Do Philippine Stocks Catch Coronavirus? Some Econometric Check-up on Pandemic Data, 2021-2022

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ABSTRACT

Using daily data from March 1, 2021 to March 31, 2022, the USD-PHP exchange rate and pandemic-related variables such as the number of cases, vaccinations, and stringency index in relation to the movements of Philippine Stock Exchange index (PSEi) were investigated. The paper views vaccination as an instrument for reducing economic uncertainty, subsequently providing a positive sentiment for investors and stock market. Ordinary least squares, autoregressive distributed lags, and vector autoregression was used to show some dynamics based on time series data. Particularly, there are indications of reported cases being negatively correlated and statistically significant for PSEi. Further, impulse response functions show that unanticipated shocks in vaccination and exchange rate temporarily affect the stock market index. Conversely, long-lasting effects were found for shocks in Covid-19 cases and stringency index. Overall, all the variables in the study only accounted for a small portion of explaining the fluctuations and movements of PSEi.

Keywords: *Philippine stock market, Covid-19 vaccinations, Covid-19 pandemic, stringency index*

Introduction

On March 11, 2020, the World Health Organization (WHO) announced that the emergence of the novel coronavirus (later named Covid-19) had put the world in a state of a global pandemic (WHO 2020). Stringent lockdowns and health protocols have slowed down economic activities. Businesses closed down, households became more reluctant, and industries were severely damaged. A global recession becomes inevitable, as seen during the early months of 2020 and the culmination of the year (Abueg 2020a, Abueg 2020b). The uncertainties and risks brought about by the Covid-19 outbreak have increased the volatility in the financial markets, affecting almost the entirety of domestic economies and the global economy at large (Boone *et al.* 2020, Ramelli & Wagner 2020). This even affected in particular some important sectors of the Philippine economy (Abueg, Zamora & Correa 2021), creeping into social and household affairs (Abueg, Gay & Castillo 2021, Abueg 2021). On March 19, 2020, the Philippine stock exchange index (PSEi) dropped by almost 24%, or 1,296.22 points, almost a week after the declaration of the pandemic, with PSEi closing at 4,623.19 points, a new historic low for the index since the 2008 global financial crisis (Dumlao-Abadilla 2020).

Uncertainties were seen to be amplified during recessions. Literature shows that uncertainty is one of the major driving forces for volatility in the stock market. For example, Veronesi (1999) presented a theoretical model that examined the link

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between economic uncertainty and stock market volatility. More recently, Jacksona, Kliesenb & Owyangb (2019) found that periods of high uncertainty tend to have an amplified effect on real economic variables.

Recent events show that the end of the current pandemic is still yet to be seen. The development of the vaccines was nearly a year into the pandemic, and pharmaceutical companies immediately applied for its emergency-use authorization. The vaccination rollout in the Philippines beginning in early 2021 has eased some pressure on the economy, as it is one of the key factors in stabilizing the economy. The arrival of the vaccines serves as the go-signal for the government to the gradual reopening of the economy. This led to the Philippine government to launch its vaccination campaign by March 2021.

Methodology

Stock market prices take into account all available information and respond quickly to recent information or events (Fama 1970). Uncertainty is one of the main factors that affect the firms' earnings and profitability. Uncertainty induced by the health crisis has affected household spending. Uncertainty about future income and job security may have influenced households to save as a precautionary measure (Giavazzi & McMahon 2012). Therefore, when the level of uncertainty rises, projects and spending become more expensive, reducing economic activity even further (Christiano, Motto & Rostagno 2014). We show these linkages in Figure 1 below.

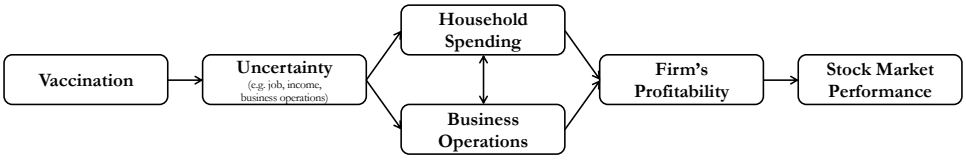

Figure 1. Linkages between vaccinations, stock market uncertainty, economic sectors, and the overall stock market performance.

The relationships between macroeconomic variables and the stock market have been a focus of scholarly studies for many years in the economic and financial fields (Asekome & Agbonkhese 2015, Asprem 1989, Brahmasrene & Jiranyakul 2007, Fama 1981, Menike 2010, Rahman, Sidek & Tafri 2009, Liu & Shrestha 2008, Shrestha & Subedi 2014). The paper initially considered daily data for the analysis given the day-to-day developments of the pandemic and health-related variables[1].

