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Does the Philippine Stock Market Respond to Domestic Economic Fundamentals and Regional Equities Markets? An ARDL Bound Testing Approach

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Abstract

This paper aims to study the impact of domestic macroeconomic factors, regional and advanced economies' equity markets on the Philippine stock market behavior. Monthly data from January 2006 to December 2013 of four macroeconomic variables namely industrial production index, money supply, short term interest rate and exchange rate; four regional equity markets returns of Thailand, Singapore, Indonesia and Malaysia; and lastly two advanced economies' equity market returns of Hong Kong and the United States of America were used in the study. By applying the Autoregressive Distributed Lag (ARDL) method and vector error correction model (VECM), it showed co-integration between Philippine stock market and aforementioned factors which meant a long-run equilibrium relationship existed. In the Granger causality sense, money supply and the Singapore stock market affects the Philippine stock prices in the long-run as well as in the short-run.

Key Words: Autoregressive Distributed Lag Method, Macroeconomic Factors, Southeast Asian Stock Markets, the Philippines

1. INTRODUCTION

Ever since its incorporation in 1992, the Philippine Stock Exchange (PSE) underwent huge transformation and performed well through the years as seen by its changes in its trading system to accommodate higher volume of trading, extended trading hours and its PSEi index's growth in terms of price and liquidity. In the paper entitled "Philippine Stock Market in Perspective" by Crisostomo et. al (2013) of the PSE's Head of Corporate Planning & Research Department, it stated that the Exchange's good performance is also credited to the strength of local firms' fundamentals that heightened interest in investing in Philippine equities.

But unfortunately, stock investment does not come without any risk especially if done in emerging countries such as the Philippines. According to Engel and Rangel (2005), emerging markets are shown to have the higher levels of low frequency volatility on macroeconomic and financial variables that may result to a lower high frequency of stock market return volatility. Higher levels of volatility are caused by larger inflation rate and risks brought about the local market distortions and political instability. On top of these domestic factors affecting the stock market, recent globalization would also tell you that it had built a stage where news and developments around the world can create a massive impact on stock markets around the globe.

Therefore, by taking into account the concern of the investors on the local stock market's performance along with adding to the literature of factors affecting the Philippine equities, the objective of the paper is to determine the influence of domestic macroeconomic factors (such as industrial production index, money supply, short term interest rate and exchange rates), regional stock markets and advanced countries' stock markets on the Philippine stock market behavior.

2. METHODOLOGY

Sampling Design and Data Collection Method

The raw time series data are obtained from four sources namely the Bangko Sentral ng Pilipinas (BSP), Philippine Statistics Authority (PSA), Datastream and Yahoo Finance from the years 2006- 2013 to cover pre-, during and post- Global Financial Crisis period. To represent the stock market of the various countries involved, their indices were used. Below are the following countries included in the study:

- Philippines (PSEi) as the interest variable,
- Thailand (SET) to represent a regional stock market effect
- Singapore (FSSTI) to represent a regional stock market effect
- Malaysia (KLCI) to represent a regional stock market effect
- Indonesia (JCI) to represent a regional stock market effect
- Hong Kong (HS) to represent an advanced country/ economy market effect
- United States of America represented by the Standard and Poor's 500 (SP) as an advanced country market effect with a ticker symbol ^GSPC.

The monthly return series is generated from the following equation:

$$R_t = (100)*(ln(P_t)-ln(P_{t-1})) \quad \textbf{(Eq.1)}$$

where *ln* is the natural logarithm operator; t represents time in weeks; R_t is the return for period t,; P_t is the index closing price for period t. Each return series is therefore expressed as a percentage. Modeling an index in this manner is typical in the literature (Nelson, 1991).

On the other hand, I used four macroeconomic variables to explain the domestic factors affecting the Philippine stock market namely

- industrial production index (IP) to proxy real output. Data were from the Value of Production Index from the PSA whose index series were rebased as 2000=100.
- money supply (M2) to proxy broad money supply. Data were from the BSP's Monthly Integrated Survey of Selected Industries (MISSI).
- exchange rate (ER). Data used was the peso versus dollar exchange rate from the BSP.
- short run interest rate (IR) proxied by the 91-days treasury bills to proxy risk-free interest rate. Data were from the BSP.

