



Modelling the Philippine Stock Market Index and Analyzing the Impact of Key Economic Variables through Multiple Linear Regression

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ABSTRACT

The main objective of this study is to formulate a mathematical model that can be used to predict the Stock Market Index in the Philippines and to determine which key economic variables that can significantly affect the stock market index using Multiple Linear Regression. The researcher obtained the monthly data from Philippine Stock Exchange (PSE), Philippine Statistics Authority (PSA) and Bangko Sentral ng Pilipinas (BSP) limited only from January 2018 up to December 2022. Monthly closing price of Philippine Stock Exchange Composite Index (PSEi) was used as a measure of stock market performance, and hence, is a dependent variable for the multiple linear regression. Six variables including inflation rate, interest rate, total foreign trade, foreign exchange rate, industrial production and sales index were used as an independent variable. This research used a Normal Estimation Equation using Matrices to create the model for Stock Market Index and used α as 0.05. The researcher also used logarithm transformation to transform the data to satisfy all the assumptions on Multiple Linear Regression Analysis. SPSS was used to formulate a mathematical model. Experimental results from stepwise multiple linear regression model show that Interest Rate, Total Foreign Trade, Industrial Production and Sales Index having a p-value of 0.0007, 0.0001, 0.0001 and 0.0000, respectively shows significant factors in determining stock market index in the Philippines. This means that any increase or decrease in the said variables can cause stock market index either to move upward or downward. After satisfying all the assumptions in Multiple Linear Regression, the formulated mathematical model has a coefficient of determination of 0.751. This indicates that the factors included in the model can explain stock market index by almost 75 percent. From the model, it can be concluded that a one increase in Interest Rate and Total Foreign Trade can cause stock market index to go down by 0.1071 and 0.2460, respectively. Moreover, a one increase in Industrial Production and Sales Index affects the stock market index to go up by 0.0769 and 0.2736, respectively. The study concludes that Multiple Linear Regression is a powerful tool in predicting stock market index in the Philippines.

Keywords: Stock Market Index, Multiple Linear Regression, SPSS, Logarithmic Transformations, Normal Estimation Equation using Matrices

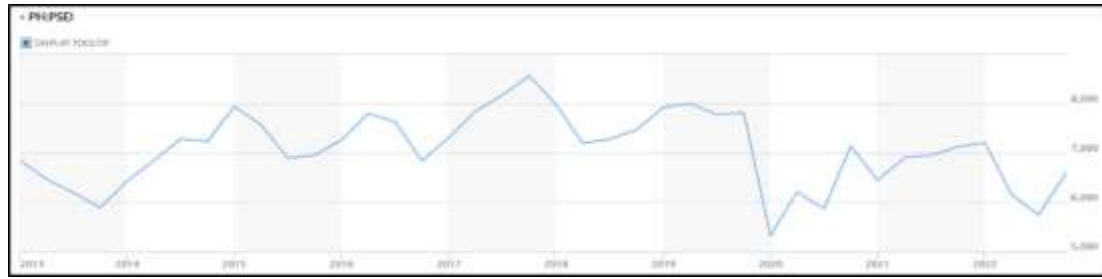
INTRODUCTION

The stock market pertains to public markets that exist for buying and selling stocks that trade on a stock exchange or over the counter. Each stock, also known as equities, represent a fractional ownership on the issuing company (CFI, 2023).

The Philippine Stock Exchange (PSE) is the only stock exchange in the Philippines and was formed from the country's two former stock exchanges, the Manila Stock Exchange (MSE), established on August 8, 1927, and the Makati Stock Exchange (MkSE), which was established on May 27, 1963. Although both the MSE and the MkSE traded the same stocks of the same companies, the bourses were separate stock exchanges for nearly 30 years until December 23, 1992, when both exchanges were unified to become the present-day Philippine Stock Exchange.

The role of PSE is to bring together companies which aim to raise capital through the issue of new securities. Through the listing of their share in the stock exchange, companies can have easier access to funds. Raising new capital through an additional public offering is easier and less expensive when the company is already listed in the Exchange. Therefore, the PSE plays a vital role in the financing of productive enterprises that use the funds for growth and expansion of new jobs. It is therefore essential to the growth of the Philippine economy (The Philippine Stock Exchange, Inc.).

The PSE Composite Index (PSEi), previously known as the PHISIX, was created to provide investors and market participants a set of benchmarks that measures the performance of Philippine stock market and its specific industry segments. The PSEi is the main index of the PSE. It is composed of a fixed basket of 30 companies, whose selection is based on a specific set of criteria. The PSEi measures the relative changes in the free float-adjusted market capitalization of the 30 largest and most active common stocks listed at the PSE. By gauging changes in the stock prices of select listed companies, the PSEi provides a snapshot of the market's overall condition. The base level of the PSEi was pegged at 1,022.045 points. This was reckoned according to the close of the index on February 28, 1990, which is the PSEi's base date (The Philippine Stock Exchange, Inc. 2021).



Source: www.marketwatch.com

Fig. 1 - Historical Data of PSE Composite Index (PSEi), 2013-2022

There are various economic variables that are used by participants on engaging in stock markets which has an impact on the valuation of companies' stock prices. For example, the increase in consumer prices or inflation brings down share prices because consumer spending tends to decrease. This will also apply on interest rates imposed by the Bank Sentral ng Pilipinas, if interest rate increases, cost to borrow money also increases, and consumer confidence decreases, resulting in lower consumer spending and business investment.

