Return Linkages Among Returns from Stock Markets

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This paper studies inter-linkages among returns from stock markets in Japan, USA, England, India and China. Daily closing levels of benchmark indices in five countries are taken for period 6th January 2003 to 21st September 2013. Augmented Dickey-Fuller unit-root test is applied to check stationary nature of the series; Regression analysis, Granger's causality model, Vector Auto Regression model, and Variance Decomposition Analysis to find out the linkages between returns. The study leads to two major findings. First, that there exist opportunities for diversification for the investors, and second is the domestic factors (macro economic variables) that influence stock markets.

1. Introduction

Stock markets have emerged as one of the preferred destinations for investors who find this a highly rewarding avenue. However, the impact of uncertainty on investment is a major concern to the investors due to market risks i.e. risk increases with increase in volatility and return decreases. Therefore, there is a strong relationship between volatility and market behavior. Investors contract risk for they expect higher return, but they tend to diversify their investment portfolio to safeguard their exposure to higher risk.

Higher risk in stock markets, as seen empirically in global market, is generally different in developed and developing countries. Per capita GDP is a factor that often determines pattern of investors' portfolio. Stated in simple terms, growth in per capita GDP in developing countries provides a funding base to invest in stock markets. The correlation and integration of the global stock markets has remained an issue of keen financial interest as the potential of economic growth of developing countries got highlighted. The growing relevance of developing economies is also visible from the growth in GDP since 1990s. GDP growth in developing economies led the investors to invest in the equity markets of emerging economies.

In fact risk is lower in less correlated securities in the portfolio. Risk is represented by the dispersion of returns around the mean and return is measured as a dispersion of Coefficient of Variation. Returns on securities are much less correlated across countries than within a country. Intuitively, this is so because economic, political and institutional factors affecting securities returns tend to vary a great deal across countries. This results in a relatively low correlation among international securities. *Eun and Resnick (1984)* reveal that the intra-country correlation is higher than the inter-country correlation with respect to USA with Germany and Japan with United Kingdom. The relationships between international stock markets have become increasingly important since *Grubel (1968)* analyzes the benefits of international diversification. Studies have been conducted in large numbers to test the linkages and integration between stock exchanges of the developed nations, namely the USA, Canada, Europe and Japan *(Kasa, 1992; Richards, 1995; Choudhry, 1996; Kanas, 1998a; Hamori and Imamura, 2000; Ahlgren and Antell, 2002)*. Inter-linkages among BRICS is also explained *(Sharma and Bodla, 2011)*. Some other studies focused on the developing and under-developed nations, have studied the linkages of those with the developed nations. Not much work has been done on developed and developing nations together. Stock exchanges serve as an important measure of financial activity in a country. Therefore, the present research concentrates on studying the inter-linkages, the return patterns and risk and volatility behaviour among USA, England, Japan, India and China.

2. Objectives

This paper aims to achieve the following research objectives:

1. To study and compare the return patterns among stock markets of selected developed and developing countries;
2. To observe the risk and volatility behaviour in stock markets of selected developed and developing countries;
3. To establish the inter-linkages between returns from selected developed and developing countries.

This paper is organized in six parts. The first part introduces the study; second part delineates objectives of the study; third part reviews the literature; fourth part elaborates the research methodology; fifth part presents the empirical analysis; and the sixth part enshrines the conclusion.

3. Review of literature

Various empirical studies are performed by different researchers on return patterns of some other researchers have also studied the inter-linkage among the stock markets. *Salomons and Grootveld (2002), Yang and Ye (2010), Hunjra, Azam and*

Azam et al. (2011), Pandey and Prachetas (2012), Safarzadeh and Nazarian (2012), Aleksandar Naumoski (2012), Samphantharak and Townsend (2013) have studied the risk and return in emerging markets. Volatility is a fast moving trend in stock markets across the world. The studies *of Schwert (1989),Yan-Ki Ho and Cheung (1994) Bekaert and Harvey (1997), Aggarwal et al. (1999), Li et al. (2005), Batra (2004) , Hammoudeh and Li (2008)), Chiou, Lee & Lee (2009)Neville Mandimika (2010),Fayyad and Daly (2010)* have studied the volatility in emerging markets. *Chan et al. (1997), Chaudhuri (1997), Masih et al. (1997) Elyasiani et al. (1998), Pan et al.(1999), Bala and Mukund (2001), S.Poshakwale and V. Murinde (2001) Sharma and Wongbangpo (2002), Worthington et al. (2003), Yang et al. (2003), Nath and Verma (2003), Bodla and Turan (2006), Hoque (2007),Rajiv Menon et al. (2009), Sharma and Bodla (2011)* find the evidence of inter linkage among emerging markets (BRICS).

