LINK BETWEEN INDIAN AND MAJOR ASIAN STOCK MARKETS: AN EMPIRICAL STUDY

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The study investigates the relationship between the NIFTY index returns of National Stock Exchange of India with the major Asian stock index returns over the period 2000 to 2014 using Johansen's co-integration test, VECM and Granger causality test.The Johansen's co-integration test suggests that all the series under the study are found to be co-integrated of order one, indicating that there is a stable long-run equilibrium relationship in these series suggesting that the returns of NIFTY index of Indiahave co-integrated with the eight major stock exchanges of Asia. The result of VECM shows that the returns of NIFTY index respond significantly to the eight major stock exchanges of Asia under the study.The findings from Granger causality based on the VECM indicate bidirectional causality exists between the returns of NIFTY and KOSPI composite index in long run and short run. While in short run Nikkei 225 index returns, Hang Seng index returns and Taiwan Weighted index returns Granger causes NIFTY index returns but not the other way around.

Key words: Asian Stock Markets, Co-integration Test, VECM, Causality Test

INTRODUCTION

The integration of international financial markets has been a topic of growing interest in recent times for many reasons. The globalization of the world stock markets is one of the most significant developments that have occurred during the last two decades. The stock market has gained its importance because of its facility in raising capital and its movements. The advancement in information technology, telecommunication and the emergence of new international financial institutions offering financial services has expedited the flows. Today, the investment opportunities are no longer restricted to domestic markets. Investors can approach overseas market to seek profitable opportunities. The global markets have become more accessible. The knowledge of international stock market is significant for portfolio managers and investors. Due to this

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fact, the researchers world-wide have keen interest in the performances of the stock markets and its inter-linkages.

According to the theories of finance, the investors can achieve a better risk-return trade-off by having a well diversified portfolio. According to the Portfolio theory (Markowitz, 1952), the diversification of portfolio is beneficial when the correlation among the assets is negative. An international investor who is willing to make an international portfolio investment in different stock markets is interested to understand if diversification can give some gain or not. If the stock markets move together then investing in different national stock market would not generate any gain. Therefore, the analysis of the relationship between the stock markets will facilitate global investors in reaching a better decision.

When stock market indices of different countries do not follow the same trend, then international investors can find good opportunities to diversify their portfolio investments among these countries. International investors are generally interested in emerging stock markets but the interdependence among these markets and developed markets may affect the scope for diversification possibilities (Pretorious, 2002).

The present study undertaken will benefit to have an understanding of the intensity of stock market integration. A study of stock market movements and integration is significant as the knowledge of this area can equip investors and policy makers to take better decisions.

LITERATURE REVIEW

The link between the stock markets has been broadly investigated by the empirical literature seeking to detect relations among developed and emerging equity markets. To begin with Singh & Sharma (2012) studying the linkages between the Stock exchanges of Brazil, Russia, India and China found that the Russian, Indian and Brazilian stock exchanges affects each other and get affected by their own return but none of these affect Chinese stock exchange. The Granger's causality model, Vector Auto Regression(VAR) model and Variance Decomposition Analysis were performed by using the data of 60 months from 1st April, 2005 through 31st March, 2010.Tripathi&Sethi (2012) found positive and significant correlation of Indian market with the Brazil, Hungary, Taiwan, Mexico, Poland and South Africa. The study uses the daily closing index value of the leading indices of the above countries for the period from January 1, 1992 to December 31, 2009. The study uses the co-integration frame work to examine the long-run relationships while the Granger causality tests were used to test the short term causality. Subhani et al.,(2011) studied the daily co-movement of the four Indices comprising of KSE-100from Karachi Stock Exchange (Pakistan), BSE Sensex (India), DSE Composite Index (Bangladesh), and NSE Index (Nepal) was examined by using the Johansen cointegration analysis for the period of May-1995 to May-2011. The study found that there is linkage of stock prices between Karachi Stock Exchange and the stock prices of Dhaka Stock Exchange, while KSE is co-integrated with the neither India nor Nepal. In an attempt to understand the volatility of market returns, Fayyad & Daly (2010) did a comparative study of United Arab Emirates (UAE) equity market, Kuwait Equity market with the equity markets of United States of America (USA), United Kingdom (UK). Taking the data from 5th October, 2005 to 5th October, 2009, MGARCH model was used in the modeling. The study found the volatility for the emerging markets of Kuwait and UAE are more volatile than the advanced markets of USA and UK over the study period. The study also found that UAE market is relatively highly correlated with the advanced markets return of UK and USA comparing to Kuwait market which is highly bidirectional correlated to the regional markets in the Gulf area. Singh & Singh (2010) analyses the linkages of stock markets of U.S., U.K., Japan and Hong Kong with Chinese and Indian markets by using the correlation test, Granger causality and the co-integration test applying Error Correction Model. The study found both Chinese and Indian markets are correlated with all four developed markets under study namely U.S., U.K., Japan and Hong Kong.