This research is expected to help policymakers, researchers, players of the stock market and investors in assessing the impact of some key economic variables on stock market performance of the country.

OBJECTIVES OF THE STUDY

The main purpose of this study is to formulate a mathematical model that can be used to predict the Stock Market Index in the Philippines and to determine which key economic variables that can significantly affect the stock market index using Multiple Linear Regression.

Variables that are considered in this study are inflation rate (x_1), interest rate (x_2), total foreign trade (x_3), forex exchange rate (x_4), industrial production index (x_5) and industrial sales index (x_6) which are considered as independent variables. The stock market index (y) is identified as dependent variable. The relationships and effects of these variables in the stock market index will be further elaborated and discussed in the Review of Related Literature and Studies.

Statement of the Problem

The study aims to formulate a mathematical model to estimate the future stock market index in the Philippines using matrices and to determine its significant factors through Multiple Linear Regression. In particular, the goal of this research is to answer the following questions:

1. What is the behavior of the graph of the following variables?
 - a. Stock Market Index
 - b. Inflation Rate
 - c. Interest Rate
 - d. Total Foreign Trade
 - e. Foreign Exchange Rate
 - f. Industrial Production Index
 - g. Industrial Sales Index
2. What could be the mathematical model that can be formulated through regression analysis that could estimate the future stock market index?
3. What are the significant factor(s) that can actually predict the stock market index?
4. Is there a significant difference between the actual and the predicted values?

CONCEPTUAL FRAMEWORK

The variables are expressed in conceptual framework section of the study. As shown in the below research paradigm, there were six (6) identified key economic factors (independent variables) to be considered in determining the Stock Market Index in the Philippines (dependent variable), selection was based on the review of related literature. These factors, namely: inflation rate (x_1), interest rate (x_2), total foreign trade (x_3), forex exchange rate (x_4), industrial production index (x_5) and industrial sales index (x_6). Significant relationships among variables were obtained after some transformation.

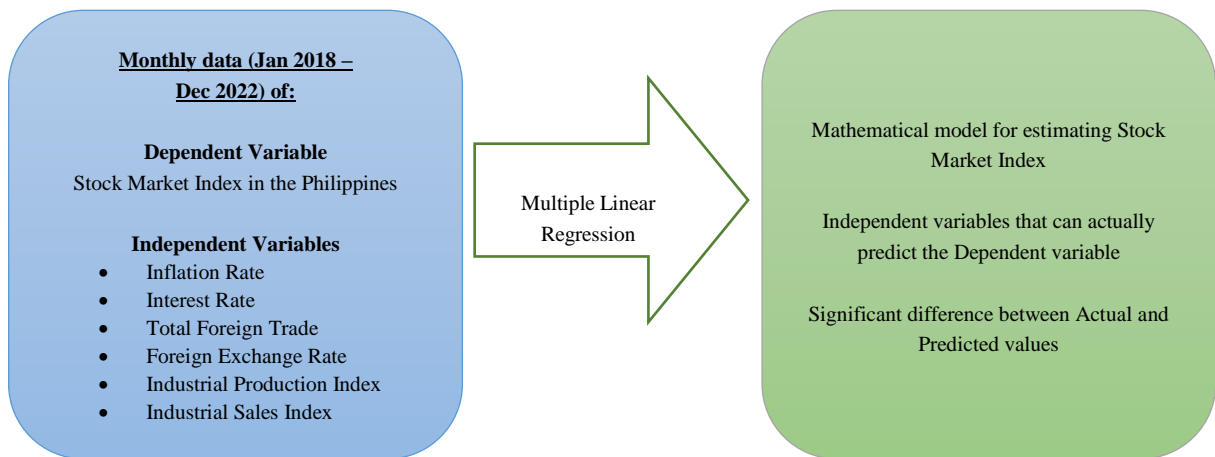


Fig. 2 - Research Paradigm

The researcher followed this research paradigm. A Multiple Linear Regression is to be applied to the monthly data after satisfying the assumptions in order to come up with the expected output as indicated in the diagram.

SCOPE AND LIMITATION OF THE STUDY

This study is limited by the researcher for 60 months. It considered months from January 2018 up to December 2022. The researcher applied Multiple Linear Regression to identify which independent variables can actually predict the dependent variable. The inflation rate, total foreign trade, industrial production and sales index were from Philippine Statistics Authority (PSA); interest rate and foreign exchange rate were from Bangko Sentral ng Pilipinas (BSP); and stock market index from Philippine Stock Exchange (PSE).

LITERATURE REVIEW

This section of the research will provide an overview of the current knowledge of the topic and allowing to identify relevant theories, methods and gaps that would help to determine the nature of the research by studying a previous work and findings to create a full understanding of the developments in this field. This will also discuss the relationship of the independent variables to the dependent variable.

As per World Bank, the COVID-19 pandemic in the country has severely impacted economic growth. Growth contracted significantly in 2020, driven by heavy declines in consumption and investment growth, and exacerbated by the slowdown in tourism and remittances. Then in 2021, the economy has started to recover with a 5.6% year-on-year expansion, but it still faces downside risks from the weak external environment, reeling from an expected global growth deceleration, rising inflation, and geopolitical turmoil. These events somehow made a significant impact on the key economic variables.

According to Securities and Exchange Commission (SEC), Philippine stocks were erratic. PSEi closed on the last trading day of the year at 6,566.39 points, down by 3.16% month-on-month (m-o-m). Notably, all sector indices suffered m-o-m losses aside from Mining and Oil which grew by 5.73%. Equities' weakness was attributed to continued investors' concern on inflation, domestic monetary tightening, and slowing global economy.

