



COVID-19 PANDEMIC EVENTS AND PHILIPPINE STOCK MARKET PERFORMANCE: TESTING FOR MULTIPLE BREAKPOINTS

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Abstract:

This study examined several PSEi breakpoints to determine if COVID-19-related headlines or events cause significant stock market breaks. From December 2, 2019 to May 5, 2022 (T=632), time-series data revealed that the stock market performed the worst during the first four months of 2020. Regression with ordinary least squares on PSEi values revealed the Philippine stock market has random walk characteristics for the same time period. The Breusch-Godfrey serial correlation LM test at two lags demonstrated serial correlation in the mean equation residuals. During COVID-19 pandemic events, the Chow test was applied to daily stock market data to identify structural breaks and PSEi shifts. The Bai-Perron test identified four noteworthy multi-breakpoints. On April 17, 2020, Leyte reported the first confirmed case of COVID-19, and Johns Hopkins University reported that the global death toll exceeded 50,000. This event is likely related to the cutoff dates of November 5 and 6, 2020, when the Philippines will have an average of 1,000 COVID-19 cases per day and the government will have identified specific sectors to receive free vaccines under the initial procurement. On March 23, 2021, 17 mayors of Metro Manila and neighbouring cities voted unanimously to close recreational establishments for two weeks, indicating a possible parallel to the breakpoints on September 3, 2021, when the Philippine Food and Drug Administration approved Moderna vaccines for 12–17-year-olds. Another breakpoint found was on October 11, 2021 when 1924,300 COVAX vaccines donated by the United States arrived at Ninoy Aquino International Airport. Breakpoint events and their implications for the study of financial economics were discussed.

Keywords: multiple breakpoints, COVID-19 pandemic events, random walk, Chow multiple breakpoints, Philippine Stocks Exchange

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1. Introduction

The Philippine Stock Exchange Index (PSEI) comprises the top 30 companies from the financial, holding firms, mining, oil, industrial, property, and services sectors (Endres, 2020). The stock market acts as a venue where reserves and investments are involved in investment plans, and in the long term, it may contribute to the creation of assets and the nation's economic progress (Chen, 2020). The law of supply and demand is what causes changes in stock prices. Stock values fall when more people want to sell a stock than want to acquire it, and vice versa (Sahoo, 2020). The Philippines managed to weather the 2008–2009 global financial crisis and maintain its stability while reaching a solid growth rate of 6% annually. The Philippines is called "Asia's Rising Tiger" due to its average GDP growth rate of 6.3 percent over the previous ten years. (Clarete & Hill 2018, 2015).

The country underwent a significant transformation and fell into a slump due to the Covid-19 pandemic. In the last weeks of December 2019, an outbreak of a novel coronavirus disease (COVID-19, previously known as 2019-novel) was discovered in one of Wuhan's seafood markets in Hubei Province, China and has spread to 26 countries worldwide (Zhou et al., 2020; Xu et al., 2020). Moreover, Hafeez et al. (2020) mentioned that the virus is highly contagious and quickly spreads through droplets while sneezing and coughing. This explains why it has quickly spread to many countries worldwide and caused enormous economic havoc. Covid-19 has been declared a global pandemic by the World Health Organization, and human-to-human transmission is spreading like wildfire, with a high reproduction rate (Rothan & Byrareddy, 2020). The ongoing COVID-19 pandemic has delivered a significant unforeseen shock that had a substantial impact on public health and the international economy. To stem the spread of the virus, the Philippine government imposed stern lockdown measures, like community quarantines and restrictions on travel. Such actions significantly impeded commercial activities, which decreased business revenues and investor confidence. The stock market's performance weakened due to the ambiguity around the length and scope of the lockdowns. Consumer spending was negatively impacted due to the enforced lockdown measure, which restricted people's movements and resulted in the temporary closure of all enterprises, job losses, and reduced employee income. Furthermore, global trade is hindered since lockdown measures are implemented locally and worldwide. Companies had trouble sustaining operations and turning a profit, which decreased investment activity, thus resulting in a falloff in investors' confidence because of the market's volatility and uncertainty (Asian Development Bank, 2020). Inadequate examination of COVID-19-related concerns might cause several issues for investors and governments. Investors may undervalue the risks in their investing decisions, resulting in financial losses. Ignoring the pandemic's impact on sectors and industries may result in portfolio imbalances. Missed opportunities in healthcare, technology, and e-commerce industries can result in lost opportunities for investors to capitalize on developing trends.

Ineffective policy responses may result from a lack of understanding of the pandemic's challenges and dynamics, making it more difficult to reduce economic effects, assist affected industries, and extend vital support. The inability of policymakers to sufficiently tackle the underlying problems or implement policies outside the particular challenges encountered by various sectors can further extend the economic recovery process. Additionally, disregarding the examination of COVID-19-related issues can harm the public's health, including long-term increases in mortality and morbidity rates, virus transmission, and other economic disturbances.

