Predicting Long-Run and Short-Run Movement of Sectoral Index: Evidence From Philippine Stock Market

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Abstract

The financial markets provide a viable avenue for investors who wants to invest their idle resources. Investors need accurate information to minimize investment risk and make the right investment decision. This study attempted to test the predictability of the Philippine Stock Exchange (PSE) sectoral indices. The data used in this study are the daily closing price of the six sectoral indices from January 2010 to December 2019. Augmented Dickey-Fuller (ADF) for stationarity test and Johansen Cointegration and Granger Causality analysis were used to test the long-run and short-run relationship among the six sectoral indices. The results showed that all indices are not predictable at the index level (I(0)) but predictable at the first difference (I(1)). The study found no long-run relationships between sectoral indices. The result also revealed that the sectoral indices have a short-run relationship in both directions.

Keywords: cointegration, efficient market hypothesis, granger causality, Arbitrage Pricing Theory (APT), stationarity

1. Introduction

Forecasting the movement of stock prices is deemed one of the main problems of every investor and fund manager. As much as the investors want a good return, investing is always associated with uncertainties. With these uncertain outcomes, investors must make precise investment decisions considering significant investment risk. One technique for reducing investment risk is to gather the needed relevant information. The lack of pertinent information would lead to a higher risk of investment disappointment (Khana & Palepu, 2010). A skeptic investor must be significantly cautious if they invest in stocks. This practice would lead them to an effective financial strategy to have a positive outcome (Sanjabi & Jamshidinavid, 2017). Arora and Marwaha (2014) claimed that a successful investor does not focus on short-term success. A successful investor has a clear direction for investment decisions by setting objectives and understanding the market and its risk.

Bahri (2015) revealed that stock investing is risky. There has been increasing attention among financial scholars investigating the stock market's risk and return characteristics. Bryzgalova and Julliard (2015) found a high variation in the stock return compared to bonds. The stock movement is highly stochastic. Palamalai and Kalaivani (2015) stated that stock price movements are unforecastable. They added that the idea of stock price movement is unforecastable. Other studies supported this claim (Aquino, 2006; Gregorio & Saldaña, 1990), while some rejected it (Hamid, Shah, & Akash, 2010; Bonsol & Binzo, 1996). The contradicting results from previous research added to the dilemma of whether the market price is forecastable. The majority of these studies analyzed the time series of individual stocks. It did not consider the influence of the other stock movement.

The randomness concept did not stop the researchers from finding a pattern in the stock prices and disproves the random walk of stock prices and returns. Over the last decades, many academic scholars and financial market experts focused on modeling stock movement, particularly stock indices. In the Philippines, Rufino (2013) evaluated the stationarity of the six sectoral indices of the Philippines Stock Exchange (PSE). Urrutia, Diaz, and Baccay (2017) created a model using seasonal autoregressive integrated moving averages (SARIMA) to forecast the PSE index.

Nedeltchevac (2015) stated that stock movement forecasting is considered the most challenging task for stock market analysts. Because of this, many experts developed models and indicators to lower investment risk. Traditional forecasting tools similar to technical analysis were unlikely to work anymore, given that many investors were already practicing it. As a result, market forecasters continue developing models for predicting stock price movement

(Timmermann & Granger, 2004).

This study explored the predictability of sectoral indices of the Philippine Stock Exchange. Over the last decades, forecasting the stock movement has been one of every investor and fund manager's enigmas. Hence, this study presents an alternative forecasting tool to predict the stock market. In 2012, the Philippine stock market was recognized as one of the world's top-performing markets (Ho & Odhiambo, 2015).

2. Literature Review

2.1 Financial Theories

Fama (1970) claimed that the current stock prices fully reflect all internal and external information about the market. The market is efficient when the stock price already reflects all information. This concept is called Efficient Market Hypothesis (EMH). Price patterns and returns were not forecastable in an efficient market (Timmermann & Granger, 2004). Investors could only attain the typical return on investment on a long-term time horizon. Getting more significant security returns than the risk-adjusted average market return is not attainable (Singh, Leepsa, & Kushwaha, 2016).

Meanwhile, Fama (1965) also asserted that stock prices are independent of each other. This concept is called the Random Walk Hypothesis (RWH), which states that stock price movement moves randomly. The future trend of stock prices is unforecastable. RWH emphasized that the past stock price does not affect the current and future prices. In addition, the Geometric Brownian Motion (GBM) model shares the same concept as RWH. However, GBM assumes that the stock price continues in time, which suggests a shorter timeframe analysis (e.g., 1 minute) (Reddy & Clinton, 2016).