Numerous studies have been done on different countries that focus on a wider number of objectives related to risk and return, volatility and inter-linkages among these countries. *Salomons and Grootveld (2002)* study the ex-post equity risk premium in a number of international markets with special attention to emerging ones. *Yang and Ye (2010)* study Return Correlation of China's Real Estate and Stock Markets. *Hunjra and Azam et al. (2011)* attempts to study the Risk and Return Relationship in Stock Market and Commodity Prices of Pakistani Markets. *Pandey and Prachetas (2012),* study the testing of risk anomalies in Indian equity market by using monthly average risk & return. *Safarzadeh and Nazarian(2012)* study the comparative analysis of Indian stock market with international markets. *Naumoski (2012)* study the country risk premium in emerging markets Republic of Macedonia. *Samphantharak and Townsend (2013)* study risk and return in village economies.
Schwert (1989) studies time variation in market volatility which can be explained by macroeconomic and microstructural factors. *Yan-Ki Ho and Cheung (1994)* found that there existed day-of-the-week variations in volatility in many of emerging Asian stock markets. *Bekaert and Harvey (1995)* examined the emerging equity market characteristics in relation to developed markets. *Harvey (1995)* found that serial correlation in emerging market returns are much higher than observed in developed markets. *Bekaert et al. (1998)* argued that emerging markets returns are highly non- normally distributed and exhibit positive skewness in it. *Aggarwal et al. (1999)* examined the events that caused large shifts in volatility in emerging markets. Both increases and decreases in variance were identified first and then events around the period when volatility shifts occurred were identified. *Li et al. (2005)* examined the relationship between expected stock return and volatility based on parametric EGARCH-M model. *Batra (2004)* analysed time variation in volatility in the Indian stock market during 1979-2003 and examined if there had been an increase in volatility persistence in Indian stock market on account of financial liberalization process in India.

Further, it also examined the shifts in stock price volatility and the nature of events that apparently cause the shifts in volatility. *Li et al. (2005)* examined the relationship between expected stock return and volatility. *Hammoudeh and Li (2008)* examined the sudden changes in volatility in emerging markets i.e. five Gulf area Arab stock markets. *Chiou, Lee & Lee (2009)* study shows how the legal environment in a country influences return and risk of stock across countries at different developmental stages and of various rules of jurisdiction. *Mandimika (2010)* study the risk-return relationship as well as the behaviour of volatility of the South African equity markets using both aggregate, industrial level and sector level data. *Fayyad and Daly (2010)* attempts to study the volatility of market returns of emerging versus mature markets.
The studies of *Chan et al. (1997), Chaudhuri (1997), Elyasiani et al. (1998), Pan et al.(1999), Bala and Mukund (2001), Sharma and Wongbangpo (2002), Worthington et al.(2003), Yang et al. (2003), Nath and Verma (2003), Bodla and Turan (2006), Hoque (2007),Rajiv Menon et al. (2009),* point towards the non-existence of linkages between the stock markets under their studies. On the other hand, *Wong et al. (2004), Narayan et al. (2004), Chuang et al. (2007), Weber (2007), Singh et al. (2008), Elyasiani et al. (1998), Nair and Ramanathan (2003)* find evidence of linkages between the stock markets under study. *Sharma and Bodla (2011)* study the inter-linkages between stock markets of India, Pakistan and Sri Lanka. *Sharma and Mahendru (2013)* study the inter-linkages between stock markets of Brazil, Russia, India, China and South Africa with the help of benchmark indices of these stock exchanges. *Wong et al (2004)* investigate the long-run equilibrium relationship and short-run dynamic linkage between Indian stock market and stock markets of major developed countries.

