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Capturing the Short-run and Long-run Causal Behavior of Philippine Stock Market Volatility under Vector Error Correction Environment

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Abstract

This study investigates the short-run and long-run causal behavior of the Philippine stock market index volatility under vector error correction environment. The variables were tested first for stationarity and then long-run equilibrium relationship. Moreover, an impulse response function was estimated to examine the extent of innovations in the independent variables in explaining the Philippine stock market index volatility. The results reveal that the volatility of the Philippine stock market index exhibit long-run equilibrium relationship with Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices. The short-run dynamics-based VECM estimates indicate that in the short-run, increases (i.e., depreciation) in Peso-Dollar exchange rate cause PSEI volatility to increase. As for the London Interbank Offered Rate, it causes increases in PSEI volatility in the short-run. The adjustment coefficients used with the long-run dynamics validates the presence of unidirectional causal long-run relationship from Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices to PSEI volatility, and bidirectional causal long-run relationship between PSEI volatility and London Interbank Offered Rate. The impulse response functions developed within the VECM framework demonstrate the positive and negative reactions of PSEI volatility to unanticipated Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil price shocks.

Keywords: Crude Oil, LIBOR, Exchange Rate, Stock Market Volatility

JEL Classification Code: C22, C53, E44, F31, G10

1. Introduction

The stock market plays a vital role in the development process of the Philippine economy since it acts as a mediator between lenders and borrowers. That is, a well-functioning stock market may assist the development process in an economy by boosting savings and allowing for a more efficient allocation of resources. At micro level for instance, the stock market provides households with assets that may satisfy their liquidity needs or risk preferences. Also, based upon the idea of liquidity, a well-functioning stock market ensures the efficiency of utilizing economic resources available to the economy in the sense that the cost of capital will be lower and gives companies easy access to capital through equity issues. This leads to improvement in capital allocation and serves as a channel for economic growth (Camba & Camba, 2020).

It is also well established that volatility characterizes the behavior of the stock market. A highly volatile stock market means that prices or returns fluctuates enormously over a specific time. That is, volatility can be considered as a measurement of the uncertainty associated with stock market investment decisions and understanding the nature of volatility patterns of the stock market can be used as a reference to pricing, hedging strategy and risk management (Tu & Liao, 2020). Excessive volatility may prevent the smooth functioning of financial markets and adversely affect the performance of the economy (Malik & Hassan, 2004; Malik & Hammoudeh, 2007; Nguyen & Nguyen, 2019).

Thus, capturing the short-run and long-run causal behavior of the Philippine stock market index volatility with Peso-Dollar exchange rate, London Interbank Offered Rate and crude oil prices under vector error correction environment is the object of this study.

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2. Literature Review

2.1. Stock Market Liquidity and Volatility

Camba and Camba (2020) examined the dynamic relationship of domestic credit and stock market liquidity on the economic growth of the Philippines from 1995 to 2018 applying the autoregressive distributed lag (ARDL) bounds testing approach to cointegration, together with Granger causality test based on vector error correction model (VECM). The ARDL model indicated a long-run relationship of stock market liquidity on GDP growth. Also, the Johansen cointegration test confirmed the existence of long-run relationship of stock market liquidity on GDP growth. The VECM concludes a long-run causality running from stock market liquidity to GDP growth.

Moreover, Al-Homaidi et al. (2020) empirically studied the determinants of liquidity of Indian listed firms. The findings reveal that leverage, return on assets, and firm age are the essential internal determinants that impact the liquidity of Indian listed firms. Furthermore, among the internal determinants, the results indicate that firm size, leverage ratio, return on assets ratio, and firm age are found to have a significant positive association with firms' liquidity, except leverage ratio and firm age has a negative relationship with firms' liquidity.

Nguyen and Nguyen (2019) applied symmetric models (GARCH, GARCH-M) and asymmetry (EGARCH and TGARCH) to measure stock price volatility on HSX. The results show that GARCH (1,1) and EGARCH (1,1) models are the most suitable models to measure both symmetry and asymmetry volatility level of VN-Index. The study also provides evidence for the existence of asymmetric effects (leverage) through the parameters of TGARCH model (1,1), showing that positive shocks have a significant effect on the conditional variance (volatility). This result implies that the volatility of stock returns has a big impact on future market movements under the impact of shocks, while asymmetric volatility increase market risk, thus increase the attractiveness of the stock market.

