the increase in crude oil prices will stimulate consumers' desire to switch to electric vehicles. But it was not in accordance with the assumptions. In detail, when consumers turn to invest in the electric car industry or decide to buy an electric car, they do not merely consider the price of oil as the main factor. Due to limitations of EV characteristic, they may look at other relevant factors, such as a number of electric charging stations and the long charging time. As well as the study of Thitalee and Suchanya (2023) and Phakdeesuk (2018) found that attitude factors influence the decision to purchase electric cars. It's not just the oil price factor alone, which is consistent with the concept of fundamental analysis that aims to analyze and cover all economic and industrial conditions in several factors.

Consumer Price Index found that there was no statistically significant relationship with Electric Vehicle Industry Index (EVINDEX), that is, the Consumer Price Index cannot affect the Electric Vehicle Industry Index (EVINDEX). Such result may be due to the COVID - 19 crisis that caused the Consumer Price Index not to reflect the relationship with Electric Vehicle Industry Index (EVINDEX), as similar to the analysis of industry conditions in fundamental analysis concept. This is consistent with the study of Dechasawat (2016) who found that the Consumer Price Index or CPI was not related to the index of real estate and construction industry groups in Thailand

6. CONCLUSION

This research aims to investigates the macroeconomic factors affecting the stock price index of the electric vehicle industry on the Stock Exchange of Thailand (SET) and the methodology for creating a new industry index based on SET's index criteria, as such an index has not yet been classified or established by SET. The researchers have reviewed theories, concepts, and relevant research, including theories of fundamental analysis of securities, macroeconomic factors, and research on the relationship between the Consumer Price Index (CPI) and stock price indices, the exchange rate between the US dollar and the Thai baht and stock price indices, the Total Return Index of SET and stock price indices, and the relationship between Dubai crude oil prices and stock price indices. The study of macroeconomic factors towards the Electric Vehicle Industry Index was conducted by collecting secondary time series data using the equation of multiple linear regression from January 2018 to February 2024, 74 months in total. The research model consists of four macroeconomic variables, namely Consumer Price Index, Exchange rate of the US dollar to the baht, Stock Exchange of Thailand Total Return Index, Dubai crude oil price, and one bespoke price index constructed from Index calculation method of the Stock Exchange of Thailand. Every variable has been examined and corrected for statistical problems.

We tested and corrected the stationary of the data (Unit Root Test) by examining the relationship between independent variables (Multicollinearity) with Correlation Coefficients and Variance Inflation Factor (VIF), and examining problems in the relationship between error values (Autocorrelation) and examining the problem of

Heteroskedasticity by various variables. Testing and troubleshooting were carried out until the results were not statistically free. This data set can then be tested using econometric methods. Then estimate the coefficients of the equation using the least squares method (Ordinary Least Squares). According to the result, Consumer Price Index (CPI) has no statistically significant correlation with the Electric Vehicle Index (EVINDEX) in the Stock Exchange of Thailand. It can be concluded that the CPI was unable to reflect a relationship with the EVINDEX. During the time Thailand's economy was depressed, and all industries were similarly affected, causing both the EVINDEX and the CPI to remain stable or show no change. This situation prevented the demonstration of a relationship between the two indices (Dechasawat, 2016). The exchange rate of the US dollar to the Thai baht has an inverse effect on the EVINDEX. Specifically, when the exchange rate decreases (meaning the baht weakens or the US dollar strengthens), it implies that Thailand, as a major manufacturing and exporting base for vehicles and auto parts, will see increased revenue from exports in US dollars when converted back to baht. Therefore, a decrease in the exchange rate (weaker baht) will significantly increase the EVINDEX because companies in this sector benefit from favorable exchange rates. This aligns with the theories of supply and demand, where increased export revenue leads to higher supply, which boosts investor demand for EV stocks, thus raising their prices (Tirapat and Chawakor, 2014; Cherdthamsathorn, 2008; Sae-Beh, 2018; Totrakulpitak, 2010). The SETTRI Index has a positive effect on the EVINDEX. When the SETTRI Index increases, indicating that stock prices in the market are rising, it can also cause the EVINDEX to increase. Investor confidence tends to rise when the SETTRI Index increases, reflecting overall positive sentiment towards the economy and the stock market. This often leads to increased investment in various industry sectors, including electric vehicles. Thus, an increase in the SETTRI Index reflects confidence, liquidity, and improved economic forecasts, making investors more interested in the EV sector, which will consequently boost the EVINDEX in line with market trends (Meunkhaw and Rujitarmongkul, 2013; Raduang, 2022).