2. Literature Review

The COVID-19 pandemic has forced nearly four million Filipino employees to leave their jobs at home and abroad, which has a detrimental effect on supply and demand. The lockdown restricts the kind of industries that can open to only the most necessary ones and favors work-from-home alternatives (Patinio, 2020). Almost all firms ceased operations, and daily life was disrupted, resulting in the highest unemployment rate and the most significant drop in Gross Domestic Product in Philippine history (Lim, 2020). Social gatherings are prohibited, successive cancellations of events, and several health protocols are implemented. Several business sectors in the country, particularly in the Luzon region, which accounts for about 70% of the country's GDP, essentially felt the economic breakdown (*Coronavirus - The situation in the Philippines* | Flanders Trade, 2021). The National Economic and Development Authority (NEDA) recognized the drop in foreign trading last August 2020 by twenty-one percent caused by the stricter 15-day Modified Enhanced Community Quarantine in Metro Manila, Bulacan, Cavite, Laguna, and Rizal (Vera, 2020). In other countries, such as the United States, Coibion, Gorodnichenko, and Weber (2020) analyzed that there has been a sharp drop in employment and consumer expenditure as the US government has implemented movement restrictions and a hard lockdown to limit the spread of the virus. It is also supported by the study of Ozili and Arun's empirical investigation (2020) that the rising number of days spent implementing the lockdown, monetary policy regulations, and imposing international travel restrictions significantly impacted economic activity and stock market values. Alam, Alam, and Chavali's (2020) study results reveal that during the lockdown period, India's stock market has significant positive Average Abnormal Returns that imply investors are already anticipating the lockdown. Countries worldwide have been persistent in executing preventive measures to lessen the spread of the virus. Enforcing government policy interventions to control people's movement and limit crowds in places helped improve market liquidity (Haroon & Rizvi, 2020).

A more robust national capability to respond to an emerging virus outbreak may matter even more. In a mediocre country like the Philippines, where assistance and safety nets are minimal, the community quarantine is forced to die of starvation rather than illness. The government invests very little money in the program, resulting in significant out-of-pocket expenses and widening the divide between rich and poor (Mangialavori,

Scholen, & Joshi, 2020). If only the Philippines had a better laboratory system that was arranged and ready for the pandemic crisis, this would save up to a 3.6 % loss in GDP in the 2020 forecast (Monsod & Bautista, 2020). Moreover, the research conducted by Camba and Camba Jr. (2020) suggests that there is a robust negative association if the number of Covid-19 daily infections will lead to a decrease in the PSE index and the retail pump price of diesel using robust least-squares regression and vector autoregression (VAR) approach.

Different empirical and theoretical studies were conducted to understand if movements in the stock market price are influenced by economic or political news. The compromise is that information from social media channels is one of the most significant influencers on the movement of stock market prices in times of political or economic uncertainty (Broadstock & Zhang, 2019; Shi & Ho, 2020). Stock market movements are asymmetrically dependent on information related to Covid-19, irrespective of whether the news is correct or not. As a result, the stock's actual price may fluctuate in response to new information. Therefore, it urgently needs more careful and effective Covid-19-related channels of communication to prevent incorrect information from influencing stakeholders' decision-making (Cepoi, 2020). The research holds global significance as it advances knowledge about how severe worldwide crises, like the COVID-19 pandemic, can impact financial markets. The research offers insights that can be useful and adaptable to other countries and marketplaces internationally by looking at the correlation between pandemic occurrences and stock market performance in the Philippine setting. Understanding the dynamics and trends in the Philippine stock market can help educate consumers, legislators, and researchers worldwide about the potential effects of similar crises on their financial markets. The research also contributes to the social value of humanity and the community by assisting authorities and lawmakers with establishing economic recovery strategies. It promotes targeted measures for market stability and investor confidence by enabling the recognition of specific events influencing stock market behavior. It can also inspire individuals to make better-informed choices about their personal investments, retirement savings, and long-term financial planning, ultimately impacting their financial stability and quality of life.

To know more about the impact of Covid 19 pandemic events, time series of data must be analyzed as this data changes from time to time and cannot be anticipated. Few studies conducted by several researchers using different types of methods in forecasting established a strong link between financial volatility and the Covid-19 pandemic. To cite some, Zaremba et al. (2020) and Almonares (2019) found that political and economic events trigger a significant increase in international market volatility if the government imposes strict protocols, cancellation of public events, and an effective information campaign. Abiad, Arao, and Dagli (2020) discussed that the worldwide economic loss for 2020 is anticipated to be between 0.1 and 0.4 percent of global GDP. Even the United States Dow Jones and S&P stock prices have fallen by 20%. Using a structural vector autoregression model, Yilmazkuday (2020) analyzed how the Covid-19 epidemic affected the US S&P 500 index from December 31, 2019, to May 1, 2020. According to the study,