Furthermore, Tu and Liao (2020) investigated the block trading volume duration in Taiwanese equity market. The empirical results indicate that VACD (2,1)-GARCH (2,1), VACD (2,1)-IGARCH (1,1) and VACD (2,1)-FIGARCH (3,0.026,1) are relatively more appropriate to capture the volume duration clustering of CHT Inc. The reciprocal of duration is significantly positive in all specifications, indicating that the longer the volume duration, the smaller the volatility of stock price and vice versa. The long memory in volume duration series increases dependence at level of volatility clustering. The volume duration of interdependence can be an effect of long memory in volatility, and the long memory in volatility is corresponding for changing in dependence structure. Moreover, the VACD (2,1)-IGARCH (1,1) exhibits relatively better performance of prediction on capturing volume duration. This volatility model is more appropriate to portray the changes of the CHT Inc. prices and provides more information about the volatility process for investing strategy.

2.2. The Link between Stock Market and Exchange Rate

Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia, Bangladesh, India and Pakistan. Their results indicated that there is no cointegrating relationship between stock prices and exchange rates. Furthermore, there is no causal relationship between the above variables.

Lee and Zhao (2014) examined the short-run and long-run causal relationship between stock market prices and exchange rates in Chinese stock markets using monthly data from January 2002 to December 2012. They found a long-run causality from exchange rates to stock prices in Chinese stock markets and a short-run causality from Japanese yen and Korean won exchange rates to stock prices in the Shanghai Stock Exchange strongly prevails while in the Shenzhen Stock Exchange weakly prevails.

The paper by Sahadudheen (2015) examined the effect of impulsiveness of euro on Indian stock market. Adopting a generalized autoregressive conditional heteroskedasticity (GARCH) and exponential GARCH (EGARCH) model, the study suggests a negative relationship between exchange rate and stock prices in India. Even though India is a major trade partner of European Union, the study couldn't find any significant statistical effect of fluctuations in Euro-rupee exchange rates on stock prices. The study also reveals that shocks to exchange rate have symmetric effect on stock prices and exchange rate fluctuations have permanent effects on stock price volatility in India.

Parsva and Lean (2017) investigated the causal relationship between stock prices and exchange rates for six Middle Eastern countries, namely, Egypt, Iran, Jordan, Kuwait, Oman, and Saudi Arabia before and during (after) the 2007 global financial crisis for the period between January 2004 and September 2015. Using Vector Autoregressive (VAR) model in a multivariate framework (including two control variables, inflation rates and oil prices) the results suggest that in the case of Jordan, Kuwait and Saudi Arabia, there exists bidirectional causalities after the crisis period but not the before. The opposite status is available for the case of Iran. In the case of Oman, there is bidirectional causality between the variables of interest in both periods. The results also reveal that the relationship between stock prices and exchange rates has become stronger after the 2007 global financial crisis. Overall, the results of this study indicate that fluctuations in foreign exchange markets can significantly affect stock markets in the Middle East.

2.3. The Link between Stock Market and Interest Rate

Maysami et al. (2004) used monthly data from January 1989 to December 2001 to examine the relationship between Singapore's composite stock index, three Singapore sector indexes (the finance index, the property index, and the hotel index), and a set of macroeconomic variables. Based on the results of Johansen's cointegration test, the Singapore stock market, finance sector index and property index showed a significant long-run relationship with long and short-run interest rates included in the analysis. On the other hand, the hotel index showed no significant relationship with short and long term interest rates.

Lee and Brahmasrene (2018) paper examined the short-run and long-run dynamic relationships between selected macroeconomic variables and stock prices in the Korea Stock Exchange. The results of vector error correction model (VECM) estimates indicate that short-term interest rate is not related to stock prices in the short-run.