De Bondt and Thaler (1985) first identified the market overreaction. They revealed that investors tend to overvalue old information and undervalue old information. According to Mynhardt & Plastun (2013), market overreaction is an example of market inefficiency. Unlike the EMH, the overreaction hypothesis proposed that the market is predictable. Overreaction in each period will make the price up or down. The price is expected to act the opposite in the next period, making the price forecastable.

Ross (1976) developed an Arbitrage Pricing Theory (APT) portfolio selection process model. APT asserted that other asset price movements affect asset price movements (Bahri, 2015). The concept of both EMH and RWH focused more on forecasting individual stocks by using their past values. The APT model suggests that the assets with similar characteristics cannot be sold at different prices.

Furthermore, the Modern Portfolio Theory (MPT) developed by Markowitz (1952) suggested that investors maximize their return by including firms they believe will perform well. However, return maximization is not attainable due to market imperfection. As a result, Markowitz introduced return and risk analysis in the form of investment diversification. A balanced portfolio can be achieved through diversification (Brigham & Houston, 2019). Dos Santos and Brandi (2017) added that the model's objective is to develop an efficient frontier of the best portfolio setup. In this setup, the investors could maximize their expected return rate after considering the risk level or volatility level. Sectoral diversification could reduce portfolio risk according to this theory. Investors may invest in those firms with no long-run relationship (Ahmed, Ali, Ejaz, & Ahmad, 2018).

In sum, the researcher presented the interrelationship of theories as anchors of this study across stocks' movements. Figure 1 shows that EMH suggested that the new information was immediately reflected in the industry index. Thus, the index moved because of the latest information introduced. However, according to the overreaction hypothesis, the movement is due to the investor's reaction to the said information. The irrational behavior of the investor makes the index movement predictable. As per RWH and GBM, the stock movement is random and unforecastable. However, this study used daily price movement, which is unsuitable for testing the GBM. According to APT, another asset, such as the industry B index, could be likely used to predict the industry A index's direction. The result would either be cointegrated or not. According to MPT, a portfolio must include both indices if it is not cointegrated.

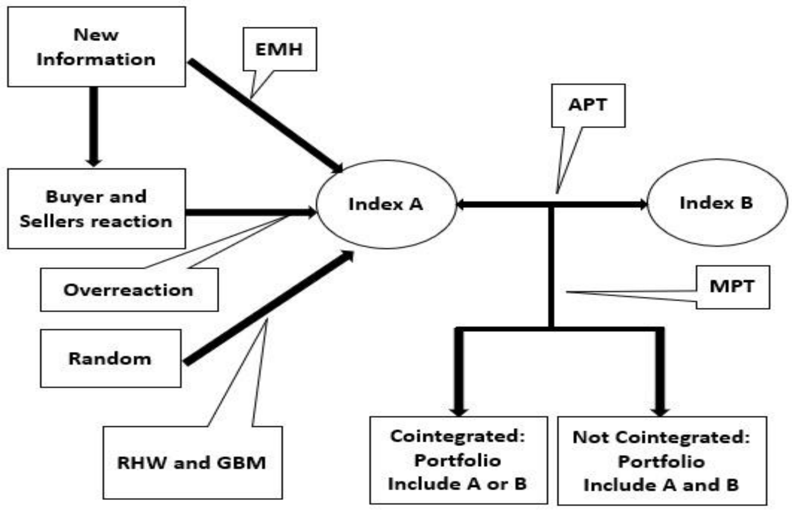


Figure 1. Stock Movement Based on Theories

2.2 Sectoral Indices

Sectoral indices are also an indicator of the country's economy in granular form (Maheshwari & Rao, 2015). According to Chimrani et al. (2018), the investor uses the value of sectoral stock indices to compare one sector's performance to the other. Companies with the same features or industries are grouped to form one industry.

In the Philippines, the PSE categorized the listed firms into six industries in 2006. This move is in response to the growing diversity of the Philippine stock market. The segmentation of the firms would supply better market analysis instead of analyzing individual stocks. PSE categorized the companies into Financials [FINA], Industrials [INDU], Holding Firms [HOLDF], Property [PROP], Services [SERV], and Mining and Oil [MINO] sectors. According to Krishnankutty and Tiwari (2011), categorizing stocks into different sectors would provide investors with additional information on the performance of each industry. This strategy could attract investment as investors like to invest in the industry with growth objectives.

