Causal nexus of foreign stock prices on the Philippine stocks exchange composite index

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ABSTRACT

This study investigates the predictive relationship existing between the Philippine Stocks Exchange Index (PSEI) and the foreign stock markets. historical data of the daily closing prices of the stock markets (s&p500 of the united states, Nikkei of Japan, Sensex of India, Shcomp of China, STI of Singapore, KLSE of Malaysia, and HKSE of hong kong) covering January 4, 2002 to January 29, 2016 (n=3,411 observations) were estimated using the Ordinary Least Squares (OLS) regression equation, having the PSEI of the Philippines as the predicted variable. It was found out that the foreign stock markets are highly correlated with the PSE. Moreover, OLS regression revealed that an increase of the daily closing prices of s&p500 of United States, Nikkei of Japan, Sensex of India and STI of Singapore increases the value of the PSEI but decreases upon the appreciation of Shcomp of china and the HKSE of Hong Kong. Meanwhile, KLSE of Malaysia yielded no statistical significance towards the PSEI.

Keywords: *Stock, Market, Exchange, Index, OLS, Philippines.*

INTRODUCTION

The world equity markets are evolving rapidly due to changes in technology, changes in regulation and falling barriers in international trade. Consequently, faster information flow makes the equity markets more volatile than the market efficiency assumed. Succinctly put, the volatility in one market can spillover to another and tends to continue after that market closes and producing volatility in geographically distant markets opening several hours later (Friedman & Shachmurove, 1997).

In particular, assertions that financial markets are now characterized by higher levels of volatility than in the past and it displays greater susceptibility to 'contagion and spillover effect' that have considerable prominence in recent years. Thus, stock prices in some sense should be more volatile than is consistent with market efficiency. Most stock price changes cannot be solely associated with contemporaneous changes in investors' expectations of futures corporate profits, as to some extent, stock prices frequently fluctuate in response to variables unrelated to dividend prospects. For example, the October 1987 crash in New York set off worldwide stock price decline, which indicates as a bear-market contagion. Such episode has been interpreted by some observers as evidence of a change in the behavior of present day financial markets (King & Wadhwani, 1990; Shiller, Konya, & Tsutsui, 1991).

There are several reasons why returns and volatility of the two equity market may be related. The two economies are related through trade and investment, so that any news about economic fundamentals in one country most likely has implications for the other country (Boubaker & Saber, 2008; Liu, Resnick & Shoesmith, 2004; Kaizoji, 2001; Asimakopoulos, Goddard & Siriopoulos, 2000). Another possible reason for the international correlation of stock price changes is market contagion (Hernandez, Ibarra & Trupkin, 2013). Due to the globalization process, economies are related to each other notably through trade and investment, so any news about economic fundamentals in one country most likely have implications in other countries (Ding et al., 2011; Lin et al., 1994). It implies that changes in stock price in one country

may be affected by the changes in another country beyond what is expected based on the economic fundamentals. This could be due to the closer relation between the world equity market and interdependence of regional as well as the global economy. Probably the best known examples are the stock market crashes of 1929, 1987 and 1997 and the more recent turbulence on the regular basis.

Recent studies have investigated how news from one national financial market influences the volatility in another market. Several researches demonstrated that private information is only gradually incorporated into prices (Bwo-Nung & Chin, 2002; Dash, 2002; Kyle, 1985; Admati & Pfleiderer, 1988). They indicated that market dynamics cause the continuity of volatility after a shock end (Lee, Rui & Wang, 2004).

Recently, Sayson (2016) reported that the Philippine equities, dubbed the worst-performing market in Southeast Asia this year, had the biggest two-day foreign outflow since September as concern about China's economic slowdown and slumping oil prices sap demand for developing-nation assets already hurt by higher U.S. interest rates. Overseas investors have sold $38.1 million of the country's shares so far this year. They withdrew a record $1.19 billion in 2015 to become net sellers for the first time since 2008.

With this bulk of studies and reports, none provided recent evidence that news in one market could partially predict the mean return in other markets. This study attempts to investigate the spillover effects of developed financial markets to the Philippine Stocks Exchange Index (PSEi).