Researchers have employed a wide array of statistical tools. *Salomons and Grootveld (2002)* have used descriptive statistics, time series analysis of returns, auto correlation, Wicoxon tests, Sharpe and Sortino ratios for equal weighted indices. *Yang and Ye (2010)* used Descriptive Statistics and Augmented Dickey Fuller tests. *Hunjra, Azam and Azam et al. (2011)* applied ADF Test to examine the stationary of the return series of data. The significance of Portmanteau Q-Test indicated that all commodities and stock prices return series confirmed the presence of volatility clustering. Further, the effect of volatility was captured through ARCH type's models. The asymmetric and nonlinear relationship between risk and return is observed on the basis of GARCH-MEAN and E-GARCH modelling approach. *Pandey and Prachetas (2012)* determined the volatility of stocks through Standard deviation of the stock returns. They also used VaR and LPSD. The cumulative histogram of VaR also established increased downside risks with higher probability for HV and market portfolio when compared with LV portfolio. *Safarzadeh and Nazarian (2012)* tested all the exchange rate and stock return data for the presence of unit roots in the individual time series. In the study, they have tested for unit roots using the Augmented Dickey-Fuller (ADF) Test, (1979), and the Phillips-Perron (1988) Test. The tests showed that stock indices of five countries in the study were non-stationary. However, a test of co-integration among the stock indices showed that the null hypothesis, existence of at least one co-integrating vector, could not be rejected at 95% level of significance. *Naumoski (2012),* have used CAPM model for calculation of cost of capital invested in emerging markets. *Samphantharak and Townsend (2013)* have used a risk-sharing benchmark and predicted only aggregate covariate risk contributes to the risk premium and an autarky benchmark predicts that overall fluctuation, idiosyncratic plus aggregate, is the only concern.

Schwert (1989) used descriptive statistics to estimate volatility of stock returns. Autoregressive models to estimate the relation between stock returns and leverage. *Ho and Cheung (1994)* used the Levene Test, and found that there exists day-of-the-week variations in volatility in many of emerging Asian stock markets. *Bekaert and Harvey (1997)* used their time-series and cross sectional models that volatility is different across emerging markets, at the time of capital market reforms in particular. *Aggarwal et al. (1999)* used ICSS to identify the shocks/sudden changes in variance of each stock market and how long the shift lasts. *Li et al. (2005)* used both a parametric and a semi parametric method to examine the relationship between stock market returns and volatility, they also used GARCH-model to recognise time varying pattern of stock market volatility. *Batra (2004)* used Descriptive statistics to relate the sensex based stock returns in India and Stock return volatility is estimated using asymmetric GARCH (E-GARCH) methodology. *Chiou, Lee & Lee (2009)* used both T-test and Mann-Whitney test to investigate the cross-nation variation and risk-return measurements Sharpe ratio and global Treynor index. *Mandimika (2010)* used Descriptive statistics to investigate the behaviour of volatility in each industry sectors and the benchmark series focussing on whether volatility is symmetric or asymmetric. GARCH-M, EGARCH-M and TARCH-M models under the Gaussian, Student–t and the GED to capture the risk return relationship. *Fayyad and Daly (2010)* used a multivariate generalised autoregressive conditional
heteroskedasticity (MGARCH) to identify the source and magnitude of volatility.

The researchers have used Granger's causality model very extensively. *Wong et al (2004),Narayan et al (2004), Mukherjee and Mishra (2005), Nair and Ramanathan (2003)* apply the Engle-Granger residual based test of co-integration. *Wong et al (2004)* apply the Granger's causality model in addition to the co-integration model applied by them in their study. *Chuang et al (2007), Wang and Gunasekarage (2005)* apply the Vector Auto Regression (VAR) model to carry out their research. *Chuang et al. (2007)* use the VAR model in their paper to investigate the volatility interdependence in six East Asian markets under study. *Wang and Gunasekarage (2005)* investigate the interdependence of world's fifteen indices including India in a framework of VAR. The studies of *Bala and Mukand (2001), Wong et al (2004), Hoque (2007), Menon, Subha,Sagaran (2009), Nath and Verma (2003), Dwyer and Wallace (1992)* apply co-integration model in order to arrive at their research objectives. *Bala and Mukand (2001)* use the theory of co-integration to study the interdependence between the BSE, NYSE and NASDAQ. Their data consists of daily closing prices for the three indices from January 1991 through December 1999. *Wong et al (2004)* investigate the pair-wise, multiple and fractional co-integrations between Indian stock market and developed stock markets such as USA, UK and Japan. *Sharma and Bodla (2011)* have used line charts, correlogram and unit-root test are applied to check the stationary nature of the series; Granger's causality model, vector auto regression (VAR) model and variance decomposition analysis to study the inter linkages between South Asian countries.