2.4. The Link between Stock Market and Crude Oil Prices

Ono (2011) examined the impact of oil prices on real stock returns between 1999 and 2009 using VAR models. The findings showed a positive and significant impact of oil prices on real stock returns for China and India.

Also, Abdalla (2013) examined the impact of oil price fluctuations on stock market returns in Saudi Arabia over the period from 2007 through 2011. The author applied a bivariate vector autoregressive-generalized autoregressive conditional heteroscedasticity (VAR-GARCH) model and found a positive impact of oil price fluctuations on stock market returns.

The paper by Al Hayky and Naim (2016) investigated the dynamic relationship between oil price and Kuwait's stock market index between 2005 and 2015. The authors used Markov Switching model and detected that there is a positive and significant relationship between the Kuwaiti stock market index and oil price fluctuations in the period of high volatility regime while no relationship was found for the period of low volatility regime.

Echchabi and Azouzi (2017) examined the possible effect of the oil price fluctuations on stock price movements applying Toda and Yamamoto's (1995) Granger non-causality test on the daily Oman stock index (Muscat Securities Market Index) and oil prices between the period of 2 January 2003 and 13 March 2016. The results indicated that the oil price fluctuations have a significant impact on stock index movements. However, the stock price movements do not have a significant impact on oil prices.

3. Research Methodology

3.1. Model Specification and Data Description

The paper utilizes the following model with 4-time series, the Philippine stock market index volatility (PSEIVOL), Peso-Dollar exchange rate (PHUSD), London Interbank Offered Rate (LIBOR) and crude oil prices(CRUDE):

$$PSEIVOL_t = \alpha_0 + \beta_1 PHUSD_t + \beta_2 LIBOR_t + \beta_3 CRUDE_t + e_t \tag{1}$$

where α_0, β_1, β_2 and β_3 are parameter estimates and e_t the error term. The data for Philippine stock market index was gathered from the Philippines Stock Exchange. The monthly Philippine stock market index volatility (PSEIVOL) may be given by the average standard deviation of the closing daily stock index. The PHUSD data is measured in terms of the end-of-the-month Peso-US Dollar exchange rate and the LIBOR data is the average 3-month US-based London interbank offered rate (LIBOR) accessed from the Bangko Sentral ng Pilipinas online database. The crude oil data is the average spot price of Brent, Dubai and West Texas Intermediate, equally weighed and accessed from US Energy Information Administration website. The data are monthly frequency running from January 2000 to December 2019, making 240 observations.

3.2. Augmented Dickey–Fuller and Phillips–Perron Unit Root Tests

This study applied two types of widely recognized unit root tests, Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) and Phillips-Perron (PP) (Phillips & Perron, 1988) tests on Philippine stock market index volatility, Peso-Dollar exchange rate, London interbank offered rate and crude oil prices. All these tests are performed at level then performed at first difference. Two different models are considered while performing the ADF and PP tests, (1) the model with an intercept (2) the model with intercept and trend. The general form of ADF test which may could be as follows:

$$\Delta X_t = a + \delta X_{t-1} + \sum_{i=1}^{q} \delta_i \Delta X_{t-i+1} + \varepsilon_t \tag{2}$$

$$\Delta X_t = a + \beta_t + \delta X_{t-1} + \sum_{i=1}^{q} \delta_i \Delta X_{t-i+1} + \varepsilon_t \tag{3}$$

where Δ is first difference, α is constant, β is coefficient of time trend, t is linear time trend X is the variable under examination, and ε represents the error term.

The null hypothesis is X (i.e., PSEIVOL, PHUSD, LIBOR and CRUDE) contains unit root, if it is found that the coefficient β is meaningfully different from zero ($\beta \neq 0$) the null hypothesis would be rejected and alternative hypothesis that X doesn't have a unit root would be accepted.