2.3 Randomness of Sectoral Indices

For the past decades, the study on time series always included the test of series stationarity or unit root test. This test could measure the market efficiency to evaluate the order of integration (Nalin & Güler, 2015). It means that the market is efficient and implies data series are non-stationary; thus, the series is random and unpredictable. In other words, the unit root test is a test of whether the data is stationary or non-stationary (unit root is present) (Hassan, Shoaib, & Shah, 2007). In addition, according to Phillips and Perron (1988: p335), a unit root is "a theoretical implication of models which postulates the rational use of information that is available to economic agents."

Various studies have been conducted to test the randomness of the movement of stock indices. Zhang, Wu, Chang, and Ve Lee (2012) analyzed the EMH in Egypt, Kenya, Morocco, South Africa, and Tunisia stock markets. The period of study from January 2000 to April 2011. The authors employed a panel Seeming Unrelated Regression (SUR) of the Kapetanios−Shin−Snell (KSS) test with a Fourier function to test the hypothesis. The result of the study indicates that the stock markets of Kenya, South Africa, and Tunisia are weak−form efficient.

In Turkey, Akgun and Sahin (2017) evaluated the four (4) indices of Borsa Istanbul. The indices included in the study are the BIST 100, BIST Industry, BIST Service, and BIST Financial. The data series was from the daily closing prices from April 2010 to February 2017. The study found no evidence of unit root in the series of all indices using traditional unit root tests such as ADF, Philips-Perron (PP), and Kwiatkowski–Phillips–Schmidt–Shi (KPPS). Therefore, all indices are stationary.

In Eastern Europe, Tokić, Bolfek, and Peša (2018) analyzed Croatia, Serbia, Slovenia, and Slovakia's stock indices. The proponents extracted the data series from the daily returns from January 2006 to December 2016. Tokić, Bolfek, and Peša (2018) performed various statistical models to test the weak form of EMH in the four stock indices. Results showed that all indices, except Serbia, failed to reject the weak form of EMH.

Novak (2019) investigated the weak form of EMH in the Croatian stock market. The data series used was the daily return of the Croatia Zagreb Stock Exchange (CROBEX) from 2000 to 2009. The study utilized the quantile autoregression approach to test the efficiency of the market. The result found evidence of inefficiency in the CROBEX daily return. This market behavior may enable the investor to predict the market.

Nalin et al. (2015) tested the random walk hypothesis in Brazil, Russia, India, China (BRIC), and Turkey stock markets. The data series was from the monthly closing price from the period of July 1997 to December 2013. The authors employed autocorrelation analysis and unit root tests to test the hypothesis. The result indicated that the stock market is efficient in weak form. The monthly closing prices follow a random walk.

Meanwhile, Singh et al. (2016) tested the weak form of EMH and RWH in the world's four stock markets, namely the Standard & Poor Bombay Stock Exchange Carbon Efficient Index [S&P BSE CARBONEX] of India, S&P 500 CARBON of USA, the S&P Tokyo Price Index [TOPIX] CARBON of Japan, and Isotopic Carbon Dioxide [ICO2] of Brazil. Daily closing prices were gathered from October 1, 2010, to December 31, 2015. The run-test result showed that all indices are non-stationary.

In Bangladesh, Sufian (2015) examined the Dhaka Stock Exchange (DSE) Limited efficiency. The study tested random walk in the data series of the three major indices of DSE: the DSE general index, the DSE 20 index, and the DSE all shares index. The study employed the Autoregressive Integrated Moving Average [ARIMA] to test the hypothesis. The result showed the three indices do not follow a random walk and confirmed that the series is not weak-form efficient.

2.4 Long-Run and Short-Run Relationship

Many scholars have been analyzing the stocks of different sectoral indices to develop a fit model to be used as a tool for decision-making. Some studies investigated the trend predictability of individual indices. In contrast, other studies related the index trend to different stock indexes or macroeconomic indicators.

Palamalai et al. (2015) examined the weak-form efficiency of the Bombay Stock Exchange (BSE) using different statistical methods, including autocorrelation. The researchers analyzed the daily market prices of the BSE and the National Stock Exchange (NSE) sectoral indices. The study also includes the BSE Sensitive Index (SENSEX) and the Standard and Poor (S&P) CNX Nifty Stock Index. The results show that the sectoral index and the two primary indices moved randomly.