In establishing the model, we survey economic literature to support the inclusion of the variables to be used in the models and analysis. The variable of interest is the Philippine Stock index (PSEi) which is a basket of 30 common stocks of listed companies, that are carefully selected to represent the general movement of the market[2], thereby serving as the benchmark in measuring the performance of the Philippine stock market (PSE Academy 2011). Several studies revealed that exchange rates are correlated with the stock market performance (Asekome & Agbonkhese 2015, Brahmasrene & Jiranyakul 2007, Liu & Shrestha 2008). A depreciation of the local currency decreases the price of the exported goods, which can potentially raise foreign demand and sales for exporting firms (Pan, Fok & Liu 2007). Covid-19 infections have been seen to have a significant effect on stock market returns as

[1] However, it is to be noted that low-frequency data (e.g., monthly and quarterly data) can still be included and linked with daily stock data using the GARCH-MIDAS model. Such model is beyond the scope of the paper, and this is elaborated in the succeeding sections.

[2] There are two instances that the PSEi composition was rebalanced during the time period studied. First is on August 16, 2021, when AC Energy Corporation and Converge Information and Communications Technology Solutions, Inc. replaced DMCI Holdings, Inc. and Emperador, Inc. (Loyola 2021). The second time is on February 14, 2022, when Monde Nissin Corp. and Emperador, Inc. replaced Bloomberry Resorts Corp. and Robinsons Retail Holdings, Inc. (BusinessWorld 2022).

mentioned by previous studies (Al-Awadhi 2020, Camba & Camba Jr. 2020, Mazur, Dang & Vega 2021). Also, Raiku, Kumeka & Aminu (2022), Chang, Peng & Zheng (2021), Yiu & Tsang (2021), and Mishra *et al.* (2022) used the stringency index as a proxy to measure the effects of lockdowns on the stock market returns. The vaccination variable is included as it will be important to look at how this variable affects stock market performance (Khalfaoui *et al.* 2021, Rouatbi *et al.* 2021). Though stock prices are theoretically assumed to be random walks, Boudoukh, Richardson & Whitelaw (1994) argue that time series patterns in stock returns occur because investors either overreact or partially adjust to new information entering the market.

Using daily data from March 1, 2021 to March 31, 2022[3], we describe the variables and data sources in Table 1.

Table 1. Variables and their definitions, data sources.

Variable	Definition	Data source
PSEi	Weighted market index of the top 30 companies in the Philippines; PSEi daily closing index	Yahoo Finance
VACC	Daily vaccination doses administered	Department of Health
CASES	Daily Covid-19 cases	Department of Health
STRING	Stringency index*; measures the strictness of government policies. Ranging from 0 to 100 (100 being the strictest)	Our World in Data
EXCH	Daily closing price of the USD-PHP exchange rate	Bangko Sentral ng Pilipinas

*The stringency index is an arithmetic mean score of the nine components: school closures; workplace closures; cancellation of public events; restrictions on public gatherings; closures of public transport; stay-at-home requirements; public information campaigns; restrictions on internal movements; and international travel controls. These data have been made available since March 2020 (Our World in Data, 2020).

Descriptive statistics, correlations, and stationarity tests are done to ensure the soundness of models in the paper. The stationarity of the variables is checked by performing unit root tests such as Augmented Dickey-Fuller (ADF) test, and Phillips-Perron (PP) test on the levels as well as the first differences of the variables. We estimate an ordinary least squares (OLS) regression given by

$$PSEi_t = \alpha + \beta_1 Exch_t + \beta_2 Vacc_t + \beta_3 Cases_t + \beta_4 String_t + \varepsilon_t$$

Furthermore, we revise the contemporaneous ordinary least squares model by introducing a lagged dependent variable (PSEit – 1) following Shrestha & Subedi (2014) that large section of investors tends to follow the trends and patterns in the stock market. This gives us the autoregressive (AR) model:

$$PSEi_t = \alpha + \beta_0 PSEi_{t-1} + \beta_1 Exch_t + \beta_2 Vacc_t + \beta_3 Cases_t + \beta_4 String_t + \mu_t$$

We further extend the above AR model to an autoregressive distributed lag (ARDL) approach introduced by Pesaran, Shin & Smith (2001). The rationale for employing the ARDL model is that it outperforms the standard OLS approach by allowing the estimation and determining the relationship of the variables even when the variables are at different orders of integration, assuming that the variables have no second-order of integration (or I(2)); otherwise, the model would fail (Acquah 2010). Hence,

$$PSEi_t = \alpha + \beta_0 PSEi_{t-k} + \beta_1 Exch_{t-k} + \beta_2 Vacc_{t-k} + \beta_3 Cases_{t-k} + \beta_4 String_{t-k} + \vartheta_t$$

[3] The authors have initially considered the whole spectrum of the pandemic for the analysis. However, the authors used March 1, 2021 as the starting point of the time series since vaccination started on this day. Moving backwards (where no vaccination data has been recorded) may affect the quality of estimates of the models used in the paper.