3.3. Johansen-Juselius Cointegration Approach

If the series used become stationary at the same level (i.e., I(1)), then it would be possible that the linear combination of the variable to stationary at the zero level (i.e., I(0)), which means that the data are cointegrated. It is also possible to have more than one linear combination, and so more than cointegration relationship between the variables,Philippine stock market index volatility, Peso-Dollar exchange rate, London interbank offered rate and crude oil prices exists. The Johansen and Juselius (1990) cointegration test is a statistical method for testing for cointegration based on a VAR model of order p to examine the long run relationships that may exist among representative variables (i.e., PSEIVOL, PHUSD, LIBOR, CRUDE). The Johansen-Juselius approach does not require the choice of dependent and independent variables, where all variables entering the VAR models are treated as endogenous variables and can be expressed mathematically in the following general form:

$$Y_t = \mu + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + ... + A_p Y_{t-p} + \varepsilon_t \quad (4)$$

where Y_t is a vector containing n variables, all of which are integrated of order 1 and the subscript t denotes the time period. μ is an (n × l) vector of constants, A_p is an (n × n) matrix of coefficients where ρ is the maximum lag included in the model, and ε_t is an (n × l) vector of error terms. This can be rewritten in a final broad form of the error correction model assuming cointegration of order p Enders (2004):

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-p} + .\varepsilon_t \quad (5)$$

where $\Gamma_i = \left(A_1 + A_2 + ...A_{p-1} - I\right)$ represents the dynamics of the model in the short run, $\Pi = \left(A_1 + A_2 + ...A_{p-1}\right)$ represents the long run relationship among the variables included in the vector Y_t, and I is the identity vector. The key idea of the Johansen-Juselius approach is to determine the rank of the matrix Π, which represents the number of independent cointegration vectors. In other words, how many error correction terms belong in the model. Two likelihood ratio statistics suggested by Johansen-Juselius approach to examine the rank of matrix Π, the trace and maximum eigenvalues tests:

$$\lambda_{trace}\left(\text{r}\right) = -\text{T} \sum\nolimits_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (6)$$

$$\lambda_{max}\left(\text{r}, \text{r}+1\right) = -\text{T} \ln(1 - \hat{\lambda}_{r+1}) \quad (7)$$

where T is the sample size and $\hat{\lambda}_i$ is the eigenvalues, or characteristic roots, which have been obtained from the matrix Π. For the trace test, the null hypothesis is that the number of cointegrating vectors is less than or equal to r, and the alternative hypothesis is that Π is of the full rank, $r = n$ cointegrating vectors. However, in the maximum eigenvalue test, the null hypothesis, =1, is tested against the alternative of $r > 1$. The results obtained from this test are used in applying the VECM which measures the long-run relationship.

3.4. Vector Error Correction Model (VECM)

Once the variables are integrated of the same order, such that the variables are first difference stationary I(1), the vector error correction model is performed to capture the long run and short run causal relationships among variables(Engel & Granger, 1987). Granger (1988) states that the causality may occur from lagged difference and error correction term. It should be mentioned here that the Philippine stock market index volatility may not only depend on the changes in PHUSD, LIBOR and CRUDE variables but also on the long-run relationship between them which invites the usages of error correction term to measure the previous disequilibrium. The significance of error correction term indicates the tendency of each variable to restore equilibrium. More precisely, the VECM is written as:

$$\begin{aligned} \Delta PSEIVOL_t &= \alpha_1 + \alpha_{PSEIVOL} \hat{e}_{t-1} + \sum_{i=1}^{n} \alpha_{11} \Delta PHUSD_{t-1} \\ &+ \sum_{i=1}^{n} \alpha_{12} \Delta LIBOR_{t-1} + \sum_{i-1}^{n} \alpha_{13} \Delta PSEIVOL_{t-1} \\ &+ \sum\nolimits_{i-1}^{n} \alpha_{14} \Delta CRUDE_{t-1} + \epsilon_{PSEIVOLt} \end{aligned} \quad (8)$$