Other authors have focused on the interdependence among developed equity markets and Eastern Europe emerging markets. For example Syriopoulos and Roumpis (2009) examined interdependences between several South Eastern Europe countries' equity markets and two mature equity markets like the US and Germany. Results show the existence of a long-run relationship although in the short term, investment opportunities may arise for investors interested in diversifying their portfolios in the South East Europe. Through the use of Dynamic Conditional Correlation models, it is shown that stock market returns of each group of countries seem to be highly correlated, while correlation among these groups is weaker. Qiao et al., (2008)examined the issue of integration among the Chinese segmented stock markets and the Hong Kong stock market, finding bi-directional volatility spillover between the B-share Chinese and Hong Kong markets. Raj and Dhal (2008) investigated the degree of integration of

India's stock markets with two Asian regional equity markets (i.e. Hong Kong and Singapore) and three leading international markets (i.e. Japan, UK, and US). Multivariate cointegration tests showed the existence of one cointegration relationship among these markets, whereas pair-wise cointegration tests between India and one of these markets rejected the hypothesis of cointegration. In another study, Chi et al., (2006)examined whether the level of integration of several Asian emerging equity markets with both the Japanese and the US equity markets changed as a consequence of the 1997 financial crisis: results confirm that the integration increased immediately after the crisis.

A paper by Ahmad et al., (2005) analyses the inter linkages and causal relation between the Nasdaq composite index of US, the Nikkei of Japan with that of NSE Nifty and BSE Sensex in India during the period January 1999 to August 2004 using daily closing data. The study using the Co-integration test and Granger causality test found out that there was no long-term relation (no co-integration) of the Indian equity market with that of US and Japanese however, the US and Japanese market had the short-term causal influence over Indian stock market for the study period. Chelley-Steeley(2004) explored the speed of market integration among developed and emerging Asia-Pacific equity markets. Results show that integration among emerging Asia-Pacific countries tends to be faster than the integration between emerging and developed markets of that geographic area. Also the work of Jang and Sul (2002) explored whether co-movements among a sample of Asian stock markets (i.e. Hong Kong Indonesia, Japan, Korea, Singapore, Taiwan and Thailand) changed as a consequence of the 1997financial crisis. By using the Engle-Granger cointegration test, these authors found that cointegration characterized only a small number of countries, while after the crisis the number of cointegrated stock markets increased dramatically. However their work does not explain why the financial crisis should have increased integration among these markets. Inter dependence among Latin American equity markets has been investigated only recently. Among these studies, Chen et al., (2002) investigated the interdependence among six Latin American stock markets during the period 1995-2000. Splitting the sample period in several sub-periods based on a number of global and regional financial crises (i.e. the 1997 Asian crisis and the 1998 Russian and Brazilian crises), these authors showed that Latin American stock markets shared a long-term relationship up until 1999. Bivariate and multivariate cointegration tests did not find evidence of a long-run equilibrium relationship after 1999. Other studies have considered both Asian and Pacific-Basin stock market relationships in order to analyse their degree of integration as well as the effect of 1997 financial crises on their equity markets. Ratanapakorn and Sharma (2002)investigated how short- and long-run relationships changed across five regional stock markets for the pre- and post 1997 Asian crisis. Results show that no long-run relationships characterized their relationship before the Asian crisis, whereas some evidence of integration was observed after the crisis. The main conclusion is that the Asian crisis increased integration among these markets. Goldberg and Dalgado consider India as part of a broader study of stock market linkages in Latin America and South-East Asia.