In order to determine how shocks in the variables can affect the stock market movements, we employ a vector autoregression (VAR) model and proceed with generating the impulse response functions (IRF) and computing for the factor error variance decompositions (FEVD) in order to assess how shocks influence the system of the variables. The VAR is given below:

$$PSEi_t = \sum \alpha_i PSEi_{t-i} + \sum \beta_j EXCH_{t-j} + \sum \gamma_k VACC_{t-k} + \sum \delta_l CASES_{t-l} + \sum \theta_m STRING_{t-m} + \theta_t$$

$$EXCH_t = \sum \alpha_i PSEi_{t-i} + \sum \beta_j EXCH_{t-j} + \sum \gamma_k VACC_{t-k} + \sum \delta_l CASES_{t-l} + \sum \theta_m STRING_{t-m} + \omega_t$$

$$VACC_t = \sum \alpha_i PSEi_{t-i} + \sum \beta_j EXCH_{t-j} + \sum \gamma_k VACC_{t-k} + \sum \delta_l CASES_{t-l} + \sum \theta_m STRING_{t-m} + \pi_t$$

$$CASES_t = \sum \alpha_i PSEi_{t-i} + \sum \beta_j EXCH_{t-j} + \sum \gamma_k VACC_{t-k} + \sum \delta_l CASES_{t-l} + \sum \theta_m STRING_{t-m} + \sigma_t$$

$$STRING_t = \sum \alpha_i PSEi_{t-i} + \sum \beta_j EXCH_{t-j} + \sum \gamma_k VACC_{t-k} + \sum \delta_l CASES_{t-l} + \sum \theta_m STRING_{t-m} + \varphi_t$$

Results and Discussion

Descriptive Statistics and Data Trends

Some descriptive statistics were provided to describe the data used in the econometric models in Table 2.

Table 2. Descriptive statistics of model variables, March 1, 2021 to March 31, 2022.

	psei	*vacc*	*cases*	*exch*	*string*
Mean	6915.068	384135.6	6419.995	49.95388	71.0369
Standard Deviation	341.5651	413684.2	6791.697	1.287631	10.78668
Sample Variance	116666.7	1.71e+11	4.61e+07	1.657994	116.3525
Minimum	6164.89	771	146	47.666	33.33
Maximum	7502.48	2815916	38367	52.427	81.02

The downward trend of the PSEi from March 2021 until the end of May 2021 was mainly due to the elevated inflation and the slow-paced vaccination rollout. These factors affect the market sentiment, reducing the trading volumes and foreign investors selling their assets (BusinessWorld 2021). Despite the vaccination rollout, Covid-19 cases continued to increase, making the Philippine government resort to implementing lockdowns, which worsened unemployment and underemployment across economic sectors (Rivas 2021a, Rivas 2021b, Epetia 2021). Further, PSE president and chief executive officer Ramon Monzon said that the pandemic may have pushed these companies to go public such as through initial public offerings, follow-on offerings, and private placements, since debt financing had become more difficult, prompted by the tightening of banks' lending standards (Rivas 2021c). Note also that despite the rebalancing of the PSEi in August 2021 and February 2022 and with the expected turbulence (Loyola 2021, BusinessWorld 2022), the index shows no indication of such volatility, reflected in Figure 2.

The sudden plunge in July 2021 is attributed to the emergence and local transmission of the Delta variant, which had worried investors as the variant could trigger new lockdowns and disrupt the economic recovery (Camus 2021). The downward trend in August 2021 was attributed to the superstition of the "ghost month" which occurs every August. For the last

three years (using PSE data in 2019 to 2022), there seemed to be a downward pattern when the month of August is approaching, which suggests that this belief is valid and consequently affecting the stock market (Amarila & Abueg 2022). Meanwhile, the uptrend of the PSEi by end of August 2021 was mainly due to the buying pressure of the blue-chip companies, and the increase in remittances caused stock prices to rise (Royandoyan 2021). The sharp drop at the end of 2021 was associated with the reports about the global surge of Omicron variant and its first detection in the country.

During the same period, the strengthening of the Philippine peso (PHP) against the US dollar (USD) was primarily due to the slump in imports, which kept the central bank's reserves of USD unspent, making the domestic currency stronger (de Vera 2021, Habito 2020). Further, the hawkish tone of the US Federal Reserve (Fed) combined with the dovish stance of the BSP has dragged down the local currency (Dumlao-Abadilla 2021). Consequently, the PHP breached the PHP51-level in January 2022 due to the Fed's hike in its monetary policy rate, and the looming threat of the Omicron variant (Cuaresma 2022). Also, the worsening of the current account has impacted the weakening of the PHP as the trade deficit increased to USD4.7 billion in January 2022. Exports grew at an annual rate of 8.9%, while imports increased at an annual rate of 27.5% (Domingo 2022). The move of the Fed in raising interest rates to control inflation amidst the rising of oil prices due to the Ukraine-Russia conflict has also had a substantial effect on the depreciation of the local currency (Rivas 2022).