$$\begin{aligned} \Delta PHUSD_t &= \alpha_2 + \alpha_{PHUSD} \hat{e}_{t-1} + \sum_{i=1}^{n} \alpha_{21} \Delta PHUSD_{t-1} \\ &+ \sum_{i=1}^{n} \alpha_{22} \Delta LIBOR_{t-1} + \sum_{i-1}^{n} \alpha_{23} \Delta PSEIVOL_{t-1} \\ &+ \sum\nolimits_{i-1}^{n} \alpha_{24} \Delta CRUDE_{t-1} + \epsilon_{PSEIVOLt} \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta LIBOR_t &= \alpha_3 + \alpha_{LIBOR} \hat{e}_{t-1} + \sum_{i=1}^{n} \alpha_{31} \Delta PHUSD_{t-1} \\ &+ \sum_{i=1}^{n} \alpha_{32} \Delta LIBOR_{t-1} + \sum_{i-1}^{n} \alpha_{33} \Delta PSEIVOL_{t-1} \end{aligned}$$

$$+\sum_{i-1}^{n}\alpha_{34}\Delta CRUDE_{t-1}+\epsilon_{LIBORt} \tag{10}$$

$$\Delta CRUDE_t=\alpha_4+\alpha_{CRUDE}\hat{e}_{t-1}+\sum_{i=1}^{n}\alpha_{41}\Delta PHUSD_{t-1}$$

$$+\sum_{i=1}^{n}\alpha_{42}\Delta LIBOR_{t-1}+\sum_{i-1}^{n}\alpha_{43}\Delta PSEIVOL_{t-1}$$

$$+\sum_{i-1}^{n}\alpha_{44}\Delta CRUDE_{t-1}+\epsilon_{CRUDEt} \tag{11}$$

where α_i, α_{ij} are parameters, $\hat{e}_{t-1}$ is the error correction term lagged one period and $\epsilon_{PSEIVOt}$, ϵ_{PHUSDt}, ϵ_{LIBORt}, and ϵ_{CRUDEt}, are the error terms.

3.5. Impulse Response Function

Impulse response functions (IRFs) track the response of a variable over time after a shock to the VAR system. The persistence of a shock indicates how quickly the system returns to equilibrium. In order to examine to what extent innovations in Peso-Dollar exchange rate, London interbank offered rate and crude oil prices can explain the Philippine stock market index volatility the IRFs was estimated. This will allow the determination of the magnitude, direction, and length of time that PSEIVOL is affected by a shock of a variable in the system, holding all other variables constant. The impulse response functions are identified using a Cholesky decomposition.

4. Results and Discussion

4.1. Descriptive Statistics

Table 1 shows that during the 2000-2019 period the monthly PSEI volatility averaged 77.1213 and recorded its minimum and maximum values from 12.5041 to 287.2621. As for PHUSD, LIBOR and CRUDE averaged 48.4361, 2.0585 and 62.8093, respectively.The recorded minimum and maximum values ranges from 40.3600 to 56.3570 for PHUSD, 0.2261 to 6.8160 for LIBOR and 18.5200 to 132.8300 for CRUDE.

4.2. Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests

Table 2 presents the ADF and PP stationarity test results of the variables in constant and linear trend components. It is clear that the null hypothesis of non-stationarity cannot be rejected for PHUSD, LIBOR and CRUDE in their levels (I(0)) since their ADF statistics are not less than the critical values at any significance level, 1 percent, 5 percent and 10 percent. Applying the same test to their first differences (I(1)) shows that the null hypothesis of a unit root is rejected

Table 1: Descriptive Statistics

	PSEIVOL	PHUSD	LIBOR	CRUDE
Mean	77.1213	48.4361	2.0585	62.8093
Median	64.7368	48.2975	1.3297	59.9850
Maximum	287.2621	56.3570	6.8160	132.8300
Minimum	12.5041	40.3600	0.2261	18.5200
Observations	240	240	240	240

at 1 percent significance level.The ADF test of PSEIVOL show stationarity at levels I(0) and first difference I(1) with significance at 1 percent level. On the basis of these results all the variables are treated as integrated of order one, I(1). The conclusions from the ADF test were confirmed by the results of the PP unit root test.

In Figure 1, the nonstationarity and stationarity of the variables were presented. The nonstationary series PSEIVOL, PHUSD, LIBOR and CRUDE were compared to their stationary series D(PSEIVOL), D(PHUSD), D(LIBOR) and D(CRUDE).