Numerous results were derived from the researches under review. *Salomons and Grootveld (2002)*, find that the equity risk premium in emerging markets is significantly higher than in developed markets. Secondly, the extent to which emerging stock markets reward investors is varying through time, and observed that differences are of a more cyclical nature. *Yang and Ye (2010)* found that Monday returns, in general, have the lowest volatility for all the emerging Asian markets except Korea. Three of the five markets that have significant day-of-the-week effect in volatility have the lowest volatility on the last trading day of the week. It is also found in their study that the close-market effect is not a good explanation of the volatility pattern across day-of-the-week. *Hunjra, Azam and Azam et al. (2011)* indicated in their findings that asymmetric and seasonal effect is present in commodities market and stock market. But the asymmetric properties and seasonal effect is most dominant in stock market prices comparative to other commodities. *Pandey and Prachetas (2012)* established high risk high returns paradigm is a fallacy in capital markets. The analysis gave higher average monthly rate of returns for low volatility stocks when compared with high volatility and market portfolios. *Safarzadeh and Nazarian (2012)* find that the BRIC Index Fund (BKE) and Emerging Markets Index Fund (EEM) allocations of funds are not consistent with the optimum allocations of funds derived from the Mathematica simulation whether the risk of exchange rate volatility is factored in or not.

Aleksandar Naumoski (2012) finds that investments in emerging countries are riskier than investments in developed countries. The return on investment in emerging countries should be rewarded with a country risk premium over the return on an equivalent investment in developed countries. There is empirical evidence confirming the strong relation between the country risk and the returns on investment in emerging countries, but no such dependency in developed countries. *Samphantharak and Townsend (2013)* arrived at the inference from semi-urban and rural Thai households with extensive family networks quantify that idiosyncratic risk is the dominant factor in total risk, but aggregate risk captures a much larger share of total risk premium. Exposure to aggregate and idiosyncratic risk is heterogeneous across households as are the corresponding risk-adjusted returns, with important implications for vulnerability and productivity.

Schwert (1989) suggest that the amplitude of fluctuations of aggregate stock volatility is difficult to explain using simple models of stock valuation during Great depression. *Bekaert and Harvey (1997)* find that the capital market liberalizations often increase the correlation between local market returns and world market but do not dry up local market volatility.
Aggarwal et al. (1999) find high volatility is marked by several shifts during 1985-1995 and there were seven shifts in Argentina. Also large changes in volatility seem to be related to country-specific political, social and economic events and include Mexican peso crisis periods of hyperinflation in Latin-America, the marcos- Aquino conflict in the Philippines, and the stock market scandal in India. They suggest the October 1987 crash is the only global event in the last decade that caused a significant jump in the volatility of several emerging stock markets. *Li et al. (2005)* find a positive but insignificant relationship between stock return and volatility. By using semi parametric specification of conditional variance, they find a significant negative relationship between expected return and volatility in six out of 12 markets during January 1980 to December 2001. *Hammoudeh and Li (2008)*, found that most of the Gulf Arab stock markets were more sensitive to global

events compared to local or regional events. This finding is in sharp contrast to the study of *Aggarwal et al. (1999)*, which found dominance of local events in causing large shifts in volatility. *Chiou, Lee & Lee (2009)* explain that equities in countries with English common-law origin have higher risk premiums than those in civil law countries, particularly for countries of the French/Spanish code.

The indicators representing high efficiency, low corruption, strong legal protection of investors' rights, and reliable political environment are associated with low risk and high performance. The elements of legal procedural formalism, however, have differing effects on volatility and return. *Mandimika (2010)* suggests there is no clear relationship between risk and return, and finds volatility is asymmetrical implying that bad news has a greater effect on volatility than good news in the South African equity market. Also reveal that the TARCH-M model under the GED was found to be the most appropriate model and volatility increases during financial crises and major global shocks. Also volatility is generally not priced on the South African equity markets. *Fayyad and Daly (2010)* show that the market daily returns have the indication of volatility clustering and Leverage effects since the relation between the regional markets of (Kuwait & UAE) and the Global markets of (USA & UK) is increased during the financial crises. Also it is noticeable 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. *Elyasiani et al. (1998)* find no significant interdependence between the Sri Lankan market and the equity market of the USA and other Asian countries. Examining the nature and extent of linkage between the US and the Indian stock markets, *Bala and Mukund (2001)* find that the Indian stock market was not affected by the movements in US markets for the entire sample period. Examining the interdependence of three major stock markets in South Asia, namely India, Singapore and Taiwan, *Nath and Verma (2003)* find no cointegration between the stock market indices during the entire study period. *Hoque (2007)* establishes that USA and India do not have any impact on Bangladesh market. Referring to the Indian scenario, the study shows that it is not affected by its own lag or by USA or Japan. The study of *Rajiv Menon et al. (2009)* suggests the absence of cointegration between the Indian stock markets and the American Stock markets. The study further observes that the Indian stock markets and Hong Kong markets operate independently of each other.