After the Asian crisis, Nagayasu (2000) investigated the effect of benchmark stock and sectoral indices on Thailand and Philippines' exchange rates. Using Vector Autoregression and Granger Causality, the result found that benchmark stock does not influence the exchange rates or exchange rates affect the benchmark stock. Moreover, the result identifies the banking and financial sectors as a factor of currency devaluation. Using the generalized impulse function method, they found the short-run shock to the stock prices.

Kumar (2014) tested the efficient market hypothesis by measuring the long-range dependency of Indian sectoral indices. He used the detrended fluctuation, and Local Whittle approaches to measure long-term dependence. The result found strong evidence that supports the long memory, particularly in the service sector, before the financial crisis. After the crisis, all indices except the financial and energy industries exhibit long-range stock price dependence.

Saeed's (2012) examined the effect of macroeconomic variables on the sectoral indices returns in the Karachi Stock Exchange Pakistan. The study employed a multifactor model within an Arbitrage Pricing Theory framework. The study consists of five macroeconomic variables and nine sectoral indices. The study data are the closing prices of the sectoral indices from June 2000 to June 2010. She measured the effect of macroeconomic variables on the returns using ordinary least squares. Based on the results, the macroeconomic variables were found to impact the sectors' returns significantly.

In the Philippines, using Johansen Cointegration analysis, Beji and Sucuahi (2020) tested the long-run relationship between the sectoral indices and the PSE index. The results showed that only the Mining sector and PSE indexes had long-run relationships. Meanwhile, Murcia and Tamayo (2015) simulated the predictive relationship of five macroeconomic variables and six Philippine Stock Exchange sectoral indices from January 2006 to May 2014. The six sectoral indices were estimated simultaneously by employing seemingly unrelated regression (SUR). The SUR result reveals that peso-dollar exchange rates, foreign reserves, and CPI significantly predict the fluctuation of the six sectoral indices. This study tested the predictability of six sectoral indices movement.

The movement of stock prices is one of the most investigated research topics in the last decades. For the past years, various theories have been developed that explain whether the movement is predictable. That is why multiple methods were used to determine the direction of the prices. In the Philippines, the movement was determined using SARIMA, SUR, and Johansen Cointegration analysis. Most of these studies focus on either analyzing single data series of a stock market index or comparing the index movement to the movement of economic variables. This study determined the relationship of index movement among sectoral indices.

The following are the hypotheses validated by this study.

H01: The PSE sectoral indices are significantly non-stationary series.

H02: There is no significant long-run relationship among sectoral indices.

H03: There is no significant short-run relationship among sectoral indices.

3. Method

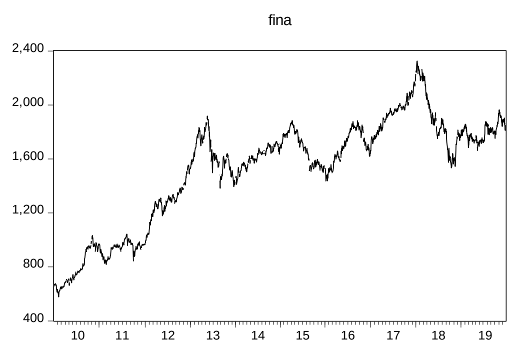
3.1 Data

This study employed data from Philippine stock market indices particularly the daily closing prices of six sectoral indices (Financial, Holding Firms, Industrial, Services, Mining and Oil, and Property). The period of the study was from January 2010 to December 2019. The series of data were collected from the Philippine Stock Exchange.