Huang et al., (2000) analysed short- and long-run relationships among two leading international stock markets (i.e. the USA and Japan) and several Asian emerging markets (China, Hong Kong and Taiwan) during the period 1992-1997. Although some evidence of short-run relationships has been detected among those markets, cointegration analysis does not find any long term equilibrium among these markets. Elyasiani et al., (1998) include the Indian and Sri Lankan markets as part of a wider study of stock market linkages between Sri Lanka and her major trading partners, but do not test for long-run relationships. They examined the relationships between Sri Lanka and Asian developed equity markets over the 1989-1994 periods. Their study found that there was no interdependence between the Sri Lankan and the other stock markets. Kasa (1992) found that there is a single common trend driving the stock markets of Canada, Germany, Japan, UK and USA. In attempting to understand the international transmission mechanism of stock market movements, Cochran & Mansur (1991)uses Pair-wise Granger tests to investigate the effects of unidirectional causality, bidirectional causality, and contemporaneous adjustment in the determination of market rates of return. The first differences of weekly returns are used in the empirical analysis and the causality tests are performed on an annual basis over the 1980-89 time frames, as well as for the sub-periods 1980-89, 1980-85III, and 1985IV- 89periods. The study found the existence of significant unidirectional and bi-directional effects which suggests that the international equity markets are not completely integrated. They conclude that international diversification can result in a reduction in portfolio risk; however, due to the apparent instability in the level of capital market integration, the ability to diversify internationally may vary over time, Eun & Shim (1989)estimated a nine-market vector autoregressive system using daily rates of return on the stock market indices from the period January 1980through December 1985. The daily return data from the nine markets viz. Australia, Canada, France, Germany, Hong Kong, Japan, Switzerland, United Kingdom, and United States were used. The study found that a substantial amount of interdependence exists among national stock markets. The U.S. stock market is found to be, by far, the most influential market in the world. No national stock market is nearly as influential as the U.S. in terms of its capability of accounting for the error variances of other markets by taking the sample of the eight countries viz. Canada, Germany, France, Netherlands, Switzerland, United Kingdom, Japan and United States.

All the above studies have broadly used cointegration methodologies to explore interaction among stock markets and detected relations among emerging and developed stock markets. The aim of this paper is to contribute to the empirical literature by analysing the existence of a long-run relationship between the Indian and several Asian developed markets that is Japan, Singapore, Hong Kong, Taiwan, South Korea, Thailand, Indonesia and China from a prospective international investor from these countries seeking to diversify his/her portfolio in the closest emerging economy like India.

Based on the above discussion, the present study tries to investigate the long run equilibrium relationship between Indian and major Asian stock markets by considering the following model:

Xt = (NIFt, NIKt, STIt, HSIt, TWIt, KCIt,SETt, JSXt, SCIt)

Where, NIF is NIFTY index returns of India, NIK is Nikkei 225 index return of Japan, STI is Straits Times index returns of Singapore, HSI is Hang Sang index returns of Hong Kong, TWI is Taiwan Weighted index returns of Taiwan, KCI is KOSPI Composite index returns of South Korea, SET is SET index returns of Thailand, JSX is JSX Composite index returns of Indonesia, SCI is Shanghai Composite index returns of China and X is a 9×1 vector of variables.

DATA & METHODOLOGY

The aim of this paper is to investigate the relationship between NIFTY index returns of National Stock Exchange of India with the major Asian stock index returns. To accomplish the research objective daily data ranging from 2000 to 2014 are obtained which comprises 2159 data points for the analysis. The choice of study period is based on the availability of data series. Descriptions of variables and data sources are presented in Table 1.