an increase of 1% in daily Covid-19 instances in the United States resulted in a 0.01 percent decline in the S&P index after one day and a 0.03 percent reduction after one month. The historical breakdown of the S&P 500 index in March 2020 has been emphasized as providing additional evidence of Covid-19's adverse effects. This is even evident in the studies conducted by Sansa (2020) that the recent health crisis has rigorously affected the global financial markets; specifically, the stock and share prices have dropped portentously. Albulescu (2020) studies that there is a mixed effect on the financial volatility of those Covid-19 cases reported inside and outside China. Financial volatility can be attributed to economic factors, institutional concerns, or market unpredictability (Hartwell, 2018). The pandemic made the stock market agitated, lowering investors' expectations. In times like this, when it is uncertain when this pandemic will end, business owners and investors need to be prudent in making financial decisions.

The stock markets across the globe are disturbed and affect a substantial threat to worldwide economies. For example, the GCC stock market indices have declined over time because of the COVID-19 pandemic's economic effects. Among other Arab countries, GCC countries have the most robust economies yet are still the most affected by the pandemic outbreak. The government's response to curbing the spreading of the virus was very efficient; however, it still resulted in a significant decline in the profit gain of the stock market. In the paper conducted by Alkhatib et al. (2021) to determine the most affected GCC country's stock market performance and examine the factors which contribute to the effect and tracking of future events, the results found that the stock market points in each GCC country are substantially connected with the COVID-19 cases. The stock market point will drop when the country records an increasing number of cases. Additionally, as per Prophet Mode for forecasting, Kuwait's stock market was the most brutal hit, with average losses of -0.28 percent. Soon, losses will escalate in all markets, with Bahrain stock markets being the most affected by the epidemic in the next two months, with losses of -0.35. This is also supported by the study of Elhassan (2021) using the GARCH model. Findings clearly show that COVID-19 impacted all GCC stock markets' returns, and its asymmetry coefficient was negative and statistically significant at the 5% level. It also revealed the presence of the leverage effect, with the volatility persistence EGARCH value near 1 for all GCC stock market returns, that the shock took longer to be resolved. From the Australian stock market perspective, (Alam et al., 2020) study found that transportation and energy industries reacted negatively upon the declaration of COVID-19, while food, pharmaceuticals, and healthcare industries have shown a positive return even after the declaration of the pandemic. It shows investors' confidence from the WHO announcement until the first few months of the pandemic. Moreover, between February and March 2020, the Egyptian Stock Index EGX30 lost 30% of its value, and the all-share index in Nigeria declined following its remarkable performance in December 2019 and January 2020, when it rose from an average value of 26,622.85 to 28,946.96 (Nwosa, 2021).

The stock exchange gradually rose to 7,200 levels when the first approved and used vaccine for Covid-19 was announced in the United Kingdom. This offers investors hope that the economy will recover sooner or later (Conoza, 2021). The stock market's fluctuation during the pandemic, as identified by Wagner (2020), gives an outline of investors' behavior on what to expect in the future.

Ross's (1976) General asset pricing theory, known as "arbitrage pricing," contends that a financial asset's expected return can be modeled as a linear function of various macroeconomic variables or speculative market indices, with each variable's sensitivity to changes represented by a factor-specific beta coefficient. The asset will then be priced accurately using the model-derived rate of return, with the asset price equalling the projected end-of-period price discounted at the rate implied by the model. Arbitrage should bring the price back into line if it diverges. The APT is a model that connects macroeconomic data with stock market results. Additionally, a different theory anchored is the Random Walk theory of Van Horne and Parker (1967) which implies that a stock's current market price is unrelated to and independent of historical market-price trends. This theory also states that a series of stock price movements has no memory and that past price behavior cannot be used to forecast future market values. Investors may alter their projections of expected future earnings when new information becomes available, and these revisions will affect their estimation of the stock's intrinsic value.

This research aims to look at the extent of the impact the Covid-19 epidemic had on the Philippine Stock Exchange and whether the market's reaction was the same pre and during the COVID-19 Pandemic by looking at structural changes and breaks for the Philippine Stock Exchange index price. Several stakeholders will be able to benefit from this research. Investors and regulators, for example, can learn about diversifying investment portfolios, adopting tactics to retain investor confidence during crises, and creating techniques to restrict risk in financial markets during these periods. Long-term investment decisions should be approached with prudence, as these markets exhibit substantial co-movement over time when impacted by global crises. Furthermore, investors and management will better understand which industries are vulnerable, allowing them to take proper precautions. In general, this will assist multiple organizational stakeholders in determining their actions if a similar pandemic occurs.