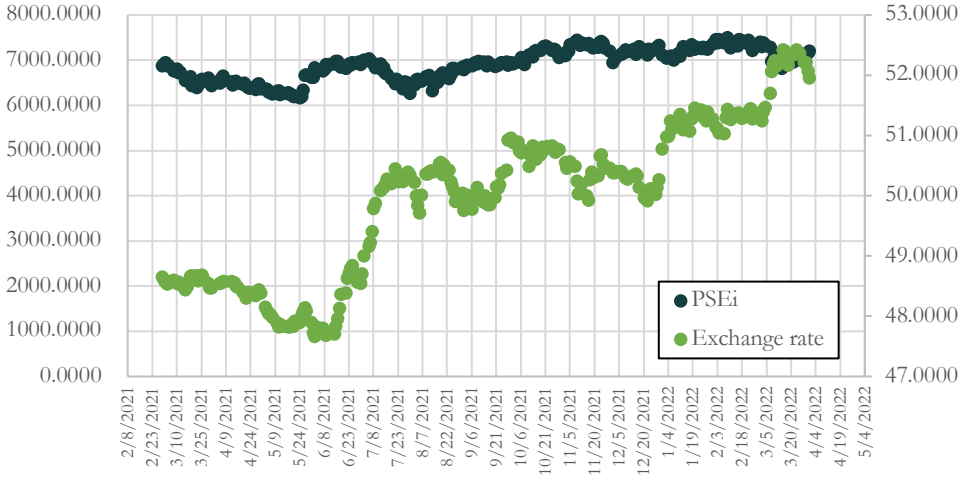

Figure 2. PSEi (left axis), and USD-PHP exchange rates (right axis), March 01, 2021 to March 31, 2022. Data from the Philippine Stock Exchange and Yahoo! Finance (for the PSEi) and Bangko Sentral ng Pilipinas (for the exchange rates).

The general trend of the daily vaccination data exhibited a slow but increasing trend over time. The fourth quarter of 2021 showed a drastic change in the pace of the vaccination rollout. Particularly, the sky-high three points in the fourth quarter of 2021 were due to the declaration of national Covid-19 vaccination days, a three-day massive vaccination drive in the country spanning from November 29 to December 1. Aside from this, booster shots had been approved and started to be administered in December 2021. However, the beginning of 2022 exhibited a slowdown in vaccination efforts attributed to Typhoon Odette's onslaught in Visayas and Mindanao, and the diversion of attention to the elections, as reflected in Figure 3.

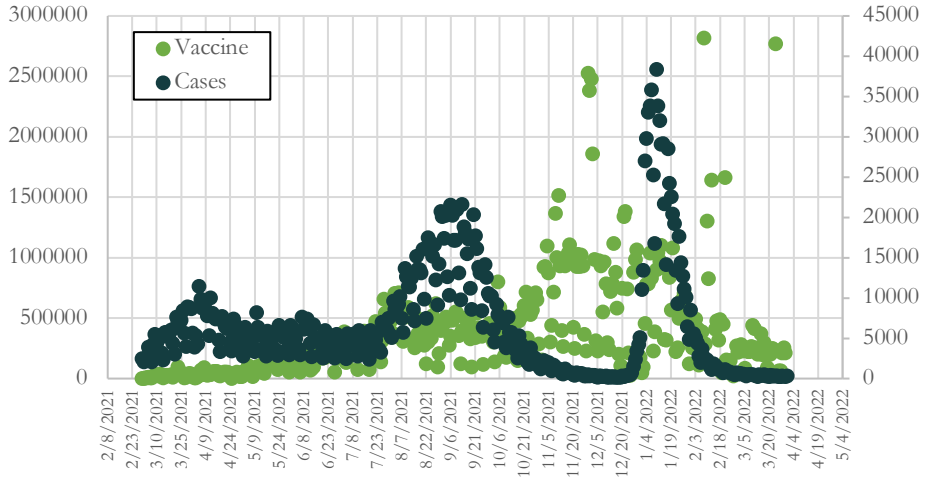

Figure 3. Daily Covid-19 infection cases (right axis), and number of administered vaccinations (left axis) in the Philippines, March 01, 2021 to March 31, 2022. Data from the Department of Health Covid-19 tracker website.

Notably, data on the stringency index over the sample period shows a distinguishing feature of being a step function. Since the stringency index measures the strictness of government policies, it is appropriate that the index would look like this over time as government policies are not dynamic and do not adjust immediately on a daily basis. Further, sharp rises and drops in the stringency index are consistent with the daily reported cases of Covid-19 such that if there are minimal cases, the stringency index goes down. In contrast, stringency measures are heightened with a sudden increase in the number of reported cases.