4.3. Long-run Equilibrium Relationship

Once confirmed that PSEIVOL, PHUSD, LIBOR and CRUDE series are integrated of order one I(1), Johansen and Juselius (1990) cointegration test was applied to detect the possible long-run equilibrium relationship between the I(1) variables. As shown in Table 3, both the trace statistic and max-eigen value statistic indicates atleast four (4) cointegrating equations at 5 percent significance level. That is, the volatility of the Philippine stock market index exhibit long-run equilibrium relationship with Peso-Dollar exchange rate, London Interbank Offered Rate and crude oil prices.

Given that there is at least 4 cointegrating vectors among the variables in the system, the analysis normalizes the cointegrating vector on PSEIVOL. The first normalized cointegrating coefficients are reported in Table 4.

Following Johansen and Juselius (1990), the first normalized cointegrating equation can be constructed from Table 4 as follows:

$$PSEIVOL = 12.2239PHUSD - 7.6271LIBOR + 2.7645CRUDE \tag{12}$$

In the long-run, Peso-Dollar exchange rate and crude oil prices are found to have positive and statistically significant relationship on the volatility of the Philippine stock market index. However, it is also found that the London Interbank Offered Rate has insignificant relationship with Philippine stock market index volatility (PSEIVOL)in the long-run.

Table 2: ADF and PP Unit Root Test Results

Variable	Levels		First Difference		Order of Integration
	Intercept	Intercept, Linear Trend	Intercept	Intercept, Linear Trend	
Augmented Dickey-Fuller (ADF)					
PSEIVOL	-4.0106***	-7.4825***	-13.8182***	-13.7858***	I(0), I(1)
PHUSD	-1.9503	-2.1902	-14.8250***	-14.8243***	I(1)
LIBOR	-2.4294	-1.6834	-10.7451***	-10.8689***	I(1)
CRUDE	-2.3908	-2.4570	-10.0088***	-10.0013***	I(1)
Phillips-Perron (PP)					
PSEIVOL	-11.1940***	-13.0909***	-53.7414***	-53.6309***	I(0), I(1)
FOREX	-2.0211	-2.2459	-14.8247***	-14.8241***	I(1)
LIBOR	-2.2124	-1.8016	-11.4275***	-11.4807***	I(1)
CRUDE	-2.1726	-2.1440	-9.9940***	-9.9837***	I(1)
Note: ADF test was performed using Schwarz information criterion and the automatic lag selection set at 14. PP test was performed with Barlett Kernel and Newey-West Bandwidth. Statistical significance: ***(1%), **(5%) and *(10%).					