In the aforementioned chapter, these variables are extensively used in the previous literature to capture the macroeconomic and foreign equity markets activities. Lastly, using the over-all monthly data ranging from January 2006 to December 2013 comprised 95 observations for the analysis

Autoregressive Distributed Lag (ARDL) method

Autoregressive Distributed Lag (ARDL) method was developed by Pesaran

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and Shin (1997, 1999), Pesaran et al. (1996) and Pesaran et al. (2001) for the cointegration test. One advantage of using this method is that it is able to test a long-run relationship among variables that are different in their level of integration. Moreover, the ARDL method is known for its simplicity as it applies a single reduced form equation instead of a system of equations. Similar to Purnomo and Rider (n.d.) which also analysed the long run relationship between macroeconomic fundamentals and stock market behaviour using the same approach, this study's model which includes the data series and utilizing the ARDL method would be the following equation

$$\begin{aligned}\Delta\ln(PSEI)_t = {} & \alpha_0 + \sum_{i=1}^{p}\beta_i \Delta\ln(PSEI)_{t-i} + \sum_{i=0}^{q}\gamma_i \Delta\ln(IP)_{t-i} + \sum_{i=0}^{q}\zeta_i \Delta\ln(M2)_{t-i} \\ & + \sum_{i=0}^{q}\eta_i \Delta\ln(ER)_{t-i} + \sum_{i=0}^{q}\theta_i \Delta(IR)_{t-i} + \sum_{i=0}^{q}\vartheta_i \Delta\ln(SET)_{t-i} \\ & + \sum_{i=0}^{q}\kappa_i \Delta\ln(FSSTI)_{t-i} + \sum_{i=0}^{q}\lambda_i \Delta\ln(KLCI)_{t-i} + \sum_{i=0}^{q}\nu_i \Delta\ln(JCI)_{t-i} \\ & + \sum_{i=0}^{q}\varpi_i \Delta\ln(HS)_{t-i} + \sum_{i=0}^{q}\varrho_i \Delta\ln(SP)_{t-i} + \delta_1\ln(PSEI)_{t-1} + \delta_2\ln(IP)_{t-1} \\ & + \delta_3\ln(M2)_{t-1} + \delta_4\ln(ER)_{t-1} + \delta_5(IR)_{t-1} + \delta_6\ln(SET)_{t-1} \\ & + \delta_7\ln(FSSTI)_{t-1} + \delta_8\ln(KLCI)_{t-1} + \delta_9\ln(JCI)_{t-1} + \delta_{10}\ln(HS)_{t-1} \\ & + \delta_{11}\ln(SP)_{t-1} + \varepsilon_i \quad \mathbf{(2)}\end{aligned}$$

To test the relationship for its significance, Pesaran et al. (2001) had tabulated sets of appropriate critical values because the ARDL method has non-standard limiting distributions. These critical values are used for the case that variables might be stationary in level term or in first difference thus the generated F-statistic will be examined against an upper and lower bound. If the F-Statistic lies above the upper level, the null hypothesis is rejected $H_0: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq \delta_9 \neq \delta_{10} \neq \delta_{11} \neq 0)$ while if it is below the lower bound, we cannot reject the null of no co-integration $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = \delta_{10} = \delta_{11} = 0)$
.

In the case of F-Statistic lies in between the lower and upper value, an inconclusive result of the co-integration test is taken. In order to select the appropriate lag length, after setting a maximum number of 8 lags then the appropriate lag would be determined by the Akaike Information Criteria (AIC) and the Swartz Bayesian Criterion (SBC) and Hannan-Quinn information criterion (HQ).

If there is evidence of co-integration, we specify the long-run model as follows:

$$\begin{aligned}\ln(PSEI)_t = {} & \alpha_0 + \sum_{i=1}^{p}\beta_i \ln(PSEI)_{t-i} + \sum_{i=0}^{q}\gamma_i \ln(IP)_{t-i} + \sum_{i=0}^{q}\zeta_i \ln(M2)_{t-i} \\ & + \sum_{i=0}^{q}\eta_i \ln(ER)_{t-i} + \sum_{i=0}^{q}\theta_i (IR)_{t-i} + \sum_{i=0}^{q}\vartheta_i \ln(SET)_{t-i} \\ & + \sum_{i=0}^{q}\kappa_i \ln(FSSTI)_{t-i} + \sum_{i=0}^{q}\lambda_i \ln(KLCI)_{t-i} + \sum_{i=0}^{q}\nu_i \ln(JCI)_{t-i} \\ & + \sum_{i=0}^{q}\varpi_i \ln(HS)_{t-i} + \sum_{i=0}^{q}\varrho_i \ln(SP)_{t-i} + \mu_i \quad \mathbf{(3)}\end{aligned}$$

The lag length is again selected based on AIC, SBC and HQ criteria. The long-run relation is predicted using OLS. Furthermore, the existence of co-integration implies that causality exist in at least one direction. Granger (1969) causality test have been extensively used in financial research to describe if one variable precedes other variable. While co-integration is concerned with long run equilibrium between variables, Granger causality is concerned with short-run forecastability (Maddala and Kim, 1998).