On the other hand, Wong *et al. (2004), Narayan et al. (2004), Chuang et al. (2007),Weber (2007), Singh et al. (2008), Elyasiani et al. (1998), Nair and Ramanathan (2003)* find evidence of linkages between the stock markets under study. *Wong et al (2004)* investigate the long-run equilibrium relationship and short-run dynamic linkage between the Indian stock market and the stock markets in major developed countries. *Sharma and Bodla(2011)* stock markets under study are influenced by each other but not to a great extent and suggested that there exist opportunities for diversification for the investors among the stock exchanges of BRICS. Also, there are domestic factors (macro economic variables) that influence the stock markets.

4. Research Methodology

This paper analyses the relationship of risk in stock markets among developed and developing countries. One of the major reasons behind this study is the limitation that most of the research studies have been done either on developed markets or on developing markets. This paper takes into consideration the major developed markets of Japan, US, England and emerging markets of India, China. The study here will examine the linkages return pattern and risk and volatility between the returns of the aforementioned markets. This study takes into account the daily index data for all the countries from 6th January 2003 to 21st September 2013.

In this research, we study the linkages between the stock exchanges of Japan, US, England, India, China. The study uses one stock exchange from each of the twenty countries as a representative of the respective country. The stock exchange with the largest volumes from each of the country has been chosen for the study. Tokyo Stock Exchange of Japan, New York Stock Exchange from US, London Stock Exchange, LSE from England, Bombay Stock Exchange (India), Shanghai Stock Exchange (China).From Japan, Nikkei225 is used. For USA, NYSE Arca Major Market Index is used. From England FTSE 100 index is taken as representative. From India, the BSE Sensex is taken as representative index. SSE Composite Index is used as the representative index for China. The daily closing levels of the five representative indices for a period beginning on 6th January 2003 through 21st September 2013 are considered the reference period. In this way, the data of total 125 months are taken for the purpose of the study. Out of the time for which data is taken, it is found that on few days, one or two of the exchanges were open while other(s) was (were) closed. The study takes the data for all the days on which any of the twenty stock exchanges were open. As a result, there are missing values in the data of some of the stock exchanges for some days. There has been much research about filling such missing data points [Mitchel and Stafford (2000), Fuller et al (2002), Moeller et al (2003), Aktas et al (2007)]. The study fills the missing values going by the most advocated method of taking the average of the two nearest cases.

Data has been examined by applying econometric system of studies which is performed on series of stationary nature. In order to confirm the random nature of the series, correlation is computed for each of the series. Augmented Dickey-Fuller Unit Root test has been used to verify whether the series are stationary or not. Further analyses has been made on the daily return observed in relation to five stock exchanges which is technically defined as "log of the series". The variable log series are named as DJAPAN, DUSA, DENGLAND, DINDIA and DCHINA. At the stationary log series of the twenty stock exchanges, the study performs the Granger's causality model in order to observe whether the return at each stock exchange granger causes the return at the stock exchanges. The *Granger causality test* (1969) has been applied to study if any change is caused by x into y, and to correlate whether lagged value of x justifies y. It has been further studied to confirm whether x can help to determine y. Therefore, it is generally seen that x granger causes y and y granger causes x, though this may not always be held that y is the result caused by x. Hence, this two way process of cause and effect is a study made under Granger

Causality test. Vector autoregression (VAR) Model and Granger Causality test are the methods generally followed to predict the inter-linked series and to study the impact of unforeseen disturbances on the variables of stock market system. The VAR technique overrides the values of internal variables in structured system of stock market. This paper is aimed to explore the possibilities under Variance Decomposition Analysis whether indices are mutually affected internally. The way that this is achieved in practice is by expressing the VAR model as a VMA -that is, the vector autoregressive model is written as a vector moving average. Provided that the system is stable, the shock should gradually die away.

The ARCH model of *Engle (1982)* and the GARCH of *Bollerslev (1986)*, and different extensions to these models have been extensively used in recent empirical studies *(Appiah-Kusi and Menyah 2003; Chinzara and Aziakpono 2009)*. In order to address the objective regarding the nature of the risk-return relationship we analyse the volatility of each of the stock exchanges with GARCH(1,1) model. We then analyse the parameter for risk and if that parameter is statistically significant, then the increase in risk, given by an increase in the conditional variance, leads to a rise in the mean return. Below is a discussion of the models and the procedures that will be used in analysing volatility and to determine the relationship between risk and return.