3. Materials and Methods

3.1 Dataset

The study used secondary data since the data are readily available and can be accessed online to observe the important changes and the different breaks in the Philippine Stocks Exchange Index. Daily data were collected from the Yahoo Finance website (finance.yahoo.com), where Philippine Stock Exchange Index (PSEi) data were retrieved from December 1, 2019, which corresponds to the pre-lockdown period, to May 5, 2022, months after the Philippine government announced the majority implementation of Alert Level 1 (referred to as "the New Normal") across the country and the pre-election period

for national and local government. After identifying the important breakpoints in the dataset, the pandemic events were picked as the basis, with the events chosen based on published headlines or news releases on the precise day(s) of the breakpoints. The information on sources and events was obtained from Yahoo! News, Google News, and several internet media publications in the Philippines.

Daily data from the PSEi were the dataset used in this study, with those criteria as its inclusion criteria. The PSEi, which consists of the stock prices of 30 businesses listed on the PSE, is the Philippine Stocks Exchange, Inc. (PSE) index. On the other hand, companies that are not included in the PSE index are excluded from the data collection. However, because no human participants were involved in the study, the withdrawal criteria did not apply.

The researcher accessed the Yahoo! Finance website to extract the daily time-series data of the Philippine Stock Exchange Index covering December 1, 2019, to May 5, 2022. Then, the data was exported to spreadsheet format before establishing the profile description of the time series. Null values were left blank to ensure the evenness of the time horizon. These null values represented no trading attributed to holidays or weekends. Mere ignoring these would mean natural breaks in the time-series data, which was fair for the statistical analysis to be subsequently done in EVIEWS software.

3.2 Design and Procedure

The study utilized a descriptive-causative research design, analyzing time-series data and multiple breakpoint analyses. According to Bai and Perron (1995), Identifying structural breaks helps understand shifts, forecasting, and estimating breakpoints, with least squares proportional to sample size.

The research was quantitative. The researcher reviewed all of the pertinent facts about the COVID-19 Pandemic, one by one, and recorded them in an Excel file. The news that has been compiled contains both local and international news. The researcher conducted a thorough and detailed collection of information throughout the study period, which lasted for four weeks. The study by Chirwa and Odhiambo (2020) highlights the structural breakpoints in parameter estimations for financial time series, emphasizing the significance of taking numerous breakpoints into account. The US-China trade tensions and the Covid-19 pandemic were two catalysts for three breakpoints in the daily time series, resulting in substantial stock market declines. The CHOW Test method was also employed in the study to look at how relationships have altered through time or between different groups. The CHOW test is reasonably robust because it can reliably identify structural breaks. This advantage is significant because the Chow test is less likely to miss a proper structural break. Additionally, the Chow test was used to estimate the model's parameters before and after the structural break, which helped the researcher better understand how the structural break influenced the model's behavior. Through this test, the researcher can yield more accurate predictions or policy recommendations by identifying turning points or events that may have impacted the dynamics underlying the relationship between variables.

3.3 Ethical Considerations

This study abided by the ethical considerations set by the University of Mindanao Ethics Committee with approved certification number UMERC-2022- 285.

4. Results and Discussion

4.1 The Behavior of the Stock Market Trends

Figure 1 displays the trajectory of stock market values from December 1, 2019, to May 5, 2022, as the Philippine Stock Exchange reported on the Yahoo! Finance website. The graph indicates that prices in the PSE index fell gradually from December 2019 to January 2020. Because of the Christmas and New Year's holidays, this has been noted to be a normal occurrence in the stock market. However, it must be considered that there has been a gradual decline in stock market prices from January 2020 to April 2020, when during this period, there was ongoing news from around the world concerning the new visible virus, which has become increasingly prevalent and fatal.