Theory base

The theory of efficient capital market says that the prices of financial assets equal the discounted value of the expected cash flows that these assets generate. Similarly, stock market efficiency implies that stock prices equal the discounted value of expected cash flows from investment in the shares. Therefore, it is assumed that investors forecast future cash flow based on available information (Granger, 1992). If capital markets are efficient in this sense, changes in stock prices will reflect new information. Moreover, publicly available information is discounted in asset prices as soon as it becomes available in the market.

To date, study of volatility spillovers across trading centers has focused on the foreign exchange market, which also trades around-the-clock in several sites. Researchers proposed two hypotheses on how volatility might manifest itself across trading centers (Fleming, 2003). The "heat wave" hypothesis is that a market's return and volatility are explained with its past values and are determined by country-specific effects. It can be better understood when volatility has only location-specific autocorrelation so that a volatile day in New York is likely to be followed by another volatile day in New York, but not typically a volatile day in Tokyo (Bwo-Nung & Chin, 2002; Dash, 2002). On the other hand, the "meteor shower" hypothesis infers that a market's return and volatility cannot be explained just with its past values and there are return and volatility spillovers to a market from others, which is typically exemplified when intraday volatility spills over from one trading center to another so that a volatile day in New York likely to be followed by a volatile day in Tokyo (Dash, 2002; Bwo-Nung & Chin, 2002).

METHOD

Research design

This study utilized the causative research design using the time-series methodology. Causal method of research requires of a causal inference which was founded on the assumptions of existence of relationship of two events, the time-lag order that cause must precede effect, and finally, that alternative explanation must be ruled out (Murcia & Tamayo, 2015; Marczyk, DeMatteo & Festinger, 2005). In this study, causal

research design was used such that the study aimed to determine if there is a causal nexus and, more especially, spillover effect of developed financial markets towards the Philippine Stocks Exchange index. The study attempts to test for the causal nexus across daily trading in the Philippine financial market by investigating the spillover effect of foreign markets on the same day of trading.

Sources of data

The researcher made use of secondary data in conducting the study. Secondary data were used since the data were readily-available in published or compiled sources. The researcher accessed the published as well as online reports compiled by Bloomberg and Wall Street websites for the daily closing prices of selected world stock markets for a period covering January 4, 2002 to January 29, 2016. A total of 3,411 observations were taken for all the stock markets.

Data gathering procedure

The researcher downloaded daily time-series data of the seven selected financial markets from Asia and the US, from the Bloomberg, Wall Street and Bangko Sentral ng Pilipinas (BSP) websites. Data were checked for matches across time and inspected for missing data and outlier using tests of normality. The estimation was done both in gretl 9.0 for the observations covering January 4, 2002 to January 29, 2016.

Furthermore this study seeks to examine whether past information regarding the stock market returns in one foreign market affects a particular markets' current mean return or not, and similarly past information of volatility in one market affects other markets' current volatility or not. This means that the Philippine Stocks Exchange market is tested if it is (or not) influenced by past volatilities of foreign markets, e.g. S&P500 (US), NIKKEI (Japan), SENSEX (India), SHCOMP (China), STI (Singapore), KLSE (Malaysia), and HKSE (Hong Kong).

Data analysis

To determine the causality of the six foreign financial stock markets to the Philippine Stocks Exchange index, the ordinary least squares regression (OLS) was used. Maddala and Nelson (1974) noted that the OLS method of estimation can easily be extended to models involving two or more explanatory variables, which can be illustrated given the case of two explanatory variables, X_1 and X_2, with Y the dependent variable. We therefore have a model

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + u_i$$

Where $u_i \sim N(0,\sigma^2)$. We look for estimators $\hat{\alpha}, \hat{\beta}_1, \hat{\beta}_2$ so as to minimize the sum of squared errors,

$$S = \sum_{i=1}^{n} (Y_i - \hat{\alpha} - \hat{\beta}_1 X_{1i} - \hat{\beta}_2 X_{2i})^2$$