The mean equation- First step in modelling volatility is to specify an appropriate mean equation. The equation can take the form of a standard structural model, an autoregressive (AR) model, or a combination of the two.

The ARCH(1), GARCH (1,1), models are estimated for the series of stock market, interest rates and exchange rate returns respectively to choose the best fitting volatility for forecasting the conditional volatility of the return series.

Finally, in order to test whether there are any remaining ARCH effects in the residuals is calculated by regressing the squared residuals on a constant and p lags. The correct number of lags in the model have been selected using AIC and SIC information criterion. The AIC and SIC criterion is lowest for GARCH /TARCH, therefore we have used GARCH/TARCH (1,1) model in the study.

5. Empirical Analysis

Table 1 *Descriptive Statistics of Returns of Major Developed and Developing Markets*

	Mean return (daily)	Mean % Return (daily)	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Coefficient of Variation
RJAPAN	0.0002	0.0151	0.0150	-0.7975	10.7388	6974.3140	0.0000	99.4636
RUS	0.0002	0.0209	0.0134	-0.3585	13.3836	12101.8000	0.0000	64.0144
RENGLAND	0.0002	0.0158	0.0122	-0.1219	11.2090	7534.3560	0.0000	77.1582
RINDIA	0.0006	0.0642	0.0157	-0.1047	11.4772	8032.6650	0.0000	24.4190
RCHINA	0.0002	0.0168	0.0163	-0.1512	6.8189	1639.3800	0.0000	96.8393

Table 1 shows that the average daily return at the Tokyo Stock Exchange (Japan), New York Stock Exchange(US), London Stock Exchange, LSE(England), Bombay Stock Exchange (India), Shanghai Stock Exchange (China) is 0.01510%, 0.02090%, 0.01580%, 0.06420%, 0.01680%, respectively.

There are a total of 2681observations for a period of 10.45 years. Hence, the total returns over a period of 10.45 years can be computed by multiplying the mean daily return with 2681. Going by this, over the period of 10.45 years, stock Exchanges of Japan, US, England, India, and China give returns of 40.4831%, 56.0329%, 42.3598%, 172.1202%, 45.0408% respectively. Going by this and dividing these total returns by 10.45 years, we get the average annual returns for the exchanges under study. In this way, the average annual returns for the five stock exchanges come out to be 3.8740%, 5.3620%, 4.0536%, 16.4708%, 4.3101%respectively. It means that on an average, the return at the Bombay Stock Exchange (India) is the maximum out of the five, followed by the New York Stock Exchange (US), Shanghai Stock Exchange (China), London Stock Exchange LSE (England), and Tokyo Stock Exchange (Japan) respectively.

Table 1 also depicts that the Coefficient of Variation of Tokyo Stock Exchange is 99.46358, which shows the highest risk in the Japanese stock market followed by the China (96.83929), England (77.15823), US (64.01435), and India (24.41900).

The Jarque-Bera probability value 0.00000 for all the five stock exchanges indicates that the null hypothesis of normality can be rejected for all the five stock exchanges. However, the non-normality is not a problem for the return series so far as those don't have fat tales *(Brooks, 2008)*. All the five series are leptokurtic in nature as the kurtosis statistic for all the five happens to be more than 3 (Kurtosis for normal distribution is 3).

It is convention that if this value is less than .05, then the correlation is considered to be significant (meaning that the researcher can be 95% confident that the relationship between the two variables is not due to chance).The values of the Pearson Correlation range from -1 to +1 with negative numbers representing a negative correlation (as one variable increases, the other variable decreases) and positive numbers representing a positive correlation (as one variable increases, the other also increases. The closer the value is to -1 or +1, the stronger the association is between the variables. In Table2 we find that the association between Japan and US, England, China, and India is significant. Similar results were found with the association between US and Japan, England, India , China; England and Japan, US, India, China; India and Japan, US, England, China; China and Japan, US, England, India which appears to be significant.