Table 1: Description of Variables

Acronyms	Construction of Variable	Data Source
LNNIF	Natural logarithm NIFTY index returns of India	www.nseindia.com
LNNIK	Natural logarithm of Nikkei 225 index returns of Japan	www.indexes.nikkei.co.jp
LNSTI	Natural logarithm of Straits Times index returns of Singapore	www.straitstimes.com
LNHSI	Natural logarithm of Hang Seng index returns of Hong Kong	www.hsi.com.hk
LNTWI	Natural logarithm of Taiwan Weighted index returns of Taiwan	www.twse.com
LNKCI	Natural logarithm of KOSPI Composite index returns of South Korea	www.bloomberg.com
LNSET	Natural logarithm of SET index returns of Thailand	www.set.or.th
LNJSX	Natural logarithm of JSX Composite index returns of Indonesia	www.markets.ft.com
LNSCI	Natural logarithm of Shanghai Composite index returns of China	www.english.sse.com.cn

The present study employs the time series data analysis technique to study the relationship between the NIF and NIK, STI, HIS, TWI, KCI, SET, JSX and SCI. In a time series analysis, the results might provide spurious results, if the data series are non-stationary. Thus, the data series must obey the time series properties i.e. the time series data should be stationary, meaning that, the mean and variance should be constant over time and the value of covariance between two time periods depends only on the distance between the two time period and not the actual time at which the covariance is computed. The most popular and widely used test for stationary is the unit root test. The presence of unit root indicates that the data series is non-stationary. The standard procedures of unit root test namely the Augmented Dickey Fuller (ADF) (1979) (1981) is performed to check the stationary nature of the series. Assuming that the series follows an AR (p) process the ADF test makes a parametric correction and controls for the higher order correlation by adding the lagged difference terms of the dependent variable to the right hand side of the regression equation. In the ADF test null hypothesis is that data set being tested has unit root. This provides a robustness check for stationary. The unit root tests also provide the order of integration of the time series variables. In a multivariate context if the variable under consideration are found to be I (1) (i.e. they are non-stationary at level but stationary at first difference), but the linear combination of the integrated variables is I (0), then the variables are said to be co-integrated (Enders, 2004). The Augmented Dickey Fuller (ADF) (1979; 1981) is performed to check the stationary nature of the series. The complete model with deterministic terms such as intercepts and trends is shown in equation (1).

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t, \quad (1)$$

Where α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process. Lag length for VAR system is, selected based on minimum sequential modified LR test statistic. The vector autoregression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system. The mathematical representation of a VAR is:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \epsilon_t \quad (2)$$

where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, $A1$, ..., Ap and B are matrices of coefficients to be estimated, and ϵ_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

Leg Length Criteria computes various criteria to select the lag order of an unrestricted VAR(Lütkepohl, 1991). The sequential modified likelihood ratio (LR) test is carried out as follows. Starting from the maximum lag, test the hypothesis that the coefficients on lag l are jointly zero using the χ^2 statistics:

$$LR = (T - m)\{\log|\Omega_{\ell-1}| - \log|\Omega_\ell|\} \sim \chi^2(k^2) \quad (3)$$

Where, m is the number of parameters per equation under the alternative, note that we employ Sims' (1980) small sample modification which uses $(T - m)$ rather than T. We compare the modified LR statistics to the 5% critical values starting from the maximum lag, and decreasing the lag one at a time until we first get a rejection.

With the non-stationary series, co-integration analysis has been used to examine whether there is any long run relationship exists. However, a necessary condition for the use of co-integration technique is that the variable under consideration must be integrated in the same order and the linear combinations of the integrated variables are free from unit root.According to Engel and Granger (1987), if the variables are found to be co-integrated, they would not drift apart over time and the long run combination amongst the non-stationary variables can be established. To conduct the co-integration test, the Engel and Granger (1987) or the Johansen and Juselius(1990) or the Johansen

(1991) approach can be used. The Engel-Granger two step approaches can only deal with one linear combination of variables that is stationary. In a multivariate practice, however, more than one stable linear combination may exist. The Johansen's co-integration method is regarded as full information maximum likelihood method that allows for testing co-integration in a whole system of equations.