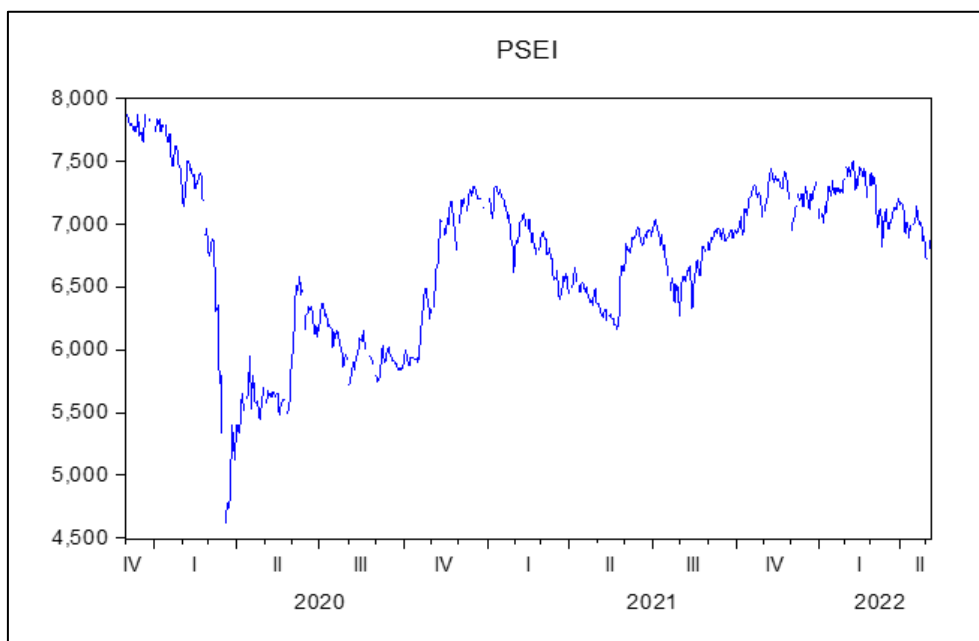


Figure 1: Time Series of Stock Market Prices from December 1, 2019, to May 5, 2022

The Philippine stock market has plunged to its lowest point in history during the first four months of the year 2020 and continuously falling after a few cases of human infection from the COVID-19 virus were reported in various parts of the world. Several factors identified caused the instant plummet of the stock market price, such as the continuously increased number of COVID-19 cases globally, the sinking oil price, and the declaration of the Philippine government of a travel ban, further worsening the situation. Whereas it was recorded that since 2008, trading on March 12, 2020, was so far the lowest drop of the stock market price, thus causing a significant negative impact on PSEi. It was

on the same day that the World Health Organization officially announced that COVID-19 is characterized as a global pandemic which reported:

"The World Health Organization (WHO) has classified the coronavirus outbreak as a pandemic. The number of cases outside of China has surged 13-fold in two weeks, according to WHO chief Dr Tedros Adhanom Ghebreyesus. He expressed "deep concern" about "alarming degrees of inactivity." A pandemic is a disease that spreads across different nations simultaneously." (BBC News, 2020)

Ichev and Marinc (2018) found that outbreak incidents have a detrimental effect on financial markets. Behavioral economics studies prove that media coverage of significant incidents, including the Ebola outbreak and the COVID-19 pandemic, can increase anxiety, depression, and terror, leading to risk aversion and despair among investors. Moreover, impacts show that market sentiment has a greater influence on more volatile stocks, stocks with highly subjective valuations, stocks of tiny firms, and stocks of enterprises focusing on specific sectors.

The graph also shows where the stock market price dropped further to its lowest point when President Rodrigo Duterte formally announced on March 16, 2020, that the entire Luzon Island was placed under an expanded enhanced community quarantine with rigorous lockdown execution to limit the spread of the virus until April 12, 2020, as stated in the news as:

"President Rodrigo Duterte imposed an expanded community quarantine in Luzon on Monday as the administration worked to curb the quickly spreading new coronavirus epidemic, which has claimed at least 12 lives in the Philippines."

"I am restricting the entire mainland of Luzon until April 12, 2020, which coincides with the end of Holy Week." "Let me be clear: this is not martial law," President Duterte stated in a public speech. The heightened community quarantine, which is equal to an "absolute lockdown or total lockdown," takes effect "immediately," according to Duterte's spokesman Salvador Panelo. Meanwhile, establishments providing basic services and goods will be permitted to operate, according to Duterte." (ABS-CBN News & Arianne Merez, 2020)

Effective March 19, 2020, regarding the increasing number of COVID-19 cases worldwide, the Philippines has suspended granting visas to all foreign citizens, as per Mr. Teodoro Locsin Jr., the country's Secretary of Foreign Affairs. The Philippine government temporarily halted the issuance of visas as a precautionary measure to avert the spread of COVID-19 in the country. Foreign nationals already in the country can stay and will be granted a 30-day visa extension if necessary. Initially, the government enforced travel restrictions on foreign visitors from China, Hong Kong, Macau, and the North Gyeongsang region of South Korea (CNN Philippines, 2020). On March 26, 2020,

it is notable that the PSEi recovered from the 44,774.27 index on March 24 to the 5,401.58 indexes when the Bayanihan to Heal as One Act was signed into law. The Bayanihan to Heal as One Act was enacted by the Philippine government in response to the COVID-19 outbreak in March 2020. The law grants the President of the Philippines emergency legitimacy to respond effectively to the outbreak. The Bayanihan to Heal as One Act empowers the President to reallocate resources from the national budget to aid the government's efforts to battle the COVID-19 pandemic. The law additionally grants the President the right to order private enterprises and industries to create critical goods and services to fight the pandemic. The law aims to include mitigating virus transmission, mobilizing the provision of necessities to families and individuals affected by the imposition of the community quarantine, taking measures to prevent overburdening the healthcare system, immediately and appropriately providing healthcare to those affected by the virus, providing recovery and rehabilitation in the form of social amelioration, and providing safety nets to all (Atienza, 2020). However, due to the increasing number of daily new COVID-19 cases and increasing death toll cases, the PSEi declined from March 26 to March 30, finishing at the 5,131.16 index.