The price of Dubai crude oil has an inverse effect on the EVINDEX. It was initially believed that rising crude oil prices would prompt users of internal combustion vehicles to switch to electric vehicles to save on fuel costs. However, consumer decisions to invest in electric vehicles are influenced by various factors beyond just oil prices, such as the availability of charging stations in Thailand, the range of electric vehicles, the longer charging time compared to refueling, and the limited number of repair facilities for electric vehicles. Therefore, changes in crude oil prices alone do not significantly drive the adoption of electric vehicles, as other practical considerations also play a crucial role. This analysis reflects how changes in crude oil prices impact the overall economic environment, helping to make informed decisions in both national and global economic contexts (Thitalee and Suchanya, 2023; Phakdeesuk, 2018).

In this study, investors can use the findings from this research to aid in their decision-making when investing in the electric vehicle industry. This study may help investors become aware of macroeconomic conditions that could impact the profitability of this industry, thereby making investment decisions more effective. The study's results are beneficial for investors, as they highlight

the impact of various economic factors and encourage careful consideration before making investment decisions.

7. ACKNOWLEDGEMENTS

REFERENCES

Abdullah, A.M., Saiti, B., Masih, M. (2016), The impact of crude oil price on Islamic stock indices of South East Asian countries: Evidence from MGARCH-DCC and wavelet approaches. Borsa Istanbul Review, 16(4), 219-232.

Al-Sharkas, A. (2004), Dynamic relations between macroeconomic factors and the Jordanian stock market. International Journal of Applied Econometrics and Quantitative Studies, 1, 97-114.

BloombergNEF. (2023), EVO Report 2023. Bloomberg Finance LP. Available from: https://about.bnef.com/electric-vehicle-outlook

Chen, N.F., Roll, R., Ross, S. (1986), Economic forces and the stock market. The Journal of Business, 59, 383-403.

Cherdthamsathorn, W. (2008), A Study of Economic Factors Affecting the Stock Index in the Transport and Logistics Sector (Master's Independent Research), Thai Chamber of Commerce University.

Dechasawat, N. (2016), Economic Factors Affecting the Index of Real Estate and Construction Industries in Thailand (Master's Independent Research). Thailand: Thammasat University.

Department of Land Transport. (2023), Number of Newly Registered Vehicles. Available from: https://web.dlt.go.th/statistics [Last accessed on 2024 Jan 03].

Federation of Thai Industries. (2023), FTI Proposes the Government to Maintain the Automotive Production Base and Upgrade Thai Automotive Parts, Ready for the Modern Automotive Industry. Available from: https://fti.or.th/2023

He, H., Sun, F., Wang, Z., Lin, C., Zhang, C., Xiong, R., Deng, J., Zhu, X., Xie, P., Zhang, S., Wei, Z., Cao, W., Zhai, L. (2022), China's battery electric vehicles lead the world: Achievements in technology system architecture and technological breakthroughs. Green Energy and Intelligent Transportation, 1(1), 100020.

Kanjanick, K. (2020), Factors influencing consumer decisions to purchase battery electric vehicles in Bangkok and its vicinity. Journal of Community Development Research (Humanities and Social Sciences), 13(3), 3.

Khantachavana, S. (2019), Electric Cars Change the Challenges in the Oil Business into Opportunities. Available from: https://www.moneyandbanking.co.th/new/27042/61/index.php

Klinphayom, M. (2016), Factors Affecting Stock Prices in the Energy Business: A Case Study of Bangchak. Mumbai: Petroleum Public Company Limited, Esso (Thailand) Public Company Limited, PTT Public Company Limited, and Thai Oil Public Company Limited (Master's Independent Research), Thai Chamber of Commerce University.