Inflation Rate and Stock Market

The study of Barnes, Boyd & Smith (1999) states that inflation can affect the nominal stock returns and financial market efficiency since the said variables have a positive correlation in high inflationary economies. On the other hand, Aduda, Onsongo (2012) concluded that regression analysis coefficient shows no relationship between stock market development and macroeconomic stability – inflation. This was backed by the result of Alvi, Rehan and Khatri (2019) research in which inflation rate has an insignificant negative relationship with Karachi Stock Index in Pakistan (KSE-100) stock returns. Same goes with data gathered from United Arab Emirates (UAE) and Kingdom of Saudi Arabia (KSA), Mgamal (2018).

Interest Rate and Stock Market

Using liner regression and pearson correlation method, the result of study is that there's no relationship between stock market price index and interest rate Mgamal (2018). Conversely, in New Zealand, the study of Gan, Lee, Yong & Zhang (2006) concluded that the value of the stock market is influenced by interest rate, money supply and real GDP. The same result was released by Bulmash and Trivoli (1991), which they found a negative relationship between the US Treasury Bill rate and stock prices.

Total Foreign Trade and Stock Market

Adjasi, Harvey, & Agyapong (2008) did a study on international trade as a key economic variable on Ghana stock exchange which showed that increase in trade deficit will lead to fall in stock index and vice versa. To elaborate, high trade deficit shows a lesser confidence about the local production amongst

the consumer and thus the prices of company's shares lowers, and they don't even see more volatility as people have lost hopes with these companies and are not willing to buy the stocks.

The result of long-run regression show that coefficient of international trade is negative and statistically significant, Ho, Odhiambo (2018). However, there is no two-way causal relationship between Indian stock market and foreign trade balance, Bhattacharya et al. (2003).

Foreign Exchange Rate and Stock Market

Mgammal (2018), there is a significant relationship between stock market price index and forex rate. Further Mishra, (2004) concluded that there is a strong correlation between foreign currency movement and stock indices. But this is still debatable since research on emerging markets was conducted by Bhattacharya et al. (2003), who examined the relationship between stock prices and macroeconomic aggregates in India from April 1990 to March 2001 and the result suggest that there is no causal linkage between stock prices and foreign exchange rate.

Industrial Production and Sales

According to Chen (1986), through the arbitrage pricing theory (APT), some economic forces such as unanticipated shifts in risk premiums; changes in the expected level of industrial production; unanticipated inflation and unanticipated movements in the shape of the term structure of interest rate influences the stock returns. But Bhattacharya and Mukherjee (2006) determined that causal relationship is not present between stock market returns and industrial index.

The fitted industrial VARMA model indicated a one-way causal relationship from industrial sales to stock prices, Tsai et al. (2006).

Based on the results of these studies, it seems that impact of key economic variables on stock market price index varies by country with stock market. This study examines the presence or absence of the influence of inflation, interest rate, foreign trade, exchange rate, industrial production and sales index on stock market trend in the Philippines.

MATERIALS & METHODS

This chapter focuses on the methods used by the researcher in this study. The study used descriptive design method to determine which key economic variables has an impact on the performance of the Philippine Stock Market Index. The researcher used secondary data that was gathered from various sources such as government reports and publications.

The researcher downloaded the chosen monthly key economic variables and then, data was transferred into an excel spreadsheet. The choice of method is based on the nature of data and research question that are used to meet the objectives of the research. Since there were more than one independent variables involved, multiple linear regression using matrices was utilized to establish the mathematical model that would best assess the stock market index in the Philippines. Another goal is to analyze the impact of key economic variables on stock market prices.

The quantitative data have been processed and analyzed with Statistical Package for the Social Sciences (SPSS); a statistical tool used by various kinds of researchers for complex statistical data analysis.

STATISTICAL TREATMENT

1. Multiple Linear Regression Model

The multiple linear regression is used to analyze the relationship between a continuous dependent variable and one or more independent variables. To conduct the Multiple Linear Regression analysis, there are assumptions that are needed to be satisfied which includes the following:

- a. Linear Relationship between the dependent variable and independent variables
- b. Normally Distributed Residuals
- c. No multicollinearity
- d. No auto-correlation
- e. Homoscedasticity

If the assumptions of the multiple linear regressions are all satisfied, then the regression can be conducted using the model below:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki} + \mu_i$$

where y is the dependent variable, x is the independent variables, β is the predicted value of the dependent variable when the independent variables are zero, and μ is the error.

1.1. Stepwise Multiple Linear Regression

The Stepwise Multiple Linear Regression is a step-by-step iterative construction of a regression model that involves automatic selection of independent variables. Stepwise regression can be achieved either by trying out one independent variable at a time and including it in the regression model if it is statistically significant, or by including all potential independent variables in the model and eliminating those that are not statistically significant, or by a combination of both methods.

2. Normal Estimation Equation

The normal equation is a closed-form solution used to find the value of θ that minimizes the cost function. Another way to describe the normal equation is as a one-step algorithm used to analytically find the coefficients that minimize the loss function.