Table 2 *Correlation*

		RJAPAN	RUS	RENGLAND	RINDIA	RCHINA
RJAPAN	Pearson Correlation	1	.509**	.367**	.162**	-.046*
RUS	Pearson Correlation	.509**	1	.623**	.314**	.085**
RENGLAND	Pearson Correlation	.367**	.623**	1	.404**	.136**
RINDIA	Pearson Correlation	.162**	.314**	.404**	1	.225**
RCHINA	Pearson Correlation	-.046*	.085**	.136**	.225**	1
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Table3 *Regression R-Square Table*

REGRESSION ANALYSIS		
Dependent Variable	R Square	Adjusted R square
Rjapan	0.295	0.29
RUS	0.775	0.774
Rengland	0.841	0.84
RINDIA	0.378	0.374
RCHINA	0.186	0.18

The higher the R-squared statistic, the better the model fits the data. R- Square varies between 0 and 1. The independent variables in the regression model account for 29.5% of total variation in dependent variable i.e. RJAPAN. The independent variables in the regression model account for 77.5% of total variation in dependent variable i.e. RUS. The independent variables in the regression model account for 84.1 % of total variation in dependent variable i.e. RENGLAND. The independent variables in the regression model account for 37.8% of total variation in dependent variable i.e. RINDIA. The independent variables in the regression model account for 18.6% of total variation in RCHINA.

Table 4 *Regerssion Analysis*

INPUT	**DEPENDENT VARIABLE**									
	RJAPAN		RUS		RENGLAND		RINDIA		RCHINA	
	B	SIG	B	SIG	B	SIG	B	SIG	B	SIG
RJapan			0.44	0	0.03	0.548	0.038	0.053	-0.06	0
RUS	0.112	0			-0.037	0.139	0.017	0.085	-0.015	0.066
REngland	0.004	0.548	-0.022	0.139			0.01	0.21	-0.012	0.053
RINDIA	0.037	0.053	0.065	0.085	0.062	0.21			0.005	0.771
RCHINA	-0.081	0	-0.083	0.066	-0.113	0.053	0.007	0.771		

Tables 4 depict the result of the application of the regression model on the returns of the Stock Exchanges of Japan, US, England, India, China. The p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to the model because changes in the predictor's value are related to changes in the response variable. Conversely, a larger (insignificant) p-value suggests that changes in the predictor are not associated with changes in the response. In RJAPAN the p-value for US and China is less than 0.05. in RUS the p-value for RJAPAN is less than 0.05. Similarly, in RCHINA, the p-value for RJAPAN is less than 0.05.There is significant cause and effect relations among all these Stock Exchanges. So there is a scope for the further study of these Variables.

Table 5 presents the summary of unit-root test and Augmented Dickey-Fuller test for the returns at the Tokyo Stock Exchange (Japan), New York Stock Exchange (US), London Stock Exchange, LSE (England), Bombay Stock Exchange (India), and Shanghai Stock Exchange (China). The result shows that the probability value of unit-root tests for all the stock exchanges is less than 0.05, which indicate towards the fact that the null hypothesis is rejected and the series return at all Five Stock Exchanges are stationary in nature.

Table 5 *Augmented Dickey-Fuller Test For Unit Root*

Null Hypothesis	Probability	Accept/Reject Null	Interpretation
JAPAN has a unit root	0.0001	Null Hypothesis is Rejected	The series is stationary
US has a unit root	0.0001	Null Hypothesis is Rejected	The series is stationary
ENGLAND has a unit root	0.0000	Null Hypothesis is Rejected	The series is stationary
INDIA has a unit root	0.0001	Null Hypothesis is Rejected	The series is stationary
CHINA has a unit root	0.0001	Null Hypothesis is Rejected	The series is stationary

Table 6 *Granger Casuality Tests*

NULL HYPOTHESIS	F-STATISTICS	PROBABILITY
CHINA does not Granger cause US	0.02395	0.9763
CHINA does not Granger Cause JAPAN	0.06840	0.9339
US does not Granger Cause JAPAN	0.08889	0.9149
CHINA does not Granger Cause ENGLAND	0.62357	0.5361
INDIA does not Granger Cause US	1.66409	0.1896
INDIA does not Granger Cause JAPAN	1.76147	0.172
ENGLAND does not Granger Cause US	2.54337	0.0788
CHINA does not Granger Cause INDIA	3.54203	0.0291
INDIA does not Granger Cause ENGLAND	4.13994	0.016
ENGLAND does not Granger Cause JAPAN	4.54783	0.0107
INDIA does not Granger Cause CHINA	6.06380	0.0024
ENGLAND does not Granger Cause INDIA	23.7086	6.00E-11
ENGLAND does not Granger Cause CHINA	24.8046	2.00E-11
US does not Granger Cause CHINA	35.8292	4.00E-16
US does not Granger Cause INDIA	79.6775	2.00E-34
JAPAN does not Granger Cause CHINA	92.9952	9.00E-40
JAPAN does not Granger Cause US	116.644	3.00E-49
US does not Granger Cause ENGLAND	200.271	9.00E-82
JAPAN does not Granger Cause INDIA	226.136	2.00E-91
JAPAN does not Granger Cause ENGLAND	256.472	1.00E-102

Table 6 represents the result of Granger's Causality model to the stock exchanges of Developed and Developing markets. From the probability values of the Granger causality test, the acceptance and rejection decision for the Null hypothesis can be taken. While we accept the null hypothesis for the cases with probability value above 0.05, we reject the ones with lesser than 0.05 probability value. Going by this RULE, we reject the null hypothesis in the following cases, where we accept the alternate hypothesis.