The Johansen methods of co-integration can be written as the following vector autoregressive framework of order p.

$$X_t = A_0 + \sum_{j=1}^{p} B_j X_{t-j} + e_t \qquad (4)$$

Where, Xt is an n×1 vector of non stationary I(1) variables, A0 is an n×1 vector of constants, p is the maximum lag length, Bj is an n×n matrix of coefficient and et is a n×1 vector of white noise terms. The number of characteristic roots can be tested by considering the following trace statistic and the maximum eigenvalue test.

$$\lambda_{trace}(r) = -T \sum_{i=j+1}^{p} \ln(1 - \hat{\lambda}_j) \qquad (5)$$

$$\lambda_{max}(r,\ r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \qquad (6)$$

Where, r is the number of co-integrating vectors under the null hypothesis, T is the number of usable observations and $\hat{\lambda}_j$ is the estimated value for the j^{th}ordered characteristic roots or the eigenvalue from the Π matrix.

A significantly non-zero eigenvalue indicates a significant co-integrating vector. The trace statistics is a joint test where the null hypothesis is that the number of co-integration vectors is less than or equal to r against an unspecified general alternative that there are more than r. Whereas, the maximum eigenvalue statistics test the null hypothesis that the number of co-integrating vectors is less than or equal to r against the alternative of r+1 (Enders, 2004) (Brooks, 2002)

A vector error correction (VEC) model is a restricted VAR designed for use with non-stationaryseries that are known to be cointegrated. The VEC Model has cointegration relations built into the specification so that it restricts the behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as theerror correctionterm since the deviation from long-run equilibrium is corrected graduallythrough a series of partial short-run adjustments.

The corresponding VEC model is:

$$\Delta y_{1,t} = \alpha_1(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{1,t} \quad (7)$$

$$\Delta y_{2,t} = \alpha_2(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{2,t} \quad (8)$$

In this model, the only right-hand side variable is the error correction term. In longrun equilibrium, this term is zero. However, ify_1 and y_2 deviate from the long run equilibrium,the error correction term will be nonzero and each variable adjusts to partially restorethe equilibrium relation. The coefficient α_i measures the speed of adjustment of the i-th endogenous variable towards the equilibrium.

Further to examine dynamic relationship between variables, bi-variate Granger Causality test (Engel & Granger, 1987) is applied. The bi-variate regressions of Granger Causality Test are:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{-l} + \epsilon_t \quad (9)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{-l} + u_t \quad (10)$$

For all possible pairs of (x, y) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = \ldots = \beta_l = 0$$

For each equation, the null hypothesis is that x does not Granger-cause y in the first regression and y does not Granger-cause x in the second equation.

EMPIRICAL ANALYSIS

The descriptive statistics for all the variables under study, namely,NIF, NIK, STI, HIS, TWI, KCI, SET, JSX and SCI are presented in Table 2. The value of skewness and kurtosis indicate the lack of symmetric in the distribution. Generally, if the value of skewness and kurtosis are 0 and 3 respectively, the observed distribution is said to be normally distributed. Furthermore, if the skewness coefficient is in excess of unity it is considered fairly extreme and the low (high) kurtosis value indicates extreme platykurtic (extreme leptokurtic). Fromthe table it is observed that the frequency distributions of underlying variables are not normal. The significant coefficient of

Jarque-Bera statistics also indicates that the frequency distributions of considered series are not normal.

Table 2: Descriptive Statistics of Variables

	LNNIF	LNNIK	LNSTI	LNHSI	LNTWI	LNKCI	LNSET	LNJSX	LNSCI
Mean	-0.0240	0.0022	0.0050	0.0142	0.0106	-0.0257	-0.0232	-0.0384	0.0072
Median	-0.0890	-0.0096	-0.0204	0.0102	-0.0229	-0.0670	-0.0607	-0.0978	-0.0142
Maximum	2.7043	2.6301	2.1326	2.3489	2.4377	2.4355	2.9137	2.6826	2.3701
Minimum	-2.7770	-2.1022	-2.0612	-2.3686	-2.3542	-2.6351	-2.4012	-2.5165	-2.2658
Std. Dev.	0.7607	0.7722	0.6277	0.7309	0.7257	0.7576	0.7050	0.7184	0.7807
Skewness	0.1819	0.1040	0.1624	0.0890	0.1640	0.1885	0.1370	0.2110	0.0677
Kurtosis	2.6392	2.3100	2.8063	2.6418	2.6547	2.5795	2.4943	2.6814	2.5957
Jarque-Bera	23.6161	46.7281	12.8643	14.3967	20.4096	28.6874	29.7590	25.1574	16.3529
Probability	0.0000	0.0000	0.0016	0.0007	0.0000	0.0000	0.0000	0.0000	0.0003
Observations	2159	2159	2159	2159	2159	2159	2159	2159	2159