In constructing a model, a matrix notation can aid for the computations and manipulations. The whole sample of n observations can be expressed in the matrix notation:

$$y = x\beta + u$$

where y is the n -dimensional column vector, x is a $n(k+1)$ matrix, β is a $(k+1)$ -dimensional column vector of parameters, and u is a n -dimensional column vector of error terms.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} 1 & x_1 & \cdots & x_{1k} \\ 1 & x_2 & \cdots & x_{2k} \\ 1 & x_3 & \cdots & x_{3k} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & \cdots & x_{nk} \end{bmatrix} \times \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ \vdots \\ u_n \end{bmatrix}$$

Ordinary least squares (OLS) minimizes the squared distances between the observed and predicted variable y :

$$S(\beta) = \sum_{i=1}^n (y_i - x_i' \beta)^2 = (y - x\beta)'(y - x\beta) \rightarrow \min \beta$$

The resulting OLS estimator of β is written as:

$$\beta' = (x'x)^{-1}x'y$$

Its matrix nature is written in the form of:

$$\begin{bmatrix} n & \sum_{i=1}^n x_{1i} & \cdots & \sum_{i=1}^n x_{2i} & \sum_{i=1}^n x_{ki} \\ \sum_{i=1}^n x_{1i} & \sum_{i=1}^n x_{1i}^2 & \cdots & \sum_{i=1}^n x_{1i}x_{2i} & \sum_{i=1}^n x_{1i}x_{ki} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ \sum_{i=1}^n x_{ki} & \sum_{i=1}^n x_{ki}x_{1i} & \cdots & \sum_{i=1}^n x_{ki}x_{2i} & \sum_{i=1}^n x_{ki}^2 \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_k \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^n y_i \\ \sum_{i=1}^n x_{1i}y_i \\ \vdots \\ \sum_{i=1}^n x_{ki}y_i \end{bmatrix}$$

This can be used to predict the dependent variable, and the error term called as residual.

3. Paired T-test

Paired sample t-test is a statistical technique that is used to compare two population means in the case of two samples that are correlated. Paired sample t-test is used in 'before-after' studies, or when the samples are the matched pairs. To calculate the parameter, the formula to be used is written as:

$$t = \frac{\bar{y}}{\sqrt{s^2/n}}$$

where \bar{y} is the mean difference between two samples, s^2 is the sample variance, n is the sample size and t is a paired sample t-test with $n - 1$ degrees of freedom.

RESULTS AND DISCUSSIONS

1. Behavior of the graph

The first graph (Figure 3) shows the behavior of Stock Market Index in the Philippines from January 2018 to December 2022. As shown in the graph, there is a fluctuating movement throughout the period. It is also noticeable that in 1st half of 2020, there was a drastic fall on stock market index which

is also affected by the Covid-19 pandemic. Since many traders and investors are being conservative on their investment portfolios as the global businesses and economies are dwindling.

Subsequently, when the government ease the community quarantine during later months of 2020, stock market was able to recover a bit. But the subsequent index is still below the pre-pandemic average index (2018 and 2019), due to continued investors' concern on inflation, domestic monetary tightening, and slowing global economy.

Inflation rate (Figure 4) for 2019 was 2.40%, 2.80 points decline from 2018. 3rd Quarter of 2019 has the lowest inflation rate during the period due to decrease in the index of the heavily-weighted food and non-alcoholic beverages. In 2020, months of April and May have the lowest inflation rate which is attributable to government's implementation of lockdowns and price freeze. But it gradually increases during 2021 and continue to spike higher in 2022 as the global economy continues to face supply chain disruptions.



Fig. 3

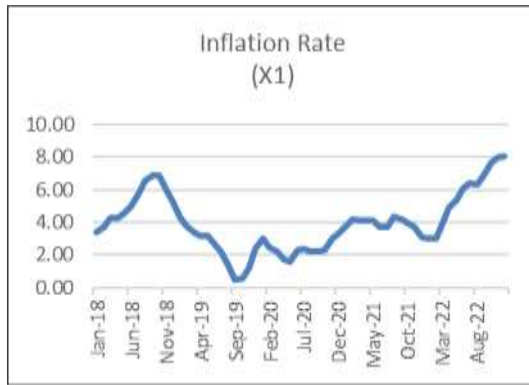


Fig. 4

As observed on interest rate graph (Fig. 5), the line movement has a slight similarity to inflation rate since this rate is being used by BSP on aiming to control inflation. BSP's Monetary Board decided to lower the interest rate on the overnight reverse repurchase facility at an all-time low of 2% effective November 2020 and this was maintained until April 2022. Interest rate continues to increase starting from 2nd Quarter of 2022 in order to alleviate the rising inflation rate.

It can be seen from graph (Fig. 6) that total foreign trade, both import and export, has a up and down movement in 2018-2019. Until it declined continuously and reached its lowest point at 6,827 million USD in April 2020, as international trading was affected by the pandemic. Then the data increases and remained steady on the succeeding years with minimal increase and decrease in value.