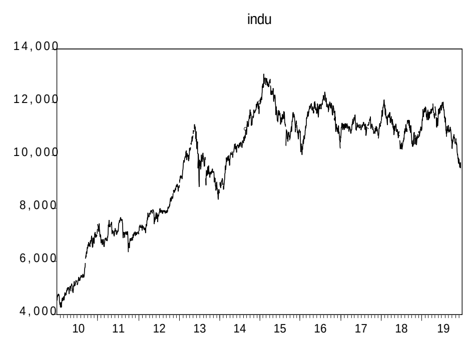
3.2 Statistical Treatment

3.2.1 Unit Root Test

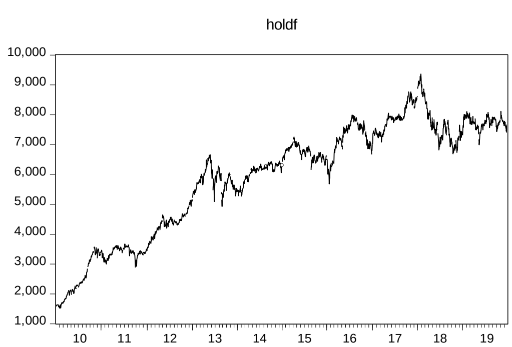
Palma (2016) stated that the time series analysis is essential for studying finance since the stock indices, prices, and volume movements are changing over the last decades. The concept of stationarity is an integral part of learning time-series analysis. A unit root test is one of the methods to test if the data is stationary or non-stationary. The order of integrating a time series is a significant factor to consider in time series analysis. Due to these reasons, different statistical tests were developed for investigating the phenomenon. The first test to conduct is to check the hypothesis if the series have a unit root or none (Lütkepohl, Krätzig, & Phillips, 2004).



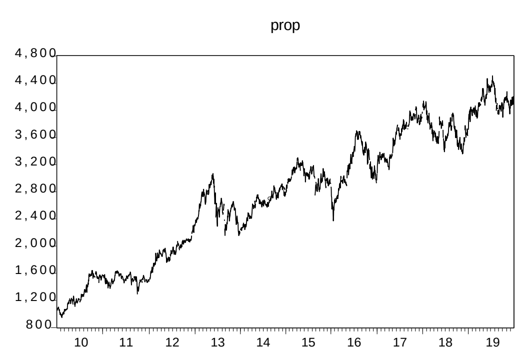
FINA



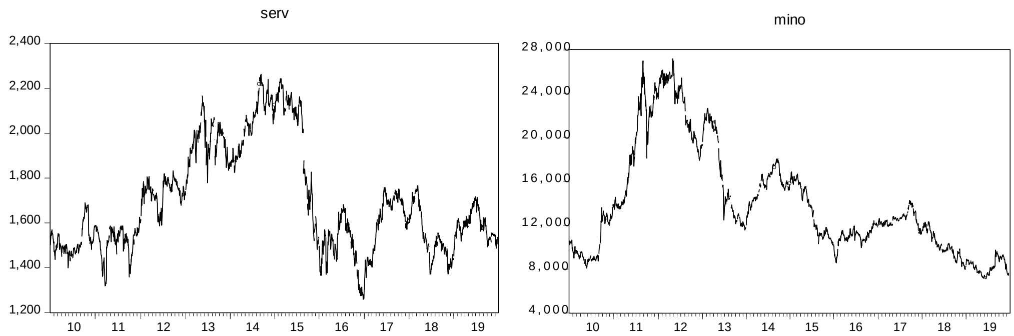
INDU



HOLDF



PROP



SERV MINO

Figure 2. Movement of PSE Sectoral Indices

A unit root test was used to determine the randomness of the data series (Al-Jafari, 2013). This study employed the Augmented Dickey-Fuller test (ADF) to test whether the data series has a unit root. ADF was used due to the sectoral indices' complex movement, which cannot be captured in simple Dickey-Fuller (DF) test. Figure 2 shows that four sectors (FINA, INDU, HOLDF, and PROP) had an uptrend movement, while the other two (2) had no trend. Hence, this study used ADF with drift and trend for FINA, INDU, HOLDF, and PROP and ADF without drift and trend for SERV and MINO. On the other hand, the Akaike Information Criterion (AIC) was employed to determine the number of lags in the equations. ADF test uses the following regressions model:

Equation 1

$$\Delta y_t = \delta y_{t-1} + \beta \sum_{i=1}^{p} \Delta y_{t-i} + u_t$$

Where, Δyt is differencing between the current index and the previous index, δ = Constant, β is the coefficient of a time trend, y_{t-1} is the previous index or lag 1, μ is the error or the white noise, and p is the lag order (Al-Jafari, 2013)

A constant mean characterizes stationary series. In other words, the price would always return to the average price. Investors who understand the stationary series concept would wait for the price to fall below the mean before buying it.

3.2.2 Cointegration Test

Two non-stationary series regressed using ordinary least squares will result in a high coefficient of determination. The result is an example of spurious regression. To solve this problem, Johansen, Engle, and Granger developed statistical procedures to get the relationship between non-stationary variables. This procedure is called cointegration analysis.