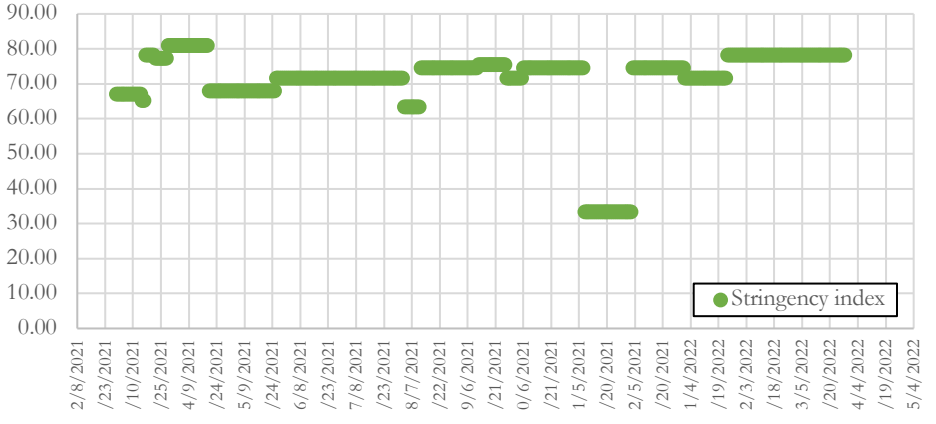

Figure 4. Stringency index for the Philippines, March 1, 2021 to March 31, 2022. Data from Our World In Data.

Correlation and Stationarity Tests

Before we begin with formal models, we provide correlation and stationarity tests for variables included in Table 1. Correlations are reported in Table 3 with the respective significance values. The first column shows that all the independent variables are significantly correlated with the dependent variable, with the exchange rate and vaccination exhibiting a positive moderate correlation, while Covid-19 cases and the stringency index shows a significant but negatively weak correlation. However, we note that at this early, there are indications of multicollinearity between the regressors shown on the other parts of Table 3.

Table 3. Correlation values of model variables, and significance levels.

	PSEi	EXCH	VACC	CASES	STRING
PSEi	1.0000				
EXCH	0.6732***	1.0000			
VACC	0.4399***	0.4028***	1.0000		
CASES	-0.1201***	0.0370	0.0682	1.0000	
STRING	-0.1352***	0.0735	-0.3834***	0.1667***	1.0000

*** significance at 1% level, ** significance at 5% level, * significance at 10% level.

It is a standard procedure in time-series analysis to test the stationarity of variables in order for the inferences of the model to be valid. Unit root testing is performed using the ADF test. The PP test is employed to reinforce the results of the ADF test as it is often criticized for having low power, as shown in Table 4. Since no variables are I(2), it can be claimed that the model is good for ARDL estimation.

Table 4. Stationarity tests using Augmented Dickey-Fuller, and Phillips-Perron tests. Both are tested under the null hypothesis that the variable is non-stationary.

Variables	Augmented Dickey-Fuller	Philips-Perron	Order of Integration
psei	-1.402	-1.292	I (1)
Δpsei	-11.562***	-11.553***	
exch	-1.150	-1.160	I (1)
Δexch	-12.263***	-12.330***	
vacc	-8.297***	-7.868***	I (0)
cases	-4.274***	-3.524***	I (0)
string	-2.942**	-3.072**	I (0)

*** significance at 1% level, ** significance at 5% level, * significance at 10% level.

Single-equation Econometric Models

Since the OLS regression and AR model require that all variables are stationary, the first difference of the PSEi and the exchange rate is used. Table 5 shows the results of the two models. Furthermore, the frequency of the data limits other variables to be included in the model. Additionally, differencing of the nonstationary variable may "throw away" some information regarding the movements in the data (Enders 2015).

Table 5. Estimates of the ordinary least squares and autoregressive models. Reported standard errors are in parentheses.

Dependent Variable: ΔPSEit		
Independent variables	**Ordinary least squares model**	**Autoregressive model, AR(1)**
Constant	-17.44911 (42.26245)	-50.52031 (51.1226)
ΔPSEi ($t-1$)		0.0145705 (0.0886296)
ΔExch	-0.8021023 (47.83769)	42.94337 (66.17496)
Vacc	0.0000157 (0.0000144)	7.93e-06 (0.0000189)
Cases	0.0001272 (0.0008278)	0.0004877 (0.0010347)
String	0.1703135 (0.5639753)	0.5584903 (0.6782653)
R-squared	-0.0137	-0.0247
F-statistic	0.32	0.30
Breusch-Godfrey LM test χ^2	0.000	0.080
White's test χ^2	13.51	11.80

*** significance at 1% level, ** significance at 5% level, * significance at 10% level.

In formulating the specifications of the ARDL model, we employ optimal lag search, which are reflected in the equation

$$PSEi_t = \alpha + \beta_0 PSEi_{t-1} + \beta_1 Exch_{t-1} + \beta_2 Vacc_{t-1} + \beta_3 Cases_{t-1} + \beta_4 Cases_{t-2} + \beta_5 Cases_{t-3} + \beta_6 String_{t-1} + \varepsilon_t$$

The results of the ARDL model shown in Table 6 reveal that the PSEi's first lag is positive and statistically significant at the 1% level, which is expected as it is assumed that large section of investors is "chartist" in nature[4]. This means that investors tend to follow the pattern and movements of the stock market in performing investment decisions. The ARDL indicates that the current reported cases show a negative correlation that is statistically significant in explaining the stock market movement. Investors changed their expectations as vaccines became available; hence, the impact of the stringency policy became limited (Yiu & Tsang 2021). Results of the Breusch-Godfrey LM test and White's test confirm that the model has no serial correlation and the residuals are homoskedastic, making the inference and estimates of the model valid to interpret.