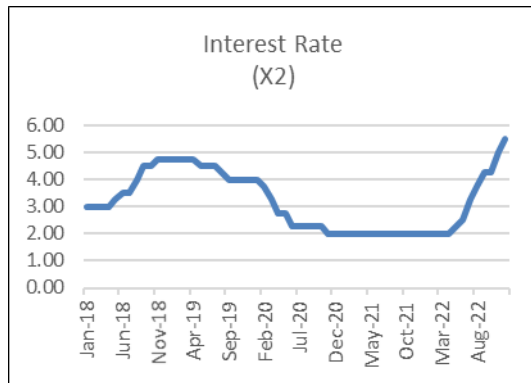


Fig. 5

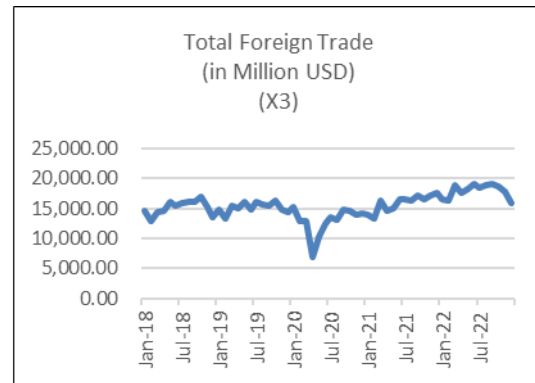


Fig. 6

It can be noted on the graph (Fig. 7) that forex rate displays a stationary pattern having its maximum and minimum value of 58.91 and 47.90, respectively, on September 2022 and May 2021 correspondingly. The data reveals that pandemic has an impact on exchange rate between Philippine Peso and U.S. Dollar since forex rate is low during peak period of the pandemic. But is started to considerably increase and achieved its highest level at year 2022.

Industrial production index (Fig. 8) had a downward trend from 2018 to 2019 and significantly fell during pandemic. The index was able to recover in the subsequent periods but still below the normal level from pre-pandemic.

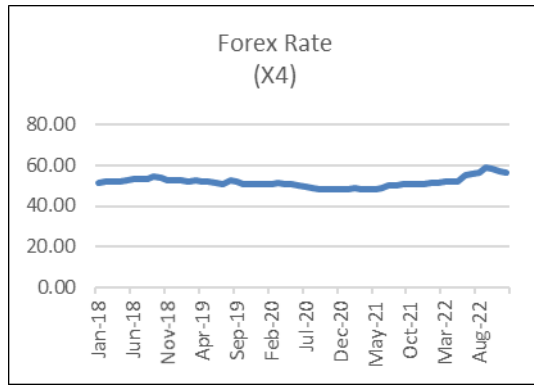


Fig. 7

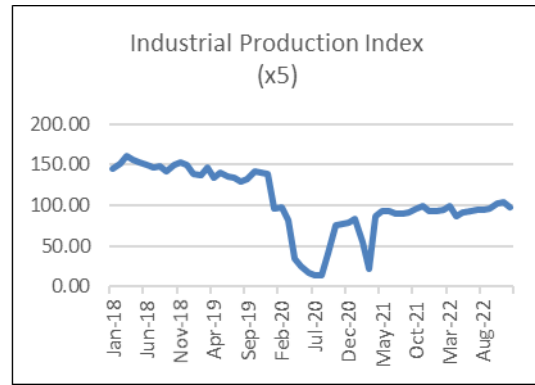


Fig. 8

During the years of 2018 and 2019, industrial sales (Fig. 9) had a low increase and decrease in index. But same with production, it reached its lowest level during the initial implementation of community quarantine in the country but then sales improved and increases gradually in the subsequent periods.

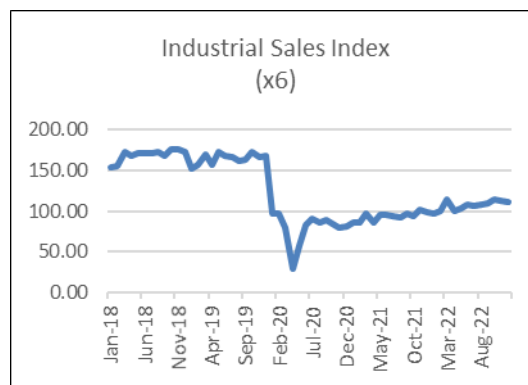


Fig. 9

2. Mathematical Model Using Normal Equation Matrices

To be able to formulate the estimating model for stock market index, the regression analysis using the matrix theory was applied to this research since there are more than one independent variable involved. The least squares estimating equations $(X'X) b = X'Y$

$$\begin{bmatrix} 60 & 32.57 & 28.75 & 251.04 & 102.75 & 117.83 & 123.95 \\ 32.57 & 21.11 & 15.75 & 136.70 & 55.93 & 64.72 & 67.52 \\ 28.75 & 15.75 & 15.14 & 120.32 & 49.36 & 57.62 & 60.25 \\ 251.04 & 136.70 & 120.32 & 1050.68 & 429.97 & 493.44 & 518.91 \\ 102.75 & 55.93 & 49.36 & 429.97 & 176.00 & 201.93 & 212.35 \\ 117.83 & 64.72 & 57.62 & 493.44 & 201.93 & 235.28 & 245.06 \\ 123.95 & 67.52 & 60.25 & 518.91 & 212.35 & 245.06 & 257.42 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \\ b_6 \end{bmatrix} = \begin{bmatrix} 230.75 \\ 125.21 \\ 110.74 \\ 965.51 \\ 395.18 \\ 453.69 \\ 477.04 \end{bmatrix}$$

The following coefficients were obtained.

$$b_0 = 4.4081; b_1 = -0.0185; b_2 = -0.0668; b_3 = -0.1639; b_4 = -0.2913; b_5 = 0.0823; b_6 = 0.2433$$

After the data analysis, the following model was obtained and can be written as:

$$\ln y = 4.4081 - 0.0185 \ln x_1 - 0.0668 \ln x_2 - 0.1639 \ln x_3 - 0.2913 \ln x_4 + 0.0823 \ln x_5 + 0.2433 \ln x_6$$

With a coefficient of determination of 0.767, this model is actually good enough in predicting the dependent variable. But since two (2) of the independent variables are found out to be insignificant predictors of stock market index after performing a regression analysis, the researchers omit that variable from the equation.