In this study, the Johansen Cointegration test was employed to test the long-run relationships of the sectoral indices. According to Sahabuddin et al. (2018), in 1988, Johansen developed two procedures to test the cointegrated matrix numbers. The first is the trace test, and the second is the Max Eigen Value test. The condition for this test is that the data series must be in the same order of integration. Due to this reason, a unit root test must be conducted first before the cointegration test. When the data series are found to be cointegrated, the VECM process must be undertaken to evaluate the long-run effect of the variables.

The model could be written as:

Equation 2

$$\Delta Y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Pi_i \, \Delta Y_{t-i} + u_t$$

$\Delta \mathrm{Y}_{\mathrm{t}} = \Pi \mathrm{y}_{\mathrm{t-1}} + \sum_{\mathrm{i=1}}^{\mathrm{p-1}} \Pi_{\mathrm{i}} \Delta \mathrm{Y}_{\mathrm{t-i}} + \mathrm{u}_{\mathrm{t}}$ which is a VECM representation, where Y_t is the vector of the endogenous variables.

The matrix Π can be written in terms of the matrix of adjustment parameters α and the matrix of cointegrating vectors β as

Equation 3

$$\Pi = \alpha\beta$$

if Π=0 then the data series are not cointegrated (Dwayer, 2015).

This study employed the Akaike Information Criterion (AIC) to determine the optimal lag length for cointegration analysis. (2008, p. 233) stated that Structural Bayesian information criterion (SBIC) is strongly consistent (but inefficient) and AIC is not consistent but is generally more efficient. In other words, SBIC would asymptotically deliver the correct model order. Simultaneously, on average, AIC would deliver too large a model even with an infinite amount of data. To sum up, no criterion is superior to others. Therefore, the researcher selected the model that could provide the smallest criterion value.

3.2.3 Granger Causality Test

This study employed the Granger causality test to explore the short-run relationships among the indices. The model will determine the causality direction of two data series. Brooks (2008) explained that since vector autoregression employs many lags in the equation, it is difficult to determine which set of variables affects the exogenous variable. The solution is to evaluate the significance of variables using joint tests on all lags of a particular variable in an equation rather than examining individual coefficient estimates. The Granger causality test examines if the past values of data series Y can affect its current value using the Autoregressive process. It also tests whether value data series X can improve the explanatory power (r-sq uare) by injecting its past model into the model. If X's coefficient is statistically significant, X is said to Granger cause Y (Paparas and Stoian, 2016).

4. Empirical Results

4.1 Sectoral Indices

Results (Table 1) show the descriptive results of the PSE sectoral index from 2010 to 2019. The MINO sector was the highest-valued sector (14,238.02) and the most volatile sector (Standard Deviation: 4,937.45, coefficient of variation: 35%). Investing in this sector is very risky. Meanwhile, the SERV sector had the lowest mean (1,695.80) among other sectors. From its 1,257.79 index value in July 2010, it only managed to climb to its all-time closing high of 2,263.47 in September 2014. Long-term investors profited only 80% of their investments during this period. However, the service sector index was the most stable index and less risky among the sectoral indices based on the result of standard deviation (233.82) and coefficient of variation (13.8%). In general, investing in PSE is both profitable and risky.

Table 1. Sectoral Indices

Indices	Mean	Min	Max	Std Dev	Coefficient of Variation
FINA	1,523.33	577.48	2,325.65	394.56	25.9%
INDU	9,697.44	4,266.78	13,068.24	2,123.49	21.9%
HOLDF	5,926.04	1,521.60	9,362.95	1,885.40	31.8%
PROP	2,752.45	946.56	4,507.29	926.58	33.7%
SERV	1,695.80	1,257.79	2,263.47	233.82	13.8%
MINO	13,993.71	7,100.34	27,194.44	4,932.43	35.2%

4.2 Stock Indices Stationarity Test

Table 2 presents the unit root test result using the ADF test at the index level I(0). The results indicated that the indices data series contains a unit root; therefore, all series are non-stationary. The results also revealed that the movement of stock indices followed a random walk at the index level. The previous index could not predict or influence the future index value. The index value moves independently from the initial values. It indicates that the market participants did not rely on their investment decision on previous prices. Most choose based on current price actions and their intuition based on their investing experience. All stock indices are a combination of individual stock prices; therefore, the indices reflect the decision made by all market participants in the stock market. Also, the result supported the claim of Fama (1979) that the stock market is unforecastable. Based on Fama's theory, stock prices depend on the investors' decisions regarding the new information provided to them.