Autoregressive Distributed Lag (ARDL) method and Granger Causality

The ARDL specification in the short-run dynamics which included the Granger causality test would then be done by constructing a model that contains an error correction term (ECT).

$$\Delta\ln(PSEI)_t = \alpha_0 + \sum_{i=1}^{p}\beta_i\,\Delta\ln(PSEI)_{t-i} + \sum_{i=0}^{q}\gamma_i\,\Delta\ln(IP)_{t-i} + \sum_{i=0}^{q}\zeta_i\,\Delta\ln(M2)_{t-i} + \sum_{i=0}^{q}\eta_i\,\Delta\ln(ER)_{t-i} + \sum_{i=0}^{q}\theta_i\,\Delta(IR)_{t-i} + \sum_{i=0}^{q}\vartheta_i\,\Delta\ln(SET)_{t-i} + \sum_{i=0}^{q}\kappa_i\,\Delta\ln(FSSTI)_{t-i} + \sum_{i=0}^{q}\lambda_i\,\Delta\ln(KLCI)_{t-i} + \sum_{i=0}^{q}\nu_i\,\Delta\ln(JCI)_{t-i} + \sum_{i=0}^{q}\varpi_i\,\Delta\ln(HS)_{t-i} + \sum_{i=0}^{q}\varrho_i\,\Delta\ln(SP)_{t-i} + \psi\mathrm{ECT}_{t-1} + \varepsilon_i \quad (4)$$

Where variable ECT is the error correction term is defined as:

$$\mathrm{ECT}_t = \ln(PSEI)_t - \alpha_0 + \sum_{i=1}^{p}\beta_i\ln(PSEI)_{t-i} + \sum_{i=0}^{q}\gamma_i\ln(IP)_{t-i} + \sum_{i=0}^{q}\zeta_i\ln(M2)_{t-i} + \sum_{i=0}^{q}\eta_i\ln(ER)_{t-i} + \sum_{i=0}^{q}\theta_i\,(IR)_{t-i} + \sum_{i=0}^{q}\vartheta_i\ln(SET)_{t-i} + \sum_{i=0}^{q}\kappa_i\ln(FSSTI)_{t-i} + \sum_{i=0}^{q}\lambda_i\ln(KLCI)_{t-i} + \sum_{i=0}^{q}\nu_i\ln(JCI)_{t-i} + \sum_{i=0}^{q}\varpi_i\ln(HS)_{t-i} + \sum_{i=0}^{q}\varrho_i\ln(SP)_{t-i} \quad (5)$$

Coefficients in the short-run equations are related to the short-run model's movement back to equilibrium. ψ represents the speed of adjustment back to its long-run relationship from the temporary short-run breakage.

3. RESULTS AND DISCUSSION

Table 1. Unit Root Test for Stationary

Variables	ADF Test	PP Test	KPSS Test	Order of Integ.
Domestic Macroeconomic Variables				
lnPSEI	-8.88***	-9.02***	0.07***	I(0)
lnIP	-2.77*	-10.90***	0.06***	I(0)
lnM2	-0.92	-11.14***	0.21***	I(0)
lnER	-6.19***	-6.07***	0.16***	I(0)
IR	-1.47	-1.19	1.03	
ΔIR	-4.97***	-8.26***	0.05***	I(1)
Regional Equity Markets				
lnSET	-4.01***	-7.68***	0.11***	I(0)
lnFSSTI	-7.64***	-7.65***	0.05***	I(0)
lnKLCI	-5.02***	-8.19***	0.06***	I(0)
lnJCI	-4.20***	-7.31***	0.08***	I(0)
Advanced Economy Equity Markets				
lnHS	-8.45***	-8.52***	0.05***	I(0)
lnSP	-3.93***	-7.45***	0.20***	I(0)

Note: *** implies significant at 1% level, * implies significant at 10% level. Δ represents first difference

Table 1 shows the unit root test results taken with the ADF test and complemented by the PP test since the ADF test is criticized for low power. A third test was also carried out using the KPSS test. Based on the three tests, all the series data are found to be stationary at level with intercept except for the IR variable which had to be first differenced. However, after taking the first difference of the IR data series, it is found to be stationary. With these mix results in terms of the order of integration, the Johansen method of co-integration would not be possible so the ARDL method would have to be utilized instead.

Table 2. Results of ARDL Co-Integration Test

Test Statistics	Max Lag	Significance level	Bound Critical Values Unrestricted Intercept and No Trend	
			I(0)	I(1)
6.907	8	1%	2.54	3.86
		5%	2.06	3.24
		10%	1.83	2.94

Critical Values based from Pesaran (2001).