Using the least square estimation:

$$\begin{bmatrix} 60 & 28.75 & 251.04 & 117.83 & 123.95 \\ 28.75 & 15.14 & 120.32 & 57.62 & 60.25 \\ 251.04 & 120.32 & 1050.68 & 493.44 & 518.91 \\ 117.83 & 57.62 & 493.44 & 235.28 & 245.06 \\ 123.95 & 60.25 & 518.91 & 245.06 & 257.42 \end{bmatrix} \begin{bmatrix} b_0 \\ b_2 \\ b_3 \\ b_5 \\ b_6 \end{bmatrix} = \begin{bmatrix} 230.75 \\ 110.74 \\ 965.51 \\ 453.69 \\ 477.04 \end{bmatrix}$$

The following coefficients were obtained.

$$b_0 = 4.2100; b_2 = -0.1071; b_3 = -0.2460; b_5 = 0.0769; b_6 = 0.2736$$

Thus, formulating a new estimation equation written in the form of:

$$\hat{y} = e^{(4.2100 - 0.1071x_2 - 0.2460x_3 + 0.0769x_5 + 0.2736x_6)}$$

This mathematical model has a coefficient of determination of 0.751. This indicates that the variables included in the model can explain stock market index by almost 75 percent. From the model, it can be concluded that a one increase in Industrial Production and Sales Index can cause the stock market index to increase by 0.0769 and 0.2736, respectively. Moreover, one increase in Interest Rate and Total Foreign Trade will result to decrease in the stock market index by 0.1071 and 0.2460, respectively.

3. Significant Factors

In determining the predictors of stock market index, the researcher used SPSS in conducting Stepwise Multiplier Linear Regression. A logarithmic transformation has taken place to both dependent and independent variables in order to satisfy all the required assumptions before conducting such a regression analysis. The level of significance used in order to determine the significant factors is considered to be 0.01. Those remaining factors which has a p-value of less than the level of significance after applying a multiple linear regression is therefore concluded to be a significant predictor of stock market index.

Table 1 – Regression Analysis

Variables	β	p-value	Remarks
Inflation Rate (lnx_1)	-0.0253	0.0988	Not significant, 2 nd elimination
Interest Rate (lnx_2)	-0.1071	0.0007	Significant
Total Foreign Trade (lnx_3)	-0.2460	0.0001	Significant
Forex Rate (lnx_4)	-0.2913	0.3367	Not significant, 1 st elimination
Industrial Production Index (lnx_5)	0.0769	0.0001	Significant
Industrial Sales Index (lnx_6)	0.2736	0.0000	Significant

As shown in Table 1, four out of six independent variables were found out to be a predictor of stock market index namely Interest Rate, Total Foreign Trade, Industrial Production and Sales Index having a p-value of 0.007, 0.001, 0.0001 and 0.0000, respectively. This means that any increase or decrease in the said variables can cause stock market index either to inflate or deflate. The other variables: Inflation Rate and Forex Rate were found to be insignificant predictors due to its p-values being greater than 0.01 after series of stepwise regression analysis.

4. Significant Difference between the Actual and Predicted Values

The researcher used the formulated mathematical model to predict the values of the stock market index. Subsequently, a Paired T-test was applied to analyze and determine whether there exists a significant difference between the actual and predicted values of the dependent variable.

Table 2 – Paired t-test

t-statistics	p-value
0.2105	0.8340

As shown in Table 2 above, the p-value of 0.8340 is greater than the level of significance of 0.01, thus the test fails to reject the null hypothesis. Therefore, it is concluded that there is no significant difference between the actual values of stock market index and the predicted ones which are obtained through the formulated model.

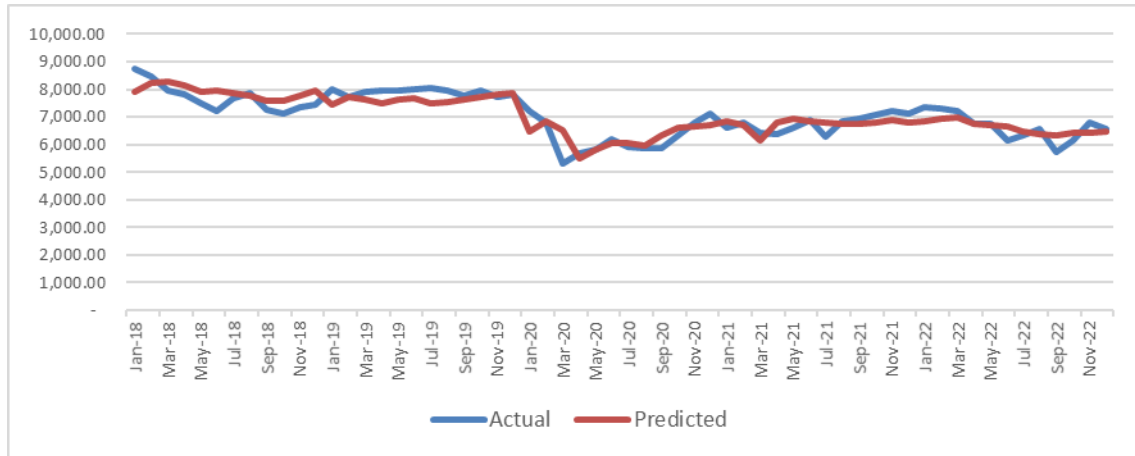


Fig. 10 - Graph of the actual and predicted values of stock market index

Furthermore, the graph of the actual and predicted values (Fig. 10) shows that the values are closely related to each other indicating that they are almost identical to each other.