Source: Author's Estimation

To check the stationarity of the underlying data series, we follow the standard procedure of unit root testing by employing the Augmented Dickey Fuller (ADF) test. The results are presented in Table 3. On the basis of the ADF test, all the series are found to be non-stationary at level with intercept. However, after taking the first difference these series are found to be stationary at 1, 5 and 10 percent significance level. Thus the stationary test indicates that all series are individually integrated of the order I (1).

Table 3: Result of Augmented Dickey-Fuller Unit Root Test

Variable			Trend		Trend & Intercept		None	
			t-Statistic	Prob.*	t-Statistic	Prob.*	t-Statistic	Prob.*
D(LNNIF)	Augmented Dickey-Fuller test statistic		-18.1453	0.0000	-18.1412	0.0000	-18.1496	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNNIK)	Augmented Dickey-Fuller test statistic		-19.7452	0.0000	-19.7405	0.0000	-19.7495	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNSTI)	Augmented Dickey-Fuller test statistic		-17.8484	0.0000	-17.8446	0.0000	-17.8526	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	

		10% level	-2.5674		-3.1279		-1.6166	
D(LNHSI)	Augmented Dickey-Fuller test statistic		-19.7018	0.0000	-19.6974	0.0000	-19.7065	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNTWI)	Augmented Dickey-Fuller test statistic		-18.2318	0.0000	-18.2290	0.0000	-18.2354	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNKCI)	Augmented Dickey-Fuller test statistic		-19.3928	0.0000	-19.3880	0.0000	-19.3974	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNSET)	Augmented Dickey-Fuller test statistic		-19.4037	0.0000	-19.3992	0.0000	-19.4082	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNJSX)	Augmented Dickey-Fuller test statistic		-19.5809	0.0000	-19.5763	0.0000	-19.5856	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	
D(LNSCI)	Augmented Dickey-Fuller test statistic		-19.9971	0.0000	-19.9941	0.0000	-20.0009	0.0000
	Test critical values:	1% level	-3.4332		-3.9623		-2.5660	
		5% level	-2.8627		-3.4119		-1.9410	
		10% level	-2.5674		-3.1279		-1.6166	

*MacKinnon (1996) one-sided p-values.

Source: Author's Estimation

The presence and the number of co-integrating relationships among the underlying variables are tested through the Johansen procedure i.e., Johansen and Juselius (1990) and Johansen (1991). Specifically, trace statistic and the maximum eigenvalue are used to test for the number of co-integrating vectors. The result of VAR leg order selection criteria are presented in the Table 4. Leg order selected for the study is based on FPE and AIC criterion. The results of both trace statics and the maximum eigenvalue test statistics are presented in Table 5. The trace statistic indicates nine co-integrating equations and the maximum eigenvalue statistics also identify nine co-integrating equations. The results show that long-run equilibrium relationship exists between the NIF and NIK, STI, HIS, TWI, KCI, SET, JSX and SCI.

Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-17449.19	NA	9.07E-05	16.23263	16.25637*	16.24131*
1	-17323.85	249.5193	**8.70e-05***	**16.19140***	16.42879	16.27825
2	-17261.19	124.2175	8.85E-05	16.20845	16.6595	16.37346
3	-17212.85	95.41454	9.12E-05	16.23882	16.90352	16.48199
4	-17163.66	96.69024	9.40E-05	16.2684	17.14675	16.58972
5	-17110.08	104.8711*	9.64E-05	16.29389	17.3859	16.69338
6	-17060.08	97.43978	9.92E-05	16.32272	17.62838	16.80036
7	-17011.5	94.28023	1.02E-04	16.35286	17.87217	16.90866
8	-16967.68	84.65947	1.06E-04	16.38743	18.1204	17.0214

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
Source: Author's Estimation