Table 6. Estimates of the autoregressive distributed lag model. Reported standard errors are in parentheses.

Independent variables	Coefficient (Std. Error)	Independent variables	Coefficient (Std. Error)
Constant	329.024	Cases	-0.0183477***
	(262.792)		(0.0064421)
PSEi (t – 1)	0.9323527***	Cases (t – 1)	0.0167141***
	(0.0249356)		(0.0055161)
Exch	12.48797	Cases (t – 2)	0.0025976
	(47.87902)		(.0021387)
Exch (t – 1)	-10.96358	Cases (t – 3)	-0.0022625
	(47.32761)		(0.002024)
Vacc	0.0000273	String	-2.709894
	(0.0000182)		(3.386734)
Vacc (t – 1)	0.0000299	String (t – 1)	3.287296
	(0.000019)		(3.376443)

F-statistic	331.30***
R-squared	0.9481
Breusch-Godfrey LM test χ^2	0.343
White's test χ^2	69.84

Vector Autoregression Model

VAR model requires that all variables in the system are jointly stationary; hence, checking for stationarity is a standard procedure for a VAR model. As mentioned earlier, the PSEi and the exchange rate were found to be nonstationary and obtaining the first difference will make these data series stationary. Choosing the third lag (i.e., the longest) for all the variables, a symmetric VAR model is given as follows[5]:

$$\Delta PSEi_t = \sum_{i=1}^{3} \alpha_i \Delta PSEi_{t-i} + \sum_{j=1}^{3} \beta_j \Delta EXCH_{t-j} + \sum_{k=1}^{3} \gamma_k VACC_{t-k} + \sum_{l=1}^{3} \delta_l CASES_{t-l} + \sum_{m=1}^{3} \theta_m STRING_{t-m} + \mu_t$$

[4] Some of these investors who are also chartists may refer to themselves as "technical analysts". Although there is no clear delineation between the two, chartists are much more on participation on stock market trading, while technical analysts usually do not engage on the trading floor and focus on the data generated by the stock market agents and players.

[5] The optimal lag is determined via an optimal lag search command from the statistical software used (Stata), where various optimal lags were suggested per variable. The authors used the longest lag among the variables to create a symmetric vector autoregression model.

$$\Delta EXCH_t = \sum_{i=1}^{3} \alpha_i \Delta PSEi_{t-i} + \sum_{j=1}^{3} \beta_j \Delta EXCH_{t-j} + \sum_{k=1}^{3} \gamma_k VACC_{t-k} + \sum_{l=1}^{3} \delta_l CASES_{t-l} + \sum_{m=1}^{3} \theta_m STRING_{t-m} + \varepsilon_t$$

$$VACC_t = \sum_{i=1}^{3} \alpha_i \Delta PSEi_{t-i} + \sum_{j=1}^{3} \beta_j \Delta EXCH_{t-j} + \sum_{k=1}^{3} \gamma_k VACC_{t-k} + \sum_{l=1}^{3} \delta_l CASES_{t-l} + \sum_{m=1}^{3} \theta_m STRING_{t-m} + \pi_t$$

$$CASES_t = \sum_{i=1}^{3} \alpha_i \Delta PSEi_{t-i} + \sum_{j=1}^{3} \beta_j \Delta EXCH_{t-j} + \sum_{k=1}^{3} \gamma_k VACC_{t-k} + \sum_{l=1}^{3} \delta_l CASES_{t-l} + \sum_{m=1}^{3} \theta_m STRING_{t-m} + \sigma_t$$

$$STRING_t = \sum_{i=1}^{3} \alpha_i \Delta PSEi_{t-i} + \sum_{j=1}^{3} \beta_j \Delta EXCH_{t-j} + \sum_{k=1}^{3} \gamma_k VACC_{t-k} + \sum_{l=1}^{3} \delta_l CASES_{t-l} + \sum_{m=1}^{3} \theta_m STRING_{t-m} + \varphi_t$$

We proceed in analyzing the VAR model through the reported IRFs given in Figure 5.