CONCLUSION

This study concludes that Interest Rate, Total Foreign Trade, Industrial Production and Sales Index having a p-value of 0.0007, 0.0001, 0.0001 and 0.0000, respectively shows significant factors in determining stock market index in the Philippines. It means that any increase or decrease in the said variables can cause stock market index either to move upward or downward. After satisfying all the assumptions in Multiple Linear Regression, the formulated mathematical model has a coefficient of determination of 0.751. This indicates that the factors included in the model can explain stock market index by almost 75 percent. From the model, it can be concluded that a one increase in Interest Rate and Total Foreign Trade can cause stock market index to go down by 0.1071 and 0.2460, respectively. Moreover, a one increase in Industrial Production and Sales Index affects the stock market index to go up by 0.0769 and 0.2736, respectively. The said conclusion was corroborated by the result of paired t-test in which, there is no significant difference between the Actual and Predicted Values.

RECOMMENDATION

The study may serve as a reference for stock market participants such as investors, traders and companies in decision making. The said participants could assess the movement of interest rate, total foreign trade, industrial production and sales index in order to project future stock market index and to sustain a resilient investment portfolio while taking advantage of market opportunities. Also, the government should implement programs to boost the significant factors so as to improve the Philippine stock market index that will help in economic recovery from the aftermath of Covid-19 pandemic. Future researchers can utilize the result of this study to innovate other stringent statistical approaches to improve potential mathematical models. The researcher also recommends adding more series of data in each variable and/or include other economic variables to predict more accurately.

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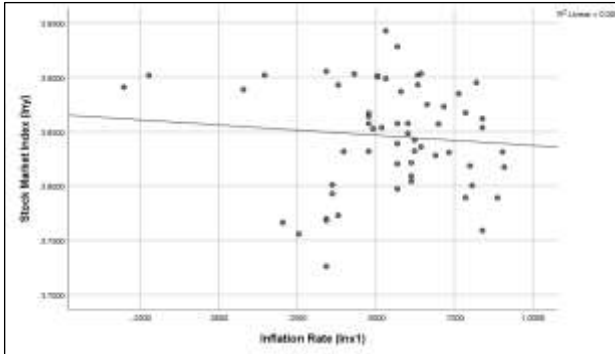
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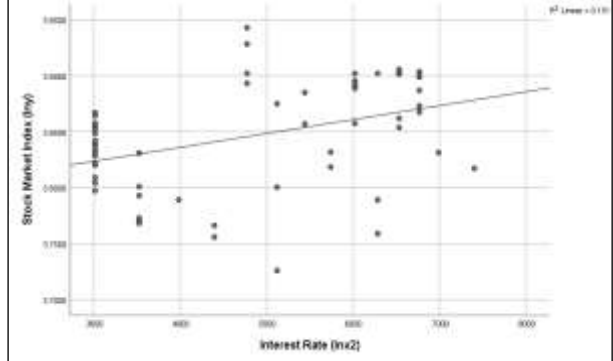
Conclusion: The Shapiro-Wilk tests the normality of the data. The test **fails to reject the null hypothesis** since the p-value is 0.202 which is greater than 0.05. Satisfying the normality test allows to state that with 95% confidence the data fits the normal distribution. Moreover, passing the normality test states that no significant departure from normality was found.

