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Interaction Modeling of the U. S, China, Japan and Philippine Stock Exchange

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Abstract

This study examines the relationship of Philippine stock market with three other markets, namely the U. S, Japan and China. The study is using the daily returns of each stock market from 2007 to 2009 to study the stock market correlation before and after the 2008 financial crisis. It is found that the Philippine stock market is most correlated with the U. S. stock markets. At the same time, U. S, Japan and China stock markets are highly correlated with each other. Since the US stock market closes about six hours before the Philippine market opens, investors can simply use this model to forecast the Philippine stock market return even during the financial crisis period.

Keywords: Stock Market Return, Forecasting Model, Constant Elasticity Model, Decoupling, and International Diversification

1. Introduction

This research aims to examine the performance of the Philippine stock market in relation to the stock markets of the top two world economies - United States, and China. In particular, this study aims to identify the markets to which the Philippine stock market has the highest correlation. Historically it has been shown that the exchange is most correlated to the U. S. . However, with the recent performance of the Philippine stock market vis-à-vis the U. S. equities market, the weakening influence of the United States on the global economy, and the emergence of China as the 2nd largest economy in the world, this long-held belief is worth re-examining.

It should be mentioned that this research will be measuring stock market performance using stock market indices of the four economies. The Philippine equities market is represented by the Philippine Stock Exchange Index (PSE). The Nikkei Average Index 225 is the single best proxy for the Japanese equities market as it tracks the top 225 blue-chip Japanese stocks listed in the Tokyo Stock Exchange (TSE). The Chinese equities market is represented by the Shanghai Stock Exchange Composite Index (SSE Composite). For the US equities market, the S&P 500 and the NYSE Composite Index will be used.

2. Previous Research

Stock market correlations among international markets has been a popular topic among researchers ever since Grubel (1968) applied Markowitz's (1952) Modern Portfolio Theory (MPT) on international stock markets, where the national stock markets of the U. S., Canada, U. K., Germany, France, Belgium, Italy, Holland, Japan, Australia and South Africa were studied. His results showed that a portfolio composed solely of U. S. stocks had a lower efficient frontier than a portfolio composed of stocks from all the eleven countries, which means it would be more efficient for an investor to invest domestically and internationally. Furthermore, if stock returns in international markets are not perfectly correlated with one's national stock market and the correlation structure is stable, the more beneficial international diversification becomes. Results from numerous early studies on the interdependence among major national stock market indices found that there was low or negative correlation among national stock indices, making the case for international diversification.

Research by Solnik (1974) found that international diversification is much better than inter-industry diversification. Using the monthly return rates of the U. S. stock market and nine other Pacific Basin markets--- the islands in the Pacific Rim and in the Pacific Ocean, Bailey and Stulz (1990) found that Pacific Basin investing lowered the risks of US investors by one-third. Furthermore, using daily return rates reduced the risks by up to fifty percent. However, Chan, Gup, and Pan (1992) examined the national stock markets of Hong Kong, South Korea, Singapore, Taiwan, Japan, and the U. S. . Using pairwise and higher-order cointegration tests, their research found no evidence of co-integration among the stock prices.

Willett, Liang, and Zhang (2011) pointed that in recent years Advanced and Emerging Market Economies (EME) are becoming increasingly interdependent owing to communication and technological improvements, increased in the liberalization of financial sectors, and the popularity of diversification, among others. In fact, some financial experts even argued that the interdependence, and consequently correlations, among stock markets are so high that it nullifies the merits of international diversification.

The U. S. equity market is the largest stock market in the word, with 29. 7 percent of the world's market capitalization. In light of this, it should not come as a surprise that the U. S. market has a strong impact on other national stock exchanges. Research by Eun and Shim (1989) validated that the U. S. is the most dominant stock market in the world as they found substantial multi-lateral interaction among the nine largest stock markets in the world—Australia, Canada, France, Germany, Hong Kong, Japan, Switzerland, U. K., and the US. Specifically, they documented the effects of U. S. news on these national stock markets and found that U. S. news are transmitted to the other markets in a clear and recognizable fashion; and no single foreign market can explain the U. S. market performance in a significant way.

A correlation between the U. S. markets and three central European markets was observed by Gilmore and McMannus (2002). Using daily prices of S&P 500 and the Istanbul Stock Exchange (ISE) 100 index from October 23, 1987 to June 8, 2004, Berument and Ince (2005) found that a positive shock to the U. S. markets has a positive effect on ISE return that lasts up to four days. Using granger causality test and monthly stock price of the NYSE Composite Index and the Philippine Stock Exchange Index (PSE) from 1996 to 2006, Quijano-Arsenio, Corpus, Kim, and Rola (2009) found that

there is synchronicity between the two markets; in particular there is a unidirectional causality from NYSE Composite Index to PSE.