Table 5: Result of Johansen's Co-integration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.392013	8234.2	197.3709	1.0000	1073.329	58.43354	0.0001
At most 1 *	0.372317	7160.871	159.5297	1.0000	1004.557	52.36261	0.0001
At most 2 *	0.366768	6156.314	125.6154	1.0000	985.5735	46.23142	0.0001
At most 3 *	0.347726	5170.741	95.75366	1.0000	921.6673	40.07757	0.0001
At most 4 *	0.340287	4249.07400	69.81889	1.0000	897.20430	33.87687	0.0001
At most 5 *	0.337224	3351.86900	47.85613	1.0000	887.21470	27.58434	0.0001
At most 6 *	0.326308	2464.65500	29.79707	1.0000	851.97620	21.13162	0.0001
At most 7 *	0.318234	1612.67800	15.49471	1.0000	826.28080	14.2646	0.0001
At most 8 *	0.305511	786.39760	3.841466	0.0000	786.39760	3.841466	0.0000

Trace test indicates 9 cointegratingeqn(s) at the 0.05 level
Max-eigenvalue test indicates 9 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Author's Estimation

Assuming one co-integrating vector, the short run and long run interaction of the underlying variables the VECM has been estimated based on the Johansen co-integration methodology. The results are presented in Table 6. The results show that a long-run equilibrium relationship exists betweenNIFTY index returns of National Stock Exchange of India with the major Asian stock index returns.The estimated co-integrating coefficients for the NIF is based onthe first normalized eigenvector are as follows. These values represent long term elasticity measures. Thus the co-integration relationship can be re-expressed as:

NIF = -0.0503 + (-1.29439)*NIK + 2.15908*STI + (-1.43573)*HSI + 1.51564*TWI + (-1.37898)*KCI+ (-0.08448)*SET + (-0.90018)*JSX + (-0.52792)*SCI

Table 6: Results of Vector Error Correction Model

Panel A: Normalized Co-integration Coefficients									
LNNIF(-1)	LNNIK(-1)	LNSTI(-1)	LNHSI(-1)	LNTWI(-1)	LNKCI(-1)	LNSET(-1)	LNJSX(-1)	LNSCI(-1)	Constant
1.0000	-1.29439	2.15908	-1.43573	1.51564	-1.37898	-0.08448	-0.90018	-0.52792	-0.0503
Standard errors	(-0.088590	(-0.12409)	(-0.10861)	(-0.0904)	(-0.09783)	(-0.08464)	(-0.08034)	(-0.0663)	
t-statistics	[-14.6118]	[17.3989]	[-13.2189]	[16.7656]	[-14.0950]	[-0.99807]	[-11.2040]	[-7.96290]	
Panel B: Coefficient of Error Correction term									
Error Correction:	D(LNNIF)	D(LNNIK)	D(LNSTI)	D(LNHSI)	D(LNTWI)	D(LNKCI)	D(LNSET)	D(LNJSX)	D(LNSCI)
CointEq1	-0.06673	0.23927	-0.01337	0.17091	-0.02563	0.20522	0.06172	0.13216	0.158985
Standard errors	(-0.01547)	(-0.01516)	(-0.01286)	(-0.0145)	(-0.01486)	(-0.01501)	(-0.01428)	(-0.01446)	(-0.01574)
t-statistics	[-4.31400]	[15.7822]	[-1.03966]	[11.7892]	[-1.72489]	[13.6759]	[4.32192]	[9.14213]	[10.1021]
F-statistic	62.4079	131.6995	77.1449	99.1408	67.5503	103.1550	85.4790	65.7560	87.4923

Standard errors in ( ) & t-statistics in [ ]

Source: Author's Estimation

The t-statistics are given in [] brackets while the error term are given in () brackets. The coefficients ofNikkei 225 index returns, Hang Seng index returns, KOSPI Composite index returns, SET index returns, JSX Composite index returns and Shanghai Composite index returns are negative and statistically significant, while the coefficient of Straits Times index returnsand Taiwan Weighted index returnsare positive and statistically insignificant. The intercept term is negative. The results revels that the relationship between NIK, HIS, KCI, SET, JSX, SCI and NIFis positive, while the relationship between the STI, TWI and NIF isnegative. The sign of the error correction coefficient in determination of NIF is negative (-0.06673) and the corresponding t-value and F-statistics are (-4.31400) and 62.4079 respectively. This indicates that return on NIFTY index (NIF) of National Stock Exchange of Indiado respond significantly to re-establish the equilibrium relationship once deviation occurs.