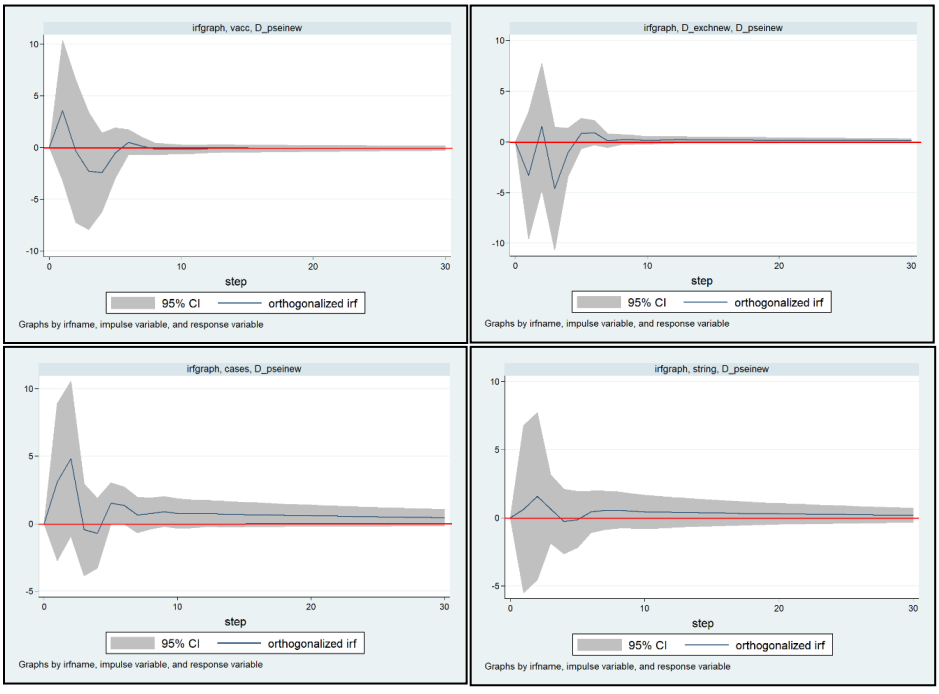

Figure 5. Impulse response functions of PSEi given shocks in vaccinations (upper left), exchange rates (upper right), infection cases (lower left), and stringency index (lower right).

While there is a quick reaction in the PSEi as observed by the sharp increase in the IRF with respect to vaccinations, the effect of the shock also starts to decline and reverts to zero before declining even further. While there is a negative initial impact for the case of the exchange rate, a similar waning effect of the shock is shared by both vaccinations and the exchange rate. This may be accounted to the goods market channel, which states that changes in exchange rates affect the competitiveness of firms and, eventually, their earnings and stock prices (Dornbusch & Fischer 1980). It also confirms that the goods market channel as a depreciation of the local currency have benefitted the exporters by making their goods cheaper and may have led to an increase in foreign demand, increasing their sales and, consequently,

their profitability and stock prices (Pan, Fok & Liu 2007). This observation is even supported by the report of the Philippine Statistics Authority (PSA) that total trade, exports, and imports have all increased between March 2021 and March 2022 (PSA 2022).

For the IRF with respect to infection cases, it shows an interesting result where an upward shock in the daily cases has a positive effect on the stock market index. Note that of all the IRFs in Figure 5, the infection cases panel shows the largest jump, and the shock lasts much longer relative to vaccinations, exchange rate, and the stringency index. This upward movement in the IRF of infection cases is contrary to the expectation that a rising number of recorded cases will have an adverse effect on the stock market. One possible explanation for this is that during the sample period, vaccines were already available in the country, which cushions the effect of the rising cases (Yiu & Tsang 2021). In addition, this result may be parallel with that of Veronesi (1999), in which bourses react more to bad information than good information. The behavior of the IRFs may also be corroborated by the significance of the lagged variable of case infections in Table 6. It may be argued also that it may be impossible to "disentangle" the VAR model given that the data on vaccines are measured side-by-side with the continuous recording of cases during the time period considered. Although the correlation coefficient between vaccinations and infection cases is nonsignificant (from Table 3), the relatively high estimate may suggest a possible connection between the two variables. Note also that while vaccinations may intend to abate uncertainty during the pandemic (as shown in Figure 1), both economic and non-economic information may affect the performance of the Philippine's bourse, as reflected by the PSEi data over time (e.g., Loyola 2021, BusinessWorld 2022, Veronesi 1999, Yiu & Tsang 2021). A similar result is also presented by Raiku, Kumeka & Aminu (2022), showing that one standard deviation shock in the total cases' growth rate has a contemporaneous positive effect on the Nigerian stock returns and diminishes in the long run. Despite this similar result, Raiku, Kumeka, and Aminu (2022), in their pooled OLS, show that infection cases have a negative and significant coefficient given stock market returns. Finally, the IRF with respect to the stringency index in Figure 5 does not show an instantaneous effect on the market index, suggesting that there is lagged response by the investors.

Figure 6 shows the FEVDs with respect to the stock market index. It can be observed that among the variables, shocks in cases yield the most contribution to fluctuations in the PSEi over the 30-day period, followed by the exchange rate, vaccination, and the stringency index. Computations in Table 7 reinforce the results in Figure 6 by providing estimates as to how much is the contribution of their shocks to the fluctuations in the stock market index.