There is a strong correlation between the PSE and the S&P 500 Index due to the global financial system becoming more and more tightly knit than ever, primarily made possible by financial innovations in securitization the past few years. The S&P 500 Index peaked in October 2007 and dropped as much as 57 percent before bottoming out at 666 on March 6, 2009. Likewise, the PSE peaked in October 2007 and similarly plunged by 57 percent before bottoming out at 1,684. 75 on October 28, 2008.

3. Data and Methodology

We collect daily closing prices from May 2007 to December 2009 of the aforementioned stock indices were downloaded from Yahoo Finance. To check for accuracy and to account for national holidays and other non-trading days, the Yahoo Finance dataset was manually counter-checked with the dataset of the online version of the Asian Wall Street Journal.

This date range was chosen because it envelops the global financial crisis, which started in December 2007 and worsened in September 2008 with the collapse of Lehman Brothers. Another reason is that the indices covered in this research were in the midst of a bull run in 2007 and bottomed out sometime in 2009. Finally, it also covers the 2007-2008 world food price crisis.

Since the US equity market is the largest stock market in the word, it is then reasonable to consider both the S&P 500 and the NYSE Composite Index. The SSE Composite Index, launched in July 1991 is a broad-based index that tracks the movements of all stocks (the A shares and the B shares) listed in the Shanghai Stock Exchange. Its base level was pegged at December 19, 1990 at 100 points.

The first step of the analysis of stock market integration in this study involves a simple correlation test to measure the strength and direction of the association between the stock indices. The significance of the correlation for each index provides a preliminary indication about the strength of association between the indices of different stock markets under study. In addition, the study utilizes partial correlation analysis. Partial correlation assumes great significance in cases where the phenomena under consideration have multiple variables influencing them. This correlation is applied to control for potentially confounding variables in correlation and regression analysis. Using the constant elasticity model, the model of the relationship between the Philippine stock exchange and others is as such:

$$Y = A \cdot X_1^{\alpha} \cdot X_2^{\beta} \qquad \text{(Model 1)}$$

Take the log of both sides to get:

$$\ln(Y) = \ln(A) + \alpha \ln(X_1) + \beta \ln(X_2) \qquad \text{(Model 2)}$$

Take the differential of both sides to get:

$$\frac{dY}{Y} = \alpha \frac{dX_1}{X_2} + \beta \frac{dX_2}{X_2} \qquad \text{(Model 3)}$$

We can find that α is the unbiased estimate of the elasticity of the X_1 with respect to the Y, β is the unbiased estimate of the elasticity of the X_2.

4. Correlation Analysis

It has been found that the PSE is highly and positively correlated to the four stock indices as the strength of all the correlation coefficients in Table 1 are categorized as somewhere between “Large” and “Very Large” in the Pearson correlation magnitude scale.comparing the PSE to other indices, this research has found that the PSE is most linearly and significantly positively correlated to the S&P 500

and the NYSE Composite Index with Pearson correlation value of 0. 880 and 0. 878, respectively, at a 0. 01 significance level. In addition, the PSE is also positively correlated to other two major Asian indices, the Nikkei Average Index 225 and the SSE with Pearson correlation values of 0. 848 and 0. 833, respectively.

Table 1: Correlation Analysis among the PSE and Three other Indices

	PSE	S&P 500	NYSE	Nikkei	SSE
PSE	1	.880**	.878**	.848**	.833**
S&P 500	.880**	1	.998**	.955**	.726**
NYSE	.878**	.998**	1	.942**	.736**
Nikkei	.848**	.955**	.942**	1	.649**
SSE	.833**	.726**	.736**	.649**	1

**When the significance level of 0. 01 (two-tailed), the relevant significant.

It should be noted that up until this point in this research, the US equities market is represented both by the S&P 500 and the NYSE Composite Index. However, there are significant differences between the two that blindly following the convention of using the former as a proxy for the US market is not appropriate for the purposes of this research.

The reason this research uses the NYSE Composite Index as the lone proxy for the US market is that one of the component stocks of the PSE, the Philippine Long Distance Telephone Company (PSE: TEL) is listed in the NYSE as an ADR (NYSE: PHI).

After studying the relationship between the Philippines and the US stock market, one should be aware of the economic role of the Philippines in terms of its geographic location. First of all, the Philippines is one of the major trade countries in Asia, the influence of China's role in the economy and thus the PSE intuitively must be quite large. In fact, a 2010 European Central Bank report calculated that the Philippines, South Korean and Taiwanese economies are now less dependent on American demand and is becoming more and more dependent on Chinese demand. Based on official Philippine records, the Philippines imports $7 billion worth of products from China and exports about $6 billion worth of products, which translates to a trade deficit of nearly $1 billion in 2010. On top of that, from Table 1, it is shown that the NYSE Composite Index is correlated to both the SSE Composite Index and the PSE. As a result, a partial correlation analysis was conducted in Table 2 with the NYSE Composite Index as the control variable.