Table 2. Augmented Dickey-Fuller Result (Unit Root Test) at I(0)

	Level			
	t-stat	**Critical (5%)**	**p-value**	**Stationarity**
FINA	-1.908	-3.411	0.6496	Non-stationary
INDU	-1.118	-3.411	0.9244	Non-stationary
HOLDF	-2.560	-3.411	0.2986	Non-stationary
PROP	-3.105	-3.411	0.0846	Non-stationary
SERV	-2.917	-1.94	0.5809	Non-stationary
MINO	-5.136	-1.94	0.4942	Non-stationary

Table 3 presents the unit root test result for I(1) series. The results revealed that the indices data series were stationary. All data series are integrated in the order of one (1) required for the cointegration test.

Table 3. Augmented Dickey-Fuller Result (Unit Root Test) at I(1)

	First Difference			
	t-stat	critical (5%)	p-value	Stationarity
FINA	-26.514	-3.411	0.000	Stationary
INDU	-19.267	-3.411	0.000	Stationary
HOLDF	-24.101	-3.411	0.000	Stationary
PROP	-15.665	-3.411	0.000	Stationary
SERV	-13.339	-1.94	0.000	Stationary
MINO	-9.498	-1.94	0.000	Stationary

4.3 Cointegration Test Result

The summary of the pairwise Johansen cointegration test results among six Philippines stock market sectoral indices is presented in Table 4. The results revealed that all sectors are not cointegrated at five (5) percent critical value. Indices of these sectors move independently in the long run. This movement reduces investment risk because one index may suffer loss while others still earn a positive return.

An investment portfolio that contains stocks with similar movements would endanger the fund to greater risk. Therefore, investors need to reduce the risk by buying a stock that does not move in the same direction. Based on the result, long-term investor could manage their stock portfolio through sectoral diversification. Modern Portfolio Theory (MPT) suggest that investor can diversify two or more stocks that are not cointegrated. Long-term investors should diversify their stock portfolios by using sectoral diversification to reduce investment risk.

Table 4. Cointegration Result Summary among Sectoral Indices

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	P-value
None	0.014676	81.35337	95.75366	0.3209
At most 1	0.007158	45.3665	69.81889	0.819
At most 2	0.004971	27.88188	47.85613	0.8188
At most 3	0.003666	15.75232	29.79707	0.7296
At most 4	0.002393	6.812405	15.49471	0.5996
At most 5	0.000403	0.980359	3.841466	0.3221

4.4 Granger Causality

Table 5 shows the statistical result of the Granger Causality test. A pairwise analysis is presented. A bidirectional causality exists on both indices when the two P-values are less than 0.05. A unidirectional causality exists if only one less than 0.05 p-value exists on both indices. Results revealed that 12 pairs of indices have a unidirectional relationship. By looking at the direction of the effects, the short-term traders know what sector to look at if they want to determine what index may go up or down in the following days.

Table 5. Result of the Granger Causality Test

Null Hypothesis:	F-Statistic	P-value
INDU does not Granger Cause FINA	3.54327	0.0291
FINA does not Granger Cause INDU	0.14923	0.8614
HOLDF does not Granger Cause FINA	3.35824	0.035
FINA does not Granger Cause HOLDF	5.83865	0.003
PROP does not Granger Cause FINA	6.81903	0.0011
FINA does not Granger Cause PROP	3.29539	0.0372
SERV does not Granger Cause FINA	3.47827	0.031
FINA does not Granger Cause SERV	1.05644	0.3478
MINO does not Granger Cause FINA	2.65571	0.0705
FINA does not Granger Cause MINO	4.78651	0.0084
HOLDF does not Granger Cause INDU	0.75882	0.4683
INDU does not Granger Cause HOLDF	10.914	0.0000
PROP does not Granger Cause INDU	0.82062	0.4403
INDU does not Granger Cause PROP	5.45952	0.0043
SERV does not Granger Cause INDU	0.13513	0.8736
INDU does not Granger Cause SERV	2.11887	0.1204
MINO does not Granger Cause INDU	0.00966	0.9904
INDU does not Granger Cause MINO	4.70552	0.0091
PROP does not Granger Cause HOLDF	14.6275	5.00E-07
HOLDF does not Granger Cause PROP	2.05671	0.1281
SERV does not Granger Cause HOLDF	4.84496	0.0079
HOLDF does not Granger Cause SERV	0.33358	0.7164
MINO does not Granger Cause HOLDF	1.72165	0.179
HOLDF does not Granger Cause MINO	3.8482	0.0214
SERV does not Granger Cause PROP	3.48927	0.0307
PROP does not Granger Cause SERV	1.96357	0.1406
MINO does not Granger Cause PROP	0.73412	0.48
PROP does not Granger Cause MINO	5.17192	0.0057
MINO does not Granger Cause SERV	2.01455	0.1336
SERV does not Granger Cause MINO	4.6684	0.0095

Figure 3 summarizes the Granger Causality results. The industrial sector affects all indices except the service sector. This sector comprises energy, food processing, and beverage processing which are the source of essential consumer needs. This contribution could benefit other sectors.