Nonetheless, stock prices began to recover in the second quarter of the same year, 2020, after it was announced that vaccinations against the COVID-19 Virus had been identified and tested to be effective. COVID-19 vaccinations have been developed by scientists worldwide, with numerous vaccines currently ready and being distributed globally. Several countries are working to develop highly effective vaccines to combat the virus. The stock market price is still oscillating until there was a modest gain on June 15, 2020, when the Inter-Agency Task Force approved re-opening some types of businesses and adding dining restaurants to sites under General Community Quarantine areas. Nevertheless, some regions of the Philippines continue to impose strict community quarantines and prohibit everyone except frontline personnel from leaving their homes. However, the Local Government Units are expected to follow the guidelines imposed based on what kind of quarantine they have. During this time, economies are slowly resuming and restoring jobs to hundreds of Filipinos displaced by the COVID-19 virus (CNN Philippines, 2020).

Many investors regained faith in the stock market when it was announced that there are several vaccines developed to fight against the COVID-19 virus. On November 19, 2020, the Philippines' President, Rodrigo Duterte, allowed advance payments to overseas COVID-19 vaccine manufacturers to secure supplies for the country. The article additionally states that the President has authorized the emergency use of vaccines for COVID-19 patients in the Philippines, given that the vaccines satisfy the safety and effectiveness standards set forth by the country's regulatory agencies (CNN Philippines, 2020).

To boost vaccination coverage and establish herd immunity against the virus, the Philippines has received numerous vaccines from multiple manufacturers, including Pfizer, Sinovac, Sputnik, AztraZeneca, and others. The vaccine doses were immediately transported to the storage facility as they landed at Manila's Ninoy Aquino International

Airport. The vaccination doses have been distributed around the whole country. The country's vaccination effort, which aims to immunize at least 50 to 70 million Filipinos to achieve herd immunity, has significantly boosted with the arrival of the vaccine shipment. Yet, as the graph illustrates, there has been an uninterrupted fluctuation in prices as investors seem to believe that the market's stability has not been impacted by the ongoing lockdown and quarantine, which is being implemented not only in the Philippines but also in every other nation worldwide, and the rapidly expanding COVID 19 virus variants and subvariants.

4.2 Preliminary Test to Establish Multiple Breakpoints in PSEi Time-Series

The result of a univariate regression analysis of the PSEI (Philippine Stock Exchange Index) as data for multiple breakpoint estimation is shown in Table 1. The coefficient, standard error, t-statistic, and probability values for the regression model's constant term (C) are displayed in the table. The constant term's value is 6718.278, while its standard error is 25.60815, indicating that it is reasonably accurate. The t-statistic of 262.3492, $p < 0.05$, indicates that the time series exhibited random walk due to a positive intercept. The regression model does not account for any of the variations in the PSEI, as shown by the model's R-squared value of 0.000000. The value of the adjusted R-squared is also 0.000000.

Meanwhile, the Akaike Information Criterion (AIC), Schwarz Criterion, and Hannan-Quinn Criterion results are 15.70721, 15.71462, and 15.71009, respectively. These standards are applied to determine the efficacy of fit across different models. The total variation in the dependent variable not explained by the model is represented by the sum of squared residuals (2.29E+08). The log-likelihood (-4640.479) is used to compare different models in maximum likelihood estimation. Lastly, the Durbin-Watson value is 0.023883, implying that the model's residuals exhibit strong evidence of positive autocorrelation.

Table 1: Univariate regression analysis of PSEI as input for multiple breakpoint estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6718.278	25.60815	262.3492	0.0000
R-squared	0.000000	Mean dependent var		6718.278
Adjusted R-squared	0.000000	SD dependent var		622.5468
SE of regression	622.5468	Akaike info criterion		15.70721
Sum squared resid	2.29E+08	Schwarz criterion		15.71462
Log-likelihood	-4640.479	Hannan-Quinn criteria		15.71009
Durbin-Watson stat	0.023883			

Table 2 illustrates the findings from multiple breakpoint tests using the Bai-Perron test to find progressively established breaks in a time series. The first column gives the sequential F-statistic determined breaks, with a total of four breakpoints found. The table also provides the F-statistic for the test for each breakpoint, which measures the breakpoint's significance. The third column displays the scaled critical value for the test,

which is used to assess whether the F-statistic is large enough to reject the null hypothesis of no breakpoint. The asterisks (*) in the second column show that the F-statistic for that breakpoint is significant at a 5% level of significance, indicating that there is strong evidence of a breakpoint at that point in the time series. The fourth column displays the actual value of the F-statistic for each breakpoint. The last column displays the scaled critical value for the last breakpoint test (4 vs. 5), which is not statistically significant. This indicates no evidence of a fifth breakpoint in the time series after the fourth breakpoint. The results indicate that there are four important breakpoints in the time series being analyzed, with the first breakpoint having the highest F-statistic value and succeeding breakpoints showing decreasing values.