The co-integration results indicate that causality exists between the co-integrated variables but it fails to show us the direction of the causal relationship. The pair-wise Granger Causality test (1987) is performed between all possible pairs of variables to determine the direction of causality. The rejected hypotheses are reported in Table 7. The result showsNikkei 225 index returns, Hang Seng index returns and Taiwan Weighted index returnsgranger causes NIFTY index returns but not the other way around. While, there is there isbidirectional causality exists between KOSPI composite index returns and NIFTY index returns.

Table 7: Result of Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNNIK does not Granger Cause LNNIF	2158	16.1531	**6.00E-05**	**Reject**
LNNIF does not Granger Cause LNNIK		2.79582	0.0947	Accept
LNSTI does not Granger Cause LNNIF	2158	2.57156	1.09E-01	Accept
LNNIF does not Granger Cause LNSTI		3.76888	5.23E-02	Accept
LNHSI does not Granger Cause LNNIF	2158	6.01168	**1.43E-02**	**Reject**
LNNIF does not Granger Cause LNHSI		0.69234	4.06E-01	Accept
LNTWI does not Granger Cause LNNIF	2158	40.4386	**2.00E-10**	**Reject**
LNNIF does not Granger Cause LNTWI		0.00258	9.60E-01	Accept
LNKCI does not Granger Cause LNNIF	2158	10.7944	**1.00E-03**	**Reject**
LNNIF does not Granger Cause LNKCI		5.90659	**1.52E-02**	**Reject**
LNSET does not Granger Cause LNNIF	2158	0.31048	5.77E-01	Accept
LNNIF does not Granger Cause LNSET		0.50862	4.76E-01	Accept
LNJSX does not Granger Cause LNNIF	2158	8.6466	**3.30E-03**	**Reject**
LNNIF does not Granger Cause LNJSX		0.07755	7.81E-01	Accept
LNSCI does not Granger Cause LNNIF	2158	0.40275	0.5257	Accept
LNNIF does not Granger Cause LNSCI		3.78987	0.0517	Accept

Source: Author's Estimation

CONCLUSION

The aim of this paper is to investigate the relationship between NIFTY index returns of National Stock Exchange of India with the major Asian stock index returns using Johansen's co-integration test, VECM and Granger causality test. The analysis used Daily data over the period 2000 to 2014 which is obtained from the websites of the respective stock exchanges as mentioned in Table 1,? It is assumed that the selected stock market index included here are representatives of Asian stock markets.

To conclude, the Augmented Dickey Fuller test suggests that all the series are found to be non-stationary at level with intercept. However, after taking the first difference these series are found to be stationary at 1, 5 and 10 percent level of significance. The Johansen's co-integration test suggests that all the series under the study are found to be co-integrated of order one, indicating that there is a stable long-run equilibrium relationship in these series suggesting that the returns of NIFTY index of National Stock Exchange of India have co-integrated with the eightmajor stock exchanges of Asia under the study.

The result of VECM shows that the returns of NIFTY index respond significantly to the eight major stock exchanges of Asia under the study. The findings from Granger causality based on the VECM indicatebidirectional causality exists between the returns of NIFTY and KOSPI composite indexin long run and short run. While in short run Nikkei 225 index returns, Hang Seng index returns and Taiwan Weighted index returns Granger causes NIFTY index returns but not the other way around. The main implications of the results of the present study are for investors and policy makers. On the basis of the results, investors may decide about their investment in shares & derivaties of these stock exchanges of Asia under the study, and the policy makers may frame right policies to increase efficient functioning of these stock exchanges.

However, the limitations of the study should not be over looked. The present study is limited to only nine major stock exchanges of Asia. Inclusion of more index returns of exchanges with a longer time period may improve the results. A similar study can be conducted for the rest of the continents or may be for the whole world.

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