Differentiating, and setting the partial differentials to zero we get

$$\frac{\partial S}{\partial \hat{\alpha}} = \sum_{i=1}^{n} 2(Y_i - \hat{\alpha} - \hat{\beta}_1 X_{1i} - \hat{\beta}_2 X_{2i})(-1) = 0 \qquad (1)$$

$$\frac{\partial S}{\partial \hat{\beta}_1} = \sum_{i=1}^{n} 2(Y_i - \hat{\alpha} - \hat{\beta}_1 X_{1i} - \hat{\beta}_2 X_{2i})(-X_{1i}) = 0 \qquad (2)$$

$$\frac{\partial S}{\partial \hat{\beta}_2} = \sum_{i=1}^{n} 2(Y_i - \hat{\alpha} - \hat{\beta}_1 X_{1i} - \hat{\beta}_2 X_{2i})(-X_{2i}) = 0 \qquad (3)$$

These three equations are called the "normal equations". They can be simplified as follows: Equation (1) can be written as

$$\sum_{i=1}^{n} Y_i = n\hat{\alpha} + \hat{\beta}_1 \sum_{i=1}^{n} X_{1i} + \hat{\beta}_2 \sum_{i=1}^{n} X_{2i}$$ or

$$\bar{Y} = \hat{\alpha} + \hat{\beta}_1 \bar{X}_1 + \hat{\beta}_2 \bar{X}_2 \qquad (4)$$

Where the bar over Y, X_1 and X_2 indicates sample mean. Equation (3) can be written as

$$\sum_{i=1}^{n} X_{1i} Y_i = \hat{\alpha} \sum_{i=1}^{n} X_{1i} + \hat{\beta}_1 \sum_{i=1}^{n} X_{1i}^{\ 2} + \hat{\beta}_2 \sum_{i=1}^{n} X_{1i} X_{2i}$$

Substituting in the value of $\hat{\alpha}$ from (4), we get

$$\sum X_{1i} Y_i = n\bar{X}_1(\bar{Y} - \hat{\beta}_1 \bar{X}_1 - \hat{\beta}_2 \bar{X}_2) + \hat{\beta}_1 \sum X_{1i}^{\ 2} + \hat{\beta}_2 \sum X_{1i} X_{2i} \qquad (5)$$

The variances of our estimators are given by

$$Var(\hat{\beta}_1) = \frac{\sigma^2}{S_{11}(1 - r_{12}^{\ 2})}$$

and

$$Var(\hat{\beta}_2) = \frac{\sigma^2}{S_{22}(1 - r_{12}^{\ 2})}$$

, where r_{12}^2 is the squared correlation coefficient between X_1 and X_2. Thus, the greater the correlation between the two explanatory variables, the greater the variance in the estimators, i.e. the harder it is to get significant results. We similarly obtain estimates for σ^2 and therefore the standard errors of the parameter estimates, and thus the t-ratios.

RESULTS AND DISCUSSION

To determine the statistical properties as well as normality of the stock markets included prior to the econometric analyses to be applied for each, descriptive profiling was done using mean, media, minimum

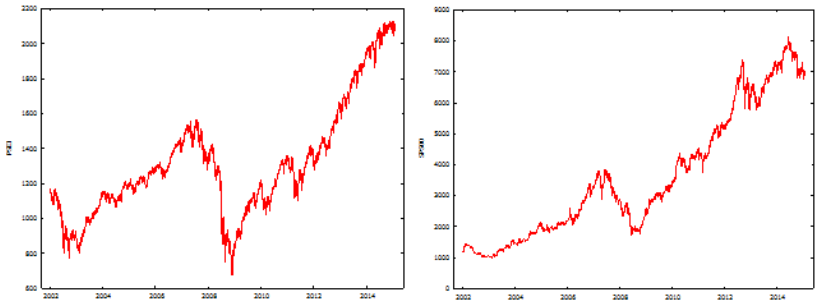
and maximum values, kurtosis and skewness of each of the series. In addition, Jarque-Bera test was also used to determine the normality of each of the series.