Meunkhaw, P., Rujitarmongkul, K. (2013), Factors impacting the index of the stock exchange of Thailand. Journal of Finance Investment Marketing and Business Management, 3(2), 338-354.

Mukherjee, T., Naka, A. (1995), Dynamic relations between macroeconomic variables and the Japanese stock market: An application of a vector error correction model. Journal of Financial Research, 18, 223-237.

Nantharat, R. (2011), The Relationship between Economic Factors and the Stock Price Index of Various Industrial Sectors (Master's Independent Research). Thailand: Thammasat University.

Paisalnikit, P. (2005), The Impact of Macroeconomic Factors on the Stock Index in the Energy Sector in the Stock Exchange of Thailand (Master's Independent Research). Thailand: Chiang Mai University.

Permphongphan, P. (2010), Economic Factors Affecting the Prices of Stocks in the Resource Sector of Energy and Utilities (Master's Independent Research). Bangkok: Thai Chamber of Commerce University.

Phakdeesuk, K. (2018), Factors Related to Attitudes, Marketing Mix, and Technology Acceptance Affecting the Decision to Purchase Electric Vehicles among the Public in Bangkok and its Vicinity (Master's Independent Research). Bangkok: Bangkok University.

Promsaphet, A. (2021), Factors Affecting the Stock Price Index of the Petrochemical and Chemical Sectors in the Stock Exchange of Thailand (Master's Independent Research). Bangkok: Bangkok University.

Raduang, W. (2022), Factors Affecting the Returns of Well-Governed Securities Based on Sustainable Stock Criteria: A Case Study of Companies Listed on the Stock Exchange of Thailand (Master's Independent Research). Thailand: Naresuan University.

Rakaariyatham, N. (2011), The Relationship between Economic Factors and the Stock Price Index of Various Industrial Sectors (Master's Independent Research). Thailand: Thammasat University.

Sae-Beh, N. (2018), Factors Affecting Stock Prices in the Energy and Utilities Sector on the Stock Exchange of Thailand (Master's Independent Research). Bangkok: Ramkhamhaeng University.

Saeeng, N. (2016), Economic Factors Affecting the Stock Price Index of Financial Industry Sectors (Master's Independent Research). Bangkok: Bangkok University.

Sangveerasil, S. (2015), Economic Factors Affecting the Price Index of Industrial Groups in the Stock Exchange of Thailand (Master's Independent Research). Bangkok: Bangkok University.

Stock Exchange of Thailand. (2015), Fundamental Factor Analysis. Available from: https://portal.set.or.th/education/th/begin/stock_content04.pdf

Stock Exchange of Thailand. (2022), Guidelines for Index Construction of the Stock Exchange of Thailand. Available from: https://media.set.or.th/set/documents/2022/nov/set/index/methodology_th_nov2022.pdf

Stock Exchange of Thailand. (2023), EV Stocks in the Thai Stock Market. Available from: https://www.set.or.th/th/about/setsource/insights/article/364/ev/stocks/in/the/thai/stock/market

Thitalee, W., Suchanya, S. (2023), Attitudes and marketing mix that affect the decision-making process of using electric vehicle charging stations in Bangkok and its vicinity. Procedia of Multidisciplinary Research, 1(7), 84-84.

Tirapat, S., Chawakor, J. (2014), Economic Factors Affecting the Movement of Stock Price Indices in Industrial Sectors on the Stock Exchange of Thailand (Master's Independent Research). Thailand: Kasetsart University.

Totrakulpitak, W. (2010), Factors Influencing the Average Stock Prices in the Energy Industry: A Case Study of Three Companies Listed on the Stock Exchange of Thailand (Master's Independent Research). Bangkok: Bangkok University.

Watcharatthain, P., Usawadi, T. (2017), Factors Affecting the Stock Price Index in the Information Technology and Communication Sector (Master's Independent Research). Thailand: Thai Chamber of Commerce University.

Wipha, R. (2022), Factors Affecting the Returns of Well-Governed Securities Based on Sustainable Stock Criteria: A Case Study of Companies Listed on the Stock Exchange of Thailand (Master's Independent Research). Thailand: Naresuan University.