Table 2: Partial Correlation Analysis between the PSE and SSE

Control Variable	Correlation Combination	Partial Correlation Coefficient	Sig. (two-tailed)
NYSE	PSE v. s. SSE	0.277	0.000

From Table 2, it is shown that the PSE is significantly partially correlated to the SSE Composite Index. However, one thing can be noticed when comparing Table 1 and Table 2. Before controlling the NYSE Composite Index, the correlation between the PSE and the SSE Composite Index is 0. 833. After controlling the factor, the correlation is 0. 277, which is a lot lower than before. Therefore, the correlation between the PSE and the SSE Composite Index is greatly influenced by the NYSE Composite Index.

4. 1. Forecasting the PSE by Using the SSE and the NYSE

Combining the above analysis, a constant-elasticity equation can be shown to predict the PSE. That is,

$$PSE = A \times NYSE^{\alpha} \times SSE^{\beta} \quad \text{(Model 4)}$$

Where:

A is constant

α is the unbiased estimate of the elasticity of the PSE with respect to the NYSE Composite Index, ceteris paribus

β is the unbiased estimate of the elasticity of the PSE with respect to the SSE Composite Index, ceteris paribus

Transforming (4) into logarithm format, Equation (5) is produced.

$$\ln PSE = \ln A + \alpha \ln NYSE + \beta \ln SSE \quad \text{(Model 5)}$$

Elasticities (α and β) are interpreted as a one percent change in the NYSE and SSE indices resulting in an α and β percent change in the PSE index. A regression is conducted by using equation (5). According to the model summary on the Table 3, R-square for the model is 0. 869, which means the NYSE Composite Index and SSE can explain the variation of PSE around 86. 9 percent. Calculating ANOVA shows that the model is significant at a 0. 01 level. Table 4 also shows VIF are less than 10, which means there is no collinearity between NYSE and SSE.

Table 3: Model Summary and Coefficient

Predictor	Coefficient	t	Sig.	Collinearity statistics	
				Tolerance	VIF
Constant	1.125	9.875	0.00		
ln(NYSE)	0.486	25.282	0.00	0.435	2.300
ln(SSE)	0.304	20.443	0.00	0.435	2.300

R-square= 0. 869 ANOVA Sig. =0. 00

From Table 3, our results by using equation (3) can be shown as below:

$$\frac{dPSE}{PSE} = 0.486\frac{dNYSE}{NYSE} + 0.304\frac{dSSE}{SSE} \quad \text{(Model 6)}$$

From the equation, result shows that the NYSE index increases 1 percent, PSE index will increase 0. 486 percent and SSE increase 1 percent, PSE index will increase 0. 304 percent. Since the US stock market closes about six hours before the Philippine market opens, investors can simply use this model to forecast the Philippine stock market.

This lends support to the research of Quijano-Arsenio, Corpus, Kim, & Rola (2009) where they found that there is synchronicity between the two markets; in particular there is a unidirectional causality from NYSE Composite Index to PSE. It also validates the research of Dooley & Hutchison (2009) where they found that from early 2007 to the summer of 2008, emerging markets decoupled but recoupled by late summer or early fall of 2008.

5. Conclusion

This research examined the relationships among the stock markets of the United States, China, Japan and the Philippines. Based on the correlation analysis conducted in this research, it was found that the Philippine equity market, thru the PSE Composite Index, is most correlated to the US equities market thru the NYSE Composite Index and the S&P 500 Index.

Part of the motivation for this research is to investigate the correlation among the American and Chinese equities market. This research found that the other three national stock markets are highly and positively correlated to one another. In the case of the Chinese equities market, it was found that the SSE Composite Index is correlated to the PSE even controlling the variable, NYSE. This result is not surprising considering the fact that the NYSE Composite includes all the ADR's listed in the New York bourse. In fact, there are 41 Chinese ADR's, comprising 1. 257 percent of the NYSE Composite Index.

The study suggests on this point, when US stock market return rise then international investors can utilize this as a predictor positive daily returns for the Philippine Stock Market. This study show

that if U. S. stock market price rises, the Philippine Stock market index will rise in tandem. Note that the closing of the U. S. stock market precedes the PSE and SSE exchange. It would be interesting as a possible future study to further examine the predictive capability of the model factoring in the time lag between the markets. In addition also suggested for future studies is the inclusion of macroeconomic variables. As stock returns are also influenced be political events, trade agreements and foreign exchange markets, it would be interesting to see if these factors can be incorporated into this model.

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