Table 1. Statistical Properties of the Time-Series Data of the Stock Markets

Test Statistic	*PSEI*	*S&P500*	*NIKKEI*	*SENSEX*	*SHCOMP*	*STI*	*KLSE*	*HKSE*
Mean	1312	3580	12411	14017	2378.4	2611.3	1241.6	18549
Median	1259.8	3046.6	11312	15379	2209.9	2797.2	1263.8	20052
Min	675.53	997.78	7055	2834.4	1011.5	1213.8	616.46	8409
Max	2130.8	8127.5	20868	29682	6092.1	3875.8	1892.7	31638
SD	321.82	2045.6	3336.6	7200.2	977.72	662.95	388.27	5126.1
Skewness	0.8331	0.6325	0.6151	0.0784	1.1144	-0.450	0.0849	-0.272
Kurtosis	0.1848	-0.8773	-0.7389	-0.8700	1.2180	-1.067	-1.371	-1.019
J-B	399.39	336.82	292.72	111.08	916.876	277.57	271.33	189.66
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	3411	3411	3411	3411	3411	3411	3411	3411

Source: Author's Calculations (via gretl 9.0)

Large standard deviations of each series indicate high volatility of stock prices of each country. This is notable for S&P500 of the United States, NIKKEI for Japan, SENSEX of India and HKSE of Hong Kong. In terms of skewness, data of STI of Singapore and HKSE of Hng Kong show negative skewness, implying the distribution has a long left tail, whereas all other series have positive skewness implying long right tails. All values are less than 1.0, implying that the skewness is substantial and the distribution is far from symmetrical. On the other hand, the values of excess kurtosis for all series are less than 3, implying that distributions are relatively normal. Moreover, the Jarque-Bera tests reject the null hypothesis of normality at 1 and 5 percent levels of significance. This is seen in the graphs in Figure 1, showing non-normal distribution of the series. Hence, the samples appropriately contain characteristics such as volatility clustering and long tails but not of leptokurtosis.