Test of Linearity

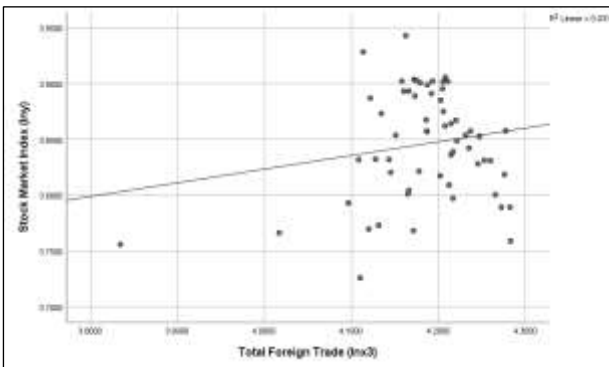
Graph 1 – Inflation Rate



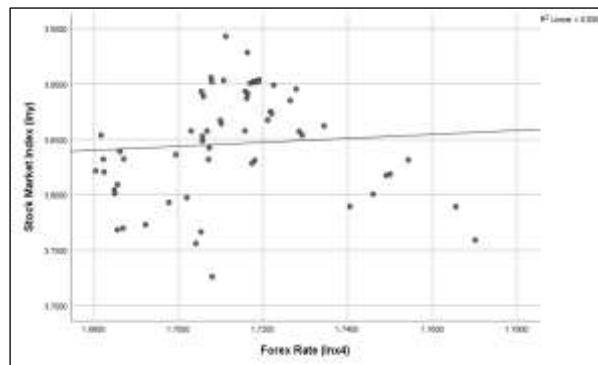
Graph 2 – Interest Rate



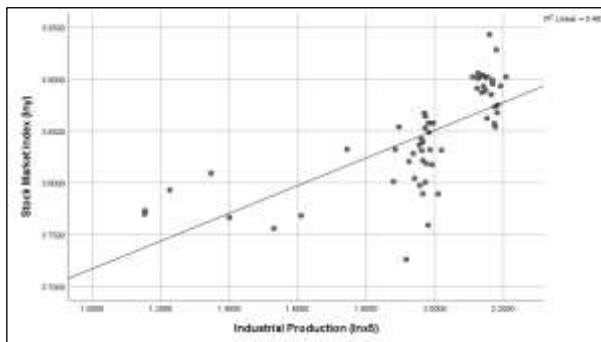
Graph 3 – Total Foreign Trade



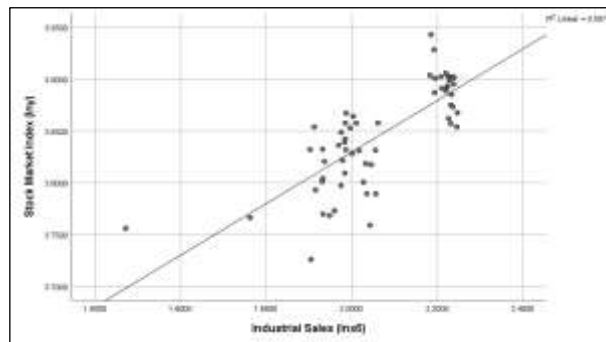
Graph 4 – Forex Rate



Graph 5 – Industrial Production Index



Graph 6 – Industrial Sales Index



Multiple linear regression requires the relationship between the independent and dependent variables to be linear. The scatterplot was used in testing the linearity assumption. The pattern of dots on a scatterplot determines whether a relationship or correlation exists between two continuous variables. If a relationship exists, the scatterplot indicates its direction and whether it is a linear or curved relationship. By looking at the plotted data, linear pattern can be seen which indicates linearity among between the independent and dependent variables.

Test of Multicollinearity

Coefficients^a

Model		Unstandardized Coefficients		Standardized	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.408	.425		10.361	.000		
	Inflation Rate (Inx1)	-.019	.017	-.092	-1.114	.270	.645	1.551
	Interest Rate (Inx2)	-.067	.045	-.210	-1.486	.143	.221	4.529
	Total Foreign Trade (Inx3)	-.164	.073	-.236	-2.234	.030	.395	2.529
	Forex Rate (Inx4)	-.291	.300	-.123	-.969	.337	.271	3.691
	Industrial Production (Inx5)	.082	.019	.434	4.448	.000	.461	2.169
	Industrial Sales (Inx6)	.243	.041	.757	5.892	.000	.266	3.755

a. Dependent Variable: Stock Market Index (Iny)

Multiple linear regression assumes that there is no multicollinearity in the data. Multicollinearity occurs when the independent variables are too highly correlated with each other. In this study, multicollinearity was tested using the variance inflation factor (VIF). It can be seen from the table that all of the computed VIFs at the last column are lesser than 10 which indicates that there is **no multicollinearity** exist between and among the independent variables.

Test of Independence

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.876 ^a	.767	.741	.0247040	1.599

a. Predictors: (Constant), Industrial Sales (Inx6), Inflation Rate (Inx1), Total Foreign Trade (Inx3), Forex Rate (Inx4), Industrial Production (Inx5), Interest Rate (Inx2)

b. Dependent Variable: Stock Market Index (Iny)

The Durbin Watson (DW) statistic was used for autocorrelation in the residuals from a statistical model or regression analysis. The Durbin-Watson statistic has a value ranging between 0 and 4. A value of 2.0 indicates there is no autocorrelation detected in the sample, and an acceptable range is 1.50 to 2.50. Values from 0 to less than 2 points to positive autocorrelation and values from 2 to 4 means negative autocorrelation. Since the result of Durbin Watson (DW) statistic is equal to 1.599 which is within the range of the rule of thumb (1.50-2.50) therefore, it satisfies the assumption that residuals are independent. Also, it is concluded that there is a positive autocorrelation considering the computed value is less than 2.

Homoscedasticity- The Breusch-Pagan Test

Test Equation

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.265438287
R Square	0.070457484
Adjusted R Square	-0.034773744
Standard Error	0.001148785
Observations	60

ANOVA							
	df	SS	MS	F	Significance F	Lagrange's Multiplier	Significance LM
Regression	6	3.30166E-06	8.83609E-07	0.669349198	0.674539652	4.227449063	0.645926766
Residual	53	6.99445E-05	1.31971E-06				
Total	59	7.52462E-05					

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.010540141	0.019791249	0.532565752	0.596360085	-0.029156077	0.05023636	-0.029156077	0.05023636
Inflation Rate (Inx1)	-0.000265164	0.000772903	-0.343075847	0.732898507	-0.001815412	0.001285083	-0.001815412	0.001285083
Interest Rate (Inx2)	0.001778242	0.002090135	0.850778368	0.398719939	-0.002414038	0.005970521	-0.002414038	0.005970521
Total Foreign Trade (in Mn USD) (Inx3)	0.000928524	0.003408015	0.272453093	0.78633234	-0.005907088	0.007764137	-0.005907088	0.007764137
Forex Rate (USD-PHP) (Inx4)	-0.005656895	0.013968512	-0.404974774	0.687126022	-0.033674183	0.022360392	-0.033674183	0.022360392
Industrial Production Index (Inx5)	0.001019549	0.000860683	1.184580897	0.241468176	-0.000706763	0.00274586	-0.000706763	0.00274586
Industrial Sales Index (Inx6)	-0.00334412	0.001919554	-1.742134257	0.087285771	-0.007194257	0.000506017	-0.007194257	0.000506017

Dependent Variable: Residual²

H₀: Homoscedasticity is present

H_a: Heteroscedasticity is present

Rejection Rule: If P-value is greater than 0.05, then fail to reject the null hypothesis.

Conclusion: Since the result of the Breusch-Pagan test for homoscedasticity is 0.645926766 then, **fails to reject the null hypothesis**. Hence, homoscedasticity exists.