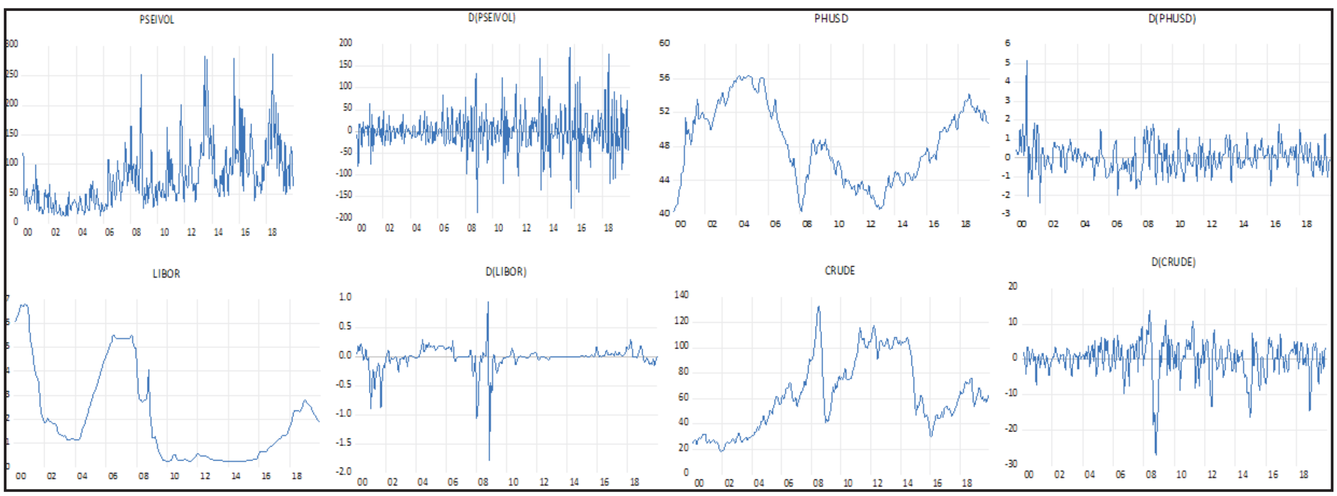

Figure 1: The Nonstationarity and Stationarity Plots

Table 3: Johansen-JuseliusCointegration Test Results

Hypothesized No. of CE(s)	Trace Statistic	5 percent		Max-Eigen Statistic	5 percent	
		Critical Value	Prob.**		Critical Value	Prob.**
	D(PSEIVOL) D(PHUSD) D(LIBOR) D(CRUDE)					
None *	191.9693	47.8561	0.0000	79.1420	27.5884	0.0000
At most 1*	112.8273	29.7971	0.0000	56.3567	21.1316	0.0000
At most 2*	56.4706	15.4947	0.0000	39.7327	14.2646	0.0000
At most 3*	16.7378	3.8415	0.0000	16.7378	3.8415	0.0000
Trace test and max-eigen value indicates 4 cointegrating eqn(s) at the 0.05 level *Rejection of the hypothesis at the 0.05 level**MacKinnon-Haug-Michelis (1999) p-values						

Table 4: Normalized Cointegrating Coefficients

PSEIVOL	PHUSD	LIBOR	CRUDE
1.0000	-12.2239***	7.6271	-2.7645***
S.E.	3.4860	6.2777	0.5661
t-value	-3.5066	1.2150	-4.8834
Statistical significance: ***(1%), **(5%) and *(10%)			

4.4. Short-run and Long-run Causal Relationship

We continue our investigation by estimating VECM models for PSEIVOL. The VECMs provide the correction terms that reflect influences of deviation of the relationship from long-run equilibrium and short-run parameters.Table 5 below presents the short-run dynamics based on vector error correction model (VECM) estimates. The results indicate that the lagged changes in Peso-Dollar exchange rate D (PHUSD(-1)) has statistically significant positive causal relationship with PSEIVOL in the short-run at 10 percent levels. Therefore, in the short-run, increases (i.e., depreciation) in Peso-Dollar exchange rate causes PSEI volatility to increase. As for the London Interbank Offered Rate at first lag, has statistically significant and positive short-run causal relationship with PSEIVOL at 10 percent level. That is, in the short-run, increases in LIBOR causes increases in PSEI volatility. However, at first lag, crude oil prices appear to have no significant causal relationship with PSEIVOL in the short-run.

The results in Table 5 also presents the adjustment coefficients for the set of variables used with the long-run dynamics. The error correction term (ECT) in PSEIVOL is found to be statistically significant with the anticipated negative sign. The adjustment coefficient associated with the PSEI volatility is -0.1130 and statistically significant at 5 percent significance level. This validates the presence of a stable long-run unidirectional causal relationship from PHUSD, LIBOR and CRUDE to PSEIVOL (i.e., PHUSD, LIBOR, CRUDE → PSEIVOL). The coefficient of the ECT was also found statistically significant at 1 percent level and negative for LIBOR suggesting bi-directional causal long-run relationship between PSEI volatility and London Interbank Offered Rate (i.e., PSEIVOL ↔ LIBOR).