This result is important for industries since it explains how they may adhere to and use data to establish effective strategies. The table shows that there are four breaks established using consecutive F-statistic testing. These breaks indicate data points where significant changes or shifts have occurred. By finding these breakpoint dates, industries can develop strategies such as allocating resources, developing new techniques, and acting or maintaining their present plans based on the changes seen. These breakpoint dates can also guide the industries in making correct and timely decisions providing them the leverage of the market dynamics by innovating their products and entering a new target market.

Table 2: Multiple breakpoint tests to determine sequentially determined breaks via Bai-Perron tests

Sequential F-statistic determined breaks:			4
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	163.1250	163.1250	8.58
1 vs. 2 *	211.4155	211.4155	10.13
2 vs. 3 *	67.43174	67.43174	11.14
3 vs. 4 *	29.05925	29.05925	11.83
4 vs. 5	0.000000	0.000000	12.25
* Significant at the 0.05 level.			
** Bai-Perron (Econometric Journal, 2003) critical values.			

4.3 Determination of Structural Breaks

Table 3 depicts a time series's structural break dates and four recurrent repartitions. Each repartition indicates a time interval between two dates during which the time series' structure changes.

Table 3: Structural break dates

	Sequential	Repartition
1	11/06/2020	4/17/2020
2	4/17/2020	11/05/2020
3	10/11/2021	3/23/2021
4	3/23/2021	9/03/2021

The first sequential implies that the time series data had a structural break on November 6, 2020, when the Philippine officials identified sectors that will receive free doses of vaccines under the government's initial procurement. Medical front liners, barangay health workers, other allied healthcare workers, personnel from the Departments of Education, Social Welfare, Bureau of Jail Management and Penology, Bureau of Customs, and other government agencies exposed to the virus due to their line of work are among those on the list, according to the Department of Health.

Furthermore, those included in the indigent population, senior citizens, and vulnerable sectors are on the priority list. President Rodrigo Duterte also mandates to include police personnel, and military soldiers be vaccinated primarily too (CNN Philippines, 2020). This break is related to April 17, 2020, when the province of Leyte reported the first verified case of COVID-19 and the fifth case in the region of Eastern Visayas. The patient was a female, 58-year-old from the town of Burauen, Leyte, who arrived in the Philippines from Guam and displayed COVID-19 symptoms, as well as being confirmed positive following the test. The occurrence compelled local governments to implement tighter anti-virus measures, including a lockdown, and the DOH and local government authorities required residents to observe social distancing and stay-at-home rules (Philippine News Agency, 2020). Additionally, data from Johns Hopkins University shows that the global death count from COVID-19 has surpassed 150,000. With over 37,000 fatalities, the United States led the way, followed by Italy, Spain, and France. Globally, the number of confirmed cases has also increased, with more than 2.2 million people affected (Al Jazeera, 2020).

The second sequential has a breakpoint on April 17, 2020, and is related to the event that happened on November 5, 2020. On this day, Denmark indicated in early November 2020 that it would slaughter its entire population of about 17 million animals, such as minks, due to the finding of a mutated strain of the COVID-19 virus. Mette Frederiksen, the country's Prime Minister, warned that the altered strain might potentially "restart" the worldwide pandemic because it is more resistant to the COVID-19 vaccine presently in development. According to reports, the mutant strain had previously been identified in humans in Denmark and was spreading to other nations. The culling of the mink was deemed necessary to prevent future virus spread and safeguard public health (Business Insider, 2020). The Department of Health recorded 1,594 new COVID-19 cases in the Philippines, bringing the country's total to 389,725. The country also recorded 42 new respiratory ailment fatalities, totaling 7,409 deaths. The Philippines is ranked 22nd in the world for the number of coronavirus cases, with an average of 1,000 patients per day (ABS-CBN News, 2020).

Furthermore, sequential implies that the time series data had its third structural break on October 11, 2021, when the National Task Force against COVID-19 reported that 924,300 doses arrived at Ninoy Aquino International Airport Terminal 3. They were donated by the United States and distributed by the global vaccine-sharing network COVAX, with some going to Filipinos aged 12 to 17. As per the National Task Force against COVID-19, the Philippines has fully immunized 23 million Filipinos as of October 8, 2021. On the other hand, COVID-19 cases are still increasing, with 2,674,814 confirmed cases as of October 11, 2021 (GMA News Online, 2020). Merck & Co. has sought the US Food and Drug Administration (FDA) to approve Molnupiravir, an investigational antiviral tablet, for emergency use in treating Covid-19 patients. The treatment, which Merck is developing in collaboration with Ridgeback Biotherapeutics, is a new pill for Covid-19 that may be used at home (Hopkins, 2021). The events are triggered and related to March 23, 2021, when the Russian Direct Investment Fund (RDIF) sought to participate in the worldwide vaccine-sharing mechanism COVAX with the Sputnik V coronavirus vaccine, according to the fund's director Vladimir Primak during a news briefing at TASS. According to projections, two billion vaccine doses will be produced and disseminated globally (TASS, 2021). Moreover, the breakpoint is impacted by Presidential Spokesperson Harry Roque's briefing, where all 17 mayors of Metro Manila, Bulacan, Cavite, Laguna, and Rizal reported as follows:

“Metro Manila mayors have already voted on this and agreed to temporarily close gyms, spas, and internet cafes for the next two weeks in compliance with the DTI rules.” (CNN Philippines, 2021).

The fourth and final breakpoint in the time series data is the same on March 23, 2021. It is connected to the event on September 3, 2021, when the Centers for Disease Control and Prevention (CDC) granted more than \$116 million in year one of a three-year, \$348 million program to institutions for community health workers (CHW) activities to aid in COVID-19 prevention and control. The CDC also dedicated over \$6 million of a \$32 million four-year program for learning, technical support, and evaluation. CHWs are frontline health professionals that have an established connection with the community and can help community people obtain accessibility to a variety of services and resources (CDC, 2021). The announcement also supports the announcement that the Philippine Food and Drug Administration (FDA) has permitted the Moderna COVID-19 vaccination as an emergency treatment for teenagers aged 12 to 17, which helps fight the highly infectious Delta variant (CNN Philippines, 2021).

5. Recommendations

Knowing structural breakpoint dates can assist investors in more efficiently managing risk. Diversifying portfolios across asset classes, industries, and geographic areas can help mitigate the negative consequences of a structural breakpoint. For example, as

happened in the Philippine stock market following the declaration of COVID-19, investors could sell transportation and energy-related assets, which reacted negatively during the COVID-19 Pandemic, and instead invest in food, pharmaceutical, or healthcare industries, which had a positive return during this period. This enables investors to limit potential losses and take advantage of new opportunities by helping them decide when to invest. Additionally, having a well-diversified portfolio can provide security during volatile periods. Investors can keep track of economic and market developments by reviewing financial news, economic statistics, market research, and expert opinions.

The limitations of the study may include but are not limited to the fact that the analysis ignores contextual factors, including governmental policies, fiscal stimulus, investor sentiment, and industry characteristics, in favor of concentrating on quantitative stock market performance and COVID-19 occurrences. It may only partially account for long-term repercussions or emerging trends because it solely considers the near future. Awareness of these limitations is essential because they allow future research to fill in the gaps and advance knowledge of the relationship between COVID-19 pandemic events and Philippine stock market performance.

Understanding the significance of these findings for practice, economic and investment policy, future research, and the context of the breakpoints allows us to negotiate the volatile nature of financial markets better and help economic recovery during and after the pandemic. This study additionally broadens our knowledge of the complex interactions among economic policies, financial markets, and public health, which is crucial for building a more resilient global economy in the face of emerging crises.

6. Conclusion

Four multiple breakpoints were found to be significant. With this finding, identifying multiple breakpoints in the stock market time series during the COVID-19 pandemic and the association of these breakpoints with news events highlights the importance of understanding the factors underlying these shifts. These breakpoints, which represent abrupt and significant changes in stock market trends, occurred at crucial moments during the pandemic, such as the imposition of modified community quarantines, the rollout of new vaccines for mass inoculation, and the identification of sectors that will receive free vaccine doses as part of the Philippine government's initial procurement. In times of crisis, the context surrounding these thresholds highlights the interdependence of public health, economic policies, and investor sentiment. Various stakeholders, including investors, policymakers, and researchers, must comprehend the context of the significant structural breakpoints in the Philippine Stocks Exchange Index. Recognizing the factors contributing to these breakpoints can assist investors in making more informed decisions, modifying their investment strategies, and mitigating the risks associated with market volatility. The context of these breakpoints highlights for

policymakers the importance of clear and transparent communication of policy decisions and proactive measures to support the economy and maintain investor confidence.

In addition, the study of these breakpoints points of the stock market during the COVID-19 pandemic provides valuable insights into how stock markets react to unprecedented shocks, which can inform future policy responses to similar crises. Understanding the mechanisms that drive stock market behavior in such situations can aid in establishing strategies and methods for mitigating the negative impacts of future crises on financial markets. The pandemic has highlighted the susceptibility of the world economy to large-scale disruptions. Furthermore, by properly determining structural breakpoint dates, investors can devise strategies for diversifying their investment portfolios. Investors can use structural breakpoint dates to make targeted changes to their portfolios by understanding when such movements are expected or have already occurred.

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