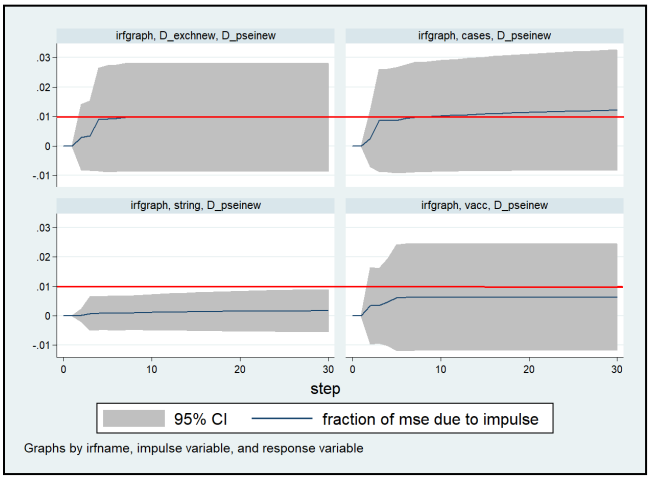

Figure 6. FEVD graphs of PSEi in response to the shocks in vaccinations (upper left), exchange rates (upper right), infection cases (lower left), and stringency index (lower right).

Table 7. Forecast error variance decomposition estimates of the vector autoregression model.

Ranking of the variables	Response variable: PSEi	Contributions of shocks
First	Cases	0.012
Second	Exchange rate	0.010
Third	Vaccine	0.006
Fourth	Stringency index	0.002

Conclusions and Recommendations

Covid-19 has become a staggering event that has brought great uncertainty to the economy. It has brought serious economic stagnation, affecting every market, especially the stock market. The vaccination campaign is seen to be an integral part of revitalizing the economy, as the recession is caused by a health-related issue, not an economic one. Vaccine availability and its inoculation have reduced the uncertainty in the markets, especially for the stock market, as it could lead to easements of restrictions, stimulating economic activities, and affecting firms' earnings and profitability, and subsequently, their stock value. The deterioration of the stock market performance was suppressed by the development and availability of vaccines (Yiu and Tsang 2021). Although vaccination campaigns just began in 2021 for the Philippines, recent studies show that vaccine generates a good outcome for the stock market. The vaccine inoculation has generated positive returns for the US stock market, as it fosters optimism for investors and the economy (Mishra *et al.* 2022). Given that few studies regarding vaccination and the stock markets have recently been emerging, this study has strived to examine the relationship and the effect of vaccination on the movements in the Philippine stock market. The study has also examined the influence of unanticipated shocks among the variables on the performance of the stock market index. Thus, to attain these goals, several models and methods were employed using data covering the period from March 1, 2021 to March 31, 2022.

However, the study utilized daily data, plus the fact that some of the variables were non-stationary. The differencing of the variables to make them stationary has "thrown away" information that could explain the movement in the stock market index (Enders, 2015). Thus, ARDL is employed as it allows the mixed integration of the variables such that none of the variables have a second order of integration. The results of the ARDL show that the first lag of the PSEi is positively significant, implying that investors do follow the trends and patterns in the stock market index. It is also expected that given the nature of the study using daily data, most investors and traders would likely tend to look into past values of the PSEi in order to help in their decision-making. Furthermore, Covid-19 cases are also statistically significant and have a negative correlation on the stock market returns, confirming the results of prior studies that stock markets react negatively to Covid-19 cases, while the first lag shows positive and significant correlation, suggesting that the stock market has exhibited a mean reverting behavior. However, vaccination exhibits positive correlation but is statistically nonsignificant, implying that the variable lacks the explanatory power in explaining the movements of the stock market over the sample period. Results of the ARDL model reinforce the argument of Veronesi (1999) that the stock market reacts more strongly to bad information than good information as confirmed cases were able to provide sufficient explanatory power in the movements of the PSEi compared to the number of vaccinations which is deemed to have a nonsignificant effect on the PSEi.

Results of the VAR model, particularly the IRFs, showed mixed results and are contrary to a priori expectations. Shocks in the vaccination and the exchange rate variables have a temporary effect on the stock market movement, while the shocks in cases and stringency index provide a long-lasting effect on the stock market index. This effect does not dissipate over the 30-day period. Both the shocks in cases and the stringency index show an overall positive influence on the stock market movement. This suggests that there could be a

diversion of assets by the investors and also the expectation of the investors in the stimulus packages that will be provided by the government, cushioning the effects of the pandemic. Results of the FEVD indicated that the variation in the exchange rate, confirmed cases, vaccination, and stringency index only accounts for 3% of the total fluctuations in the stock market index, with vaccination accounting for only 0.6%. The result showed that vaccination has little effect on the movements in the PSEi.

The findings in this paper provide initial insights regarding the effect of vaccination on the stock market movements in the Philippines. Although results show that vaccination has no explanatory power in the stock market movements over the sample period, vaccination is still an integral part of economic recovery, especially for the stock market, as it reduces the risk of infections. Econometric results in this paper have shown that the rising number of infections is detrimental to the stock market. The paper also provides an initial assessment of the effect of vaccination in the Philippine stock market movement, which can be updated and expanded further given data and developments, feeding into the growing literature on the pandemic and stock market performance.

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