On the other hand, the service sector also affects all indices except the industrial sector. The result means that past indices significantly affect the other four indices' future values. However, there is not enough evidence that the industrial and service sectors have a short-run relationship.

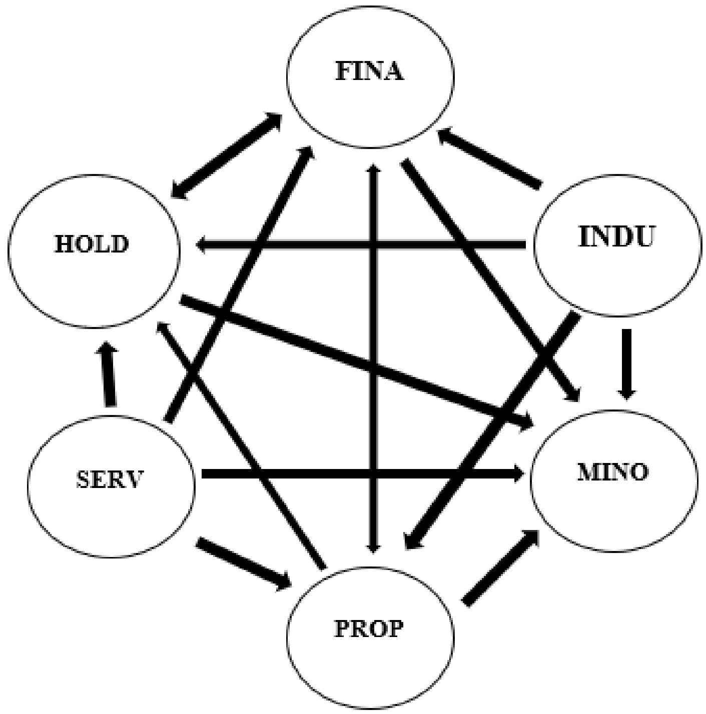


Figure 3. Granger Causality Result

Meanwhile, the mining sector index movement is affected by past index values of all sectors. The past index value of the mining sector does not affect the index movement of the other five (5) sectors. On the other hand, the Financial sector index movement has a bidirectional relation between the property sector index and the holding firm sector index. The past value of the financial index affects the future price movement of both sectors. While the past value of the property and holding sectors also affects the future price movement of the financial sector index.

5. Conclusion

Predicting the movement of stock prices is one of the main problems of every investor. A high-risk investment like stocks needs precise information to maximize wealth growth and minimize investment loss. However, theories and previous empirical studies stated that stock price movement is stochastic due to high volatility. The Efficient Market Hypothesis and Random Walk Hypothesis can explain this stock movement problem. The result of this paper shows that sectoral index movements are not predictable by using their previous value, which supports EMH and RWH notions.

Since index movement is unpredictable by using previous prices, investment diversification can still reduce the investment risk. The cointegration test revealed that all indices have no long-run relationship with each other. Therefore, spreading the investment into different sectors can lower the investment risk using the buy-and-hold strategy in the long run. Furthermore, the Granger Causality test found that indices have unidirectional and bidirectional short-run relationships. The results could help short-term investors in their short-term investment decision.

Lastly, this paper analyzed the stock market at the macro level, which is the indices. Future researchers may conduct a similar study at the micro-level using selected blue chip (index) stocks. This study may explain what share that belongs to the PSE index are stationary and which indices have a long-run and short-run relationship. The future researcher may also do the same by analyzing specific sectors. They may also use stock returns instead of the index and include economic shocks in their study's inputs.

This study adds to the growing literature on employing a cointegration analysis and Granger Causality on the Philippine sectoral indices. This study provides a real-world application to test financial management theories using forecasting. It allows future researchers to use time series analysis in analyzing financial data. The results can be used as a baseline study to analyze stock movements further. Future researchers may use this study as one of their guides in conducting time series analysis in managing their portfolios.

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