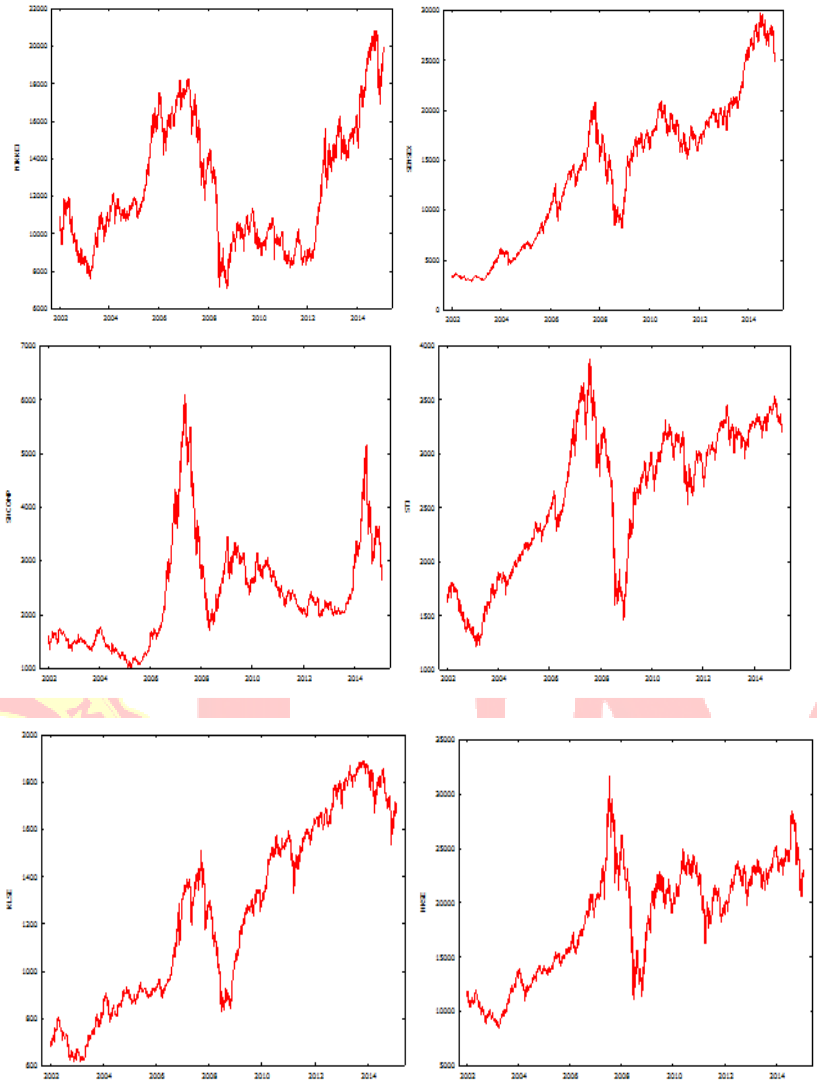


Figure 1. Daily Values of the Stock Prices of Selected Countries
from January 4, 2002 to January 29, 2016

An assumption of the multiple regression model is that there is no exact linear relationship between any of the independent variables. Thus, Pearson's correlation analysis has been performed here to check the existence of multicollinearity. A suggested rule of thumb is that if the pairwise correlation between two regressors is very high, in excess of 0.8, multicollinearity may pose serious problem.

According to Table 2, several stock markets show very high correlations. The stock markets that are found to have very significant correlations with PSEI is S&P 500 (r=0.853, $p<0.01$), SENSEX (r=0.801, $p<0.01$). S&P 500 was also found to significantly correlate with all stock returns, with *r*-coefficients greater than 0.80, particularly with SENSEX (r=0.914, $p<0.01$) and KLSE (r=0.955, $p<0.01$). SENSEX significantly correlated with all stock returns, especially STI (r=0.891, $p<0.01$), KLSE (r=0.934, $p<0.01$) and HKSE (r=0.910, $p<0.01$). Moreover, STI highly correlated with KLSE (r=0.876, $p<0.01$) and HKSE (r=0.942, $p<0.01$). KLSE and HKSE also highly correlated (r=0.801, $p<0.01$). These significant correlations are found to be higher than 0.8, indicating that there might be possible multicollinearity that exists amongst selected independent variables.

Table 2. *Correlation Matrix of the Selected Stock Prices of the World's Stock Markets*

Variables	*PSEI*	*SP500*	*NIKKEI*	*SENSEX*	*SHCOMP*	*STI*	*KLSE*	*HKSE*
PSEI	1							
SP500	.853**	1						
NIKKEI	.778**	.477**	1					
SENSEX	.801**	.914**	.476**	1				
SHCOMP	.448**	.448**	.440**	.626**	1			
STI	.772**	.794**	.544**	.891**	.673**	1		
KLSE	.781**	.955**	.387**	.934**	.515**	.877**	1	
HKSE	.701**	.782**	.483**	.910**	.715**	.942**	.876**	1

Source: Author's Calculations (via IBM-SPSS 20)

Table 3 reports the ordinary least-squares regression results that intend to determine the effect of each foreign stock market to the Philippine Stocks Exchange Composite Index (PSEI). The value of the R^2 is 0.9216 which imply that the variability of PSEI price is highly explained by the variation of all selected foreign stock markets for the period covering January 4, 2002 to January 29, 2016. The F value is significant at the 0.05 level (F=5712.521). Therefore at 5% significance level, it can be statistically concluded that the model fits to explain the effect of selected foreign stock markets on the Philippine Stocks Exchange Composite Index.