4.5. Impulse Response Function (IRF)

To have a better understanding about the dynamic relationship of PSEI volatility on PHUSD, LIBOR and CRUDE an impulse response function (IRF) was applied. Figure 2 show the responses of PSEIVOL to one positive standard deviation shock to PHUSD, LIBOR and CRUDE.A positive shock to PHUSD is associated with positive effect on PSEI volatility where PSEIVOL rises by almost 6 percent in the 2nd month, a fall of 0.58 percent in the 3rd month and then eventually rises to turn positive by the 4th month, the price remains higher by more than 1 percent up to the 10th month.A positive shock to LIBOR is associated with positive effects on PSEIVOL with increases in the 2nd, 4th, 5th and 7th months before falling from 0.20 percent in the 8th month up to 0.48 percent in the 10th month. Initially, the response of the PSEI volatility to positive CRUDE shocks is negative at around 1 percent during the 2nd month, eventually turning positive and continues to rise during the 3rd-10th month period, the shock appears to have worked its way out of the system.

5. Conclusions

Capturing the short-run and long-run causal behavior of the Philippine stock market index volatility with Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices under vector error correction environment is the object of this study.

Applying ADF stationarity test to their first differences (I(1)) shows that Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices are stationary. The ADF test of PSEIVOL show stationarity at levels I(0) and first difference I(1) with significance at 1 percent level. The results from the ADF test were confirmed by PP unit root test. The Johansen cointegration test confirmed that

Table 5: Causal Behavior via VECM

Short-run Causality		Long-run Causality		
	PSEIVOL		D(PSEIVOL)	D(LIBOR)
D(PHUSD(-1))	6.6336*	ECT	-0.1130**	-0.0006***
D(LIBOR(-1))	27.7558*	Std. error	-0.0440	-0.0002
D(CRUDE(-1))	-0.5442	t-statistic R-squared F-statistics	-2.5719 0.4010 16.8848	-2.7337 0.2190 7.0730
Statistical significance: ***(1%), **(5%) and *(10%)				

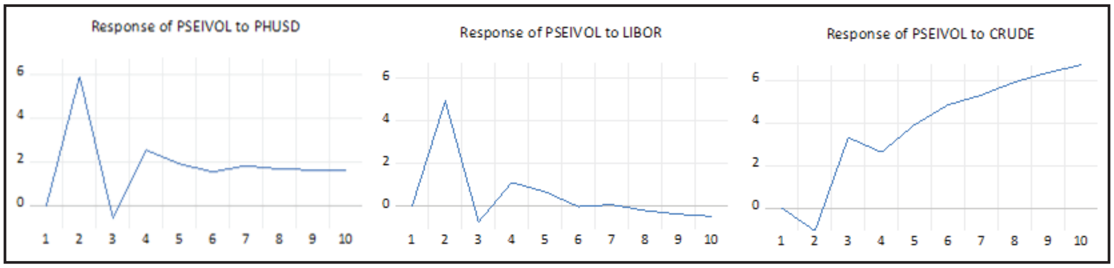

Figure 2: Response to Cholesky One S.D. (d.f. adjusted) Innovations

PSEI volatility exhibit long-run equilibrium relationship with Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices. That is, both the trace statistic and max-eigenvalue statistic indicates atleast four cointegrating equations at 5-percent significance level. The short-run dynamics-based VECM estimates indicate that, in the short-run, increases in Peso-Dollar exchange rate cause PSEI volatility to increase. As for the London Interbank Offered Rate, it cause increases in PSEI volatility in the short-run. The adjustment coefficients used with the long-run dynamics validates the presence of unidirectional causal long-run relationship from Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices to PSEI volatility, and bidirectional causal long-run relationship between PSEI volatility and London Interbank Offered Rate. The impulse response functions developed within the VECM framework demonstrate the positive and negative reactions of PSEI volatility to unanticipated Peso-Dollar exchange rate, London Interbank Offered Rate and crude oil price shocks.

The above results will be a great reference to have better understanding about the short-run and long-run volatility of the Philippine stock market index. More specifically, investors should look at the systematic risks revealed by the Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices when structuring portfolios and diversification investment strategies in the Philippine stock market.Moreover, financial regulators and policy-makers may need to take Peso-Dollar exchange rate, London Interbank Offered Rate, and crude oil prices variables into account when formulating economic and financial policies.

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