Before estimating the ARDL model found in Eq.3, there was a need to estimate the unrestricted error correction model. Despite the AIC, BIC and HQ is showing zero lags to be used, running the Breusch-Godfrey Serial Correlation LM Test on the data series showed serial correlation. Thus, there was a need to add lags on the variables and upon re-checking, no serial correlation is evident on newly-lagged series.

As serial correlation is now not found in the data series, the estimation of the ARDL model could be done through the generation of the Wald test as reported in Table 2. It is the Wald test which would determine if there is co-integration in the relationship between the local stock market and the other aforementioned data series. The test gave an F-Statistic of 6.907 which is higher compared to both lower and upper bound of the critical values found in Pesaran (2001)'s Case III where (k + 1) = the number of variables. This implied the rejection of null hypothesis of no co-integration, thus a long-run relationship was manifested in the model stated in Eq. 3. Since the bounds test detected the presence of long run relationship amongst the variables, error correction model should now be done to examine the causality between the variables and to know the speed of adjustment to restore equilibrium after the temporary disturbance.

Table 3. Result of Granger causality test

	Dependent Variable:	
	Chi-Squared	**Granger**
Domestic Macroeconomic Variables		
IP	H_0 0.046104	Not Evident
M2	5.165201*	Evident
ER	7.670933**	Evident
IR	2.477238	Not Evident
Regional Equity Markets		
SET	2.513392	Not Evident
FSSTI	5.75637*	Evident
KLCI	3.109977	Not Evident
JCI	8.499093**	Evident
Advanced Economy Equity Markets		
HS	1.065859	Not Evident
SP	1.430451	Not Evident

Note: ** implies significant at 5% level, * implies significant at 10% level.

But before the model would determine the time of adjustment, it is also interesting to note if there is any short-run causality between the domestic economic fundamentals, regional and advanced countries' equity markets and the Philippine Stock Exchange Index. By employing Vector Error Corrrection Granger Causality to test any relationship, Table 3 revealed exchange rate (ER), money supply (M2) are among domestic macroeconomic variables which showed evidence of Granger causality to Philippine equities while among regional equity markets, only the Indonesian and Singaporean stock indices showed any Granger causality to the local stock market. Based on the correlation matrix between these two variables, an increased (or decreased) level in money supply may result to an increased (or decreased) growth in stock market prices. As for the exchange rate, an increased (or decreased) in the exchange rates can decreased (or increased) in the returns of the local stock market. Lastly, for regional equities markets, only the Singaporean and Indonesian stock indices which showed a direct relationship with the Philippine stock index. Unfortunately, for advanced equity markets, they don't Granger cause the local market. Also, no relationship was analysed on how the PSEi would Granger cause any of the variables in that direction as this is not part of the scope of the study.

Table 4. Result of Error Correction Model

	Dependent Variable:	
	Coefficient	**T-Statistics**
Domestic Macroeconomic Variables		
IP	-0.01999	-0.20464
M2	0.973267**	2.20654
ER	-1.907748	-2.23691
IR	0.571934	0.36873
Regional Equity Markets		
SET	-0.058315	-0.35416
FSSTI	0.829256**	2.08180
KLCI	-0.458217*	-1.66213
JCI	-0.826655***	-2.89534
Advanced Economy Equity Markets		
HS	-0.143126	-0.67732
SP	0.004437	0.02293
ECT Coef.	-0.594706***	-2.95256

Note: *** implies significant at 1% level, ** implies significant at 5% level, * implies significant at 10% level.
Significance levels based on T-Distribution.

Upon estimating the error corrected ARDL model, it resulted to a negative lagged error correction term (ECT) which would represent the speed of adjustment to move back towards equilibrium. As the ECT gave a -.5947 coefficient that is statistically significant at the 1% level, it could be interpreted as about 59.5% of disequilibrium "corrected" each month by changes in PSEi. It is to be noted that only money supply and three regional markets namely Singaporean, Indonesian and Malaysian markets are significant factors. Looking closely, money supply and the Singaporean are positively and statistically significantly related with Philippine stock market while the Indonesian and Malaysian stock market are statistically significantly with Philippine stock market.

4. CONCLUSION

This paper investigates the long run relationship between the Philippine stock market by using several domestic macroeconomic variables and foreign stock market indices from 2006 to 2013.

The use of Autoregressive Distributed Lag (ARDL) method to analysis the co-integration relationship was to incorporate the different level of integration amongst the variables. It resulted to finding evidence of co-integration in the selected variables through the Wald Test. Our Granger causality test results revealed that the money supply and the Singaporean stock market is evident to the Philippine stock market which had similar results in the VECM models.

These findings would be helpful to policymakers who are into monetary policy especially with the statistical results in the long and short-run on how money supply is affecting the stock market. In terms of trade, despite the US and China being the Philippine largest trader, trade with Singapore should be taken into more weight as its equity market is affecting the local equity market as well.

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