Table 3. *Least-Squares Regression Results Showing the Causal Relationship of Foreign Stock Markets on the Philippine Stocks Exchange*

Stock Markets	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
(Constant)	406.503	12.8558	31.6202	<0.0001
SP500	0.0803548	0.00420982	19.0875	<0.0001
NIKKEI	0.0453514	0.000754891	60.0768	<0.0001
SENSEX	0.00918473	0.000861749	10.6582	<0.0001
SHCOMP	−0.0262498	0.0024711	−10.6227	<0.0001
STI	0.154287	0.0083153	18.5546	<0.0001
KLSE	−0.0259197	0.0259072	−1.0005	0.3171
HKSE	−0.0206001	0.00120705	−17.0664	<0.0001
Mean dependent var	1311.962	S.D. dependent var		321.8230
Sum squared resid	27698372	S.E. of regression		90.21861
R-squared	0.921573	Adjusted R-squared		0.921412
F(7, 3403)	5712.521	*p*-value(F)		0.000000

Looking on each coefficient of the foreign stock markets, it can be surmised that there are two important causalities that can be gleaned: the negative and positive effects. As for positive effects, the S&P500 of the United States, NIKKEI of Japan, SENSEX of India and STI of Singapore have positive coefficients, which mean that an increase of 1 unit of these stock markets will cause a respective 0.08, 0.045, 0.01 and 0.15 increase of the PSE Composite Index of the Philippines, holding other variables constant. Of the four markets, the one that has a considerable effect is the STI of Singapore. This strong causal nexus is reported and validated by the Singapore Business Federation (2014), averring that Singapore and the Philippines are enjoying a close bilateral relationship, which will be a key driver for the region to work towards closer economic integration. The Philippines' economic resurgence is driven by robust growth in domestic demand, strong infrastructure spending and structural economic reforms, which have led to renewed investor interest. Moreover, the strengthening economic relations mean robustness of their financial markets. De Leon (2014) also espoused that since then, bilateral relations of Singapore and Philippines have become stronger. From the peace agreement collaboration down to their tourism industries, the macroeconomics of Singapore have proven to provide amiable nexus towards the Philippines as underpinned also in the growth of each economy, immigration, commerce, security and tourism.

As for the negative effects, the SHCOMP of China and the HKSE of Hong Kong exhibited negative beta coefficients, which mean that an increase of 1 unit of these stock markets will hurt the PSE Composite Index by 0.03 and 0.02 respectively, holding other variables constant. This was inimical to the recent hullabaloo in the PSE Composite index, known as the "Black Monday" wherein the Philippine Stock Exchange Index (PSEi) fell sharply, closing at 6,288.26, down 287.17 points or 4.37%. Sayson (2016) reported that the decline was the steepest since the August 24, 2015 "Black Monday", when the Philippine stock market plunged 6.7% or 487.97 points down. Gonzales (2016), however, attributes this relationship to the move of China to devalue its currency, the yuan, knocking over three percent off its value. It was believed that China attempts to boost exports in support of its slowing economic growth although the state-run People's Bank of China said the devaluation is all part of reforms as the nation moves toward a more market-oriented economy. In effect, money managers, including foreign funds, are assessing and rebalancing their exposure to emerging markets following the sell-off, adding that the situation though does not change what is happening in the real economy, with the growth drivers seemingly intact, citing the strong business process outsourcing performance, robust consumer sector, lower inflation, and growth in infrastructure.

CONCLUSION

This study shed light on the initial hypothesis of possible effects of foreign stock markets to a stock market of a developing country like the Philippines. This study considered the effects of the countries' stock returns and their resulting oscillations towards the movement of the Philippine stock market. This lies on the premise of what happens to a larger stock market in relation to a smaller stock market. In effect, this can be substantiated of the close economic ties of these countries, which is true in the case of the Philippines.

PSE stocks are appreciated in the boost of the American, Japanese, Indian and Singaporean stock markets. Of the four, the Singaporean stock market provided a more sensitive effect on the oscillations of the PSE Composite index due to the strengthened economic relations brought by ASEAN Integration. On the other hand, the Chinese and Hong Kong stock markets' oscillations may hurt the PSE. This might be attributed to certain decisions of the Chinese government, i.e. devaluation of their currency, yuan. No significant effect of the Malaysian stock market was evident.

Note that the time period covering January 4, 2002 to January 29, 2016 was able to capture significant economic and political shocks, despite of its non-implicit discussions in the paper. Finally, while the PSE Composite index is affected by the countries, it is noteworthy that other significant factors can influence the movement of the latter. Hence, it is very important that the Philippine government maintain healthy domestic policies in order to maintain the stability of the stock market.

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