Table 7 indicates Vector autoregression (VAR) Model at the stock exchanges of Japan, US, England, India, China. It has been observed that the integration of a stock exchange with the other can be established if the table value is more than 1.96. Following inferences can be drawn from Table7-

1. RChina (Return in China) at the lag of 1 has no significant influence. Also, at the lag 2 it has no influence on any other stock exchange.
2. REngland (Return in England) at the lag of 1 has influence on China, England. With the lag of 2, REngland has no influence on other stock exchanges.
3. RIndia (Return in India) at the lag 1 has no significant influence on any other stock exchange. With the lag of 2 Rindia has its influence on England, India.
4. RJapan (Return in India) at the lag of 1 has influence on China, England, India, US. With the lag of 2, it has influence on China, England, India, US.
5. RUS (Return in US) at the lag of 1, it has influence on England. With the lag of 2, it has influence on England, India, US.

Table 7 *Vector Autoregression Analysis*

Vector Auto regression Estimates					
Standard errors in ( ) & t-statistics in [ ]					
	RCHINA	**RENGLAND**	**RINDIA**	**RJAPAN**	**RUS**
RCHINA(-1)	-0.00756	-0.00789	-0.00869	0.00038	0.011422
	[-0.36417]	[-0.55772]	[-0.46077]	[0.01937]	[0.68058]
RCHINA(-2)	0.010069	0.007237	0.025809	0.012834	0.003545
	[0.48525]	[0.51198]	[1.36958]	[0.65422]	[0.21125]
RENGLAND(-1)	0.160562	-0.22657	-0.07873	-0.06439	0.074853
	[2.48913]	[-5.15617]	[-1.34394]	[-1.05584]	[1.43508]
RENGLAND(-2)	-0.06352	-0.01404	0.082975	0.002227	-0.0487
	[-0.99858]	[-0.32393]	[1.43634]	[0.03703]	[-0.94689]
RINDIA(-1)	0.009495	0.005614	-0.01858	0.009833	-0.0044
	[0.38336]	[0.33277]	[-0.82617]	[0.41997]	[-0.21990]
RINDIA(-2)	0.023545	0.034047	-0.06103	-0.00404	0.032127
	[0.95305]	[2.02305]	[-2.72023]	[-0.17316]	[1.60820]
RJAPAN(-1)	0.240727	0.275611	0.37503	-0.04409	0.28472
	[9.78295]	[16.4421]	[16.7819]	[-1.89514]	[14.3095]
RJAPAN(-2)	-0.06638	0.052055	0.058866	0.029002	0.102547
	[-2.29841]	[2.64605]	[2.24446]	[1.06225]	[4.39138]
RUS(-1)	0.073128	0.375461	0.044213	0.064999	-0.2138
	[1.39719]	[10.5306]	[0.93014]	[1.31360]	[-5.05163]
RUS(-2)	0.09006	0.138221	0.157419	0.04763	-0.09759
	[1.74746]	[3.93700]	[3.36328]	[0.97756]	[-2.34185]
C	9.90E-05	5.70E-05	0.00045	8.96E-05	0.000153
	[0.32102]	[0.27126]	[1.60632]	[0.30744]	[0.61176]

Variance Decomposition Analysis: The Variance Decomposition Analysis of the twenty stock exchanges is presented in the table 8. The table decomposes the returns at the twenty stock exchanges for a period ranging from 1 to 10.

Table 8 *Variance Decomposition Analysis*

Variance Decomposition of RCHINA:						
Period	S.E.	RCHINA	RENGLAND	RINDIA	RJAPAN	RUS
1	0.015677	98.71105	0	0	0	0
2	0.016301	91.34999	0.253074	0.045671	3.957371	0.064637
3	0.016385	90.4244	0.367074	0.082884	4.009653	0.191216
4	0.016393	90.33023	0.366925	0.083415	4.005526	0.210034
5	0.016396	90.30411	0.367102	0.083548	4.006055	0.211437
6	0.016396	90.29733	0.367084	0.083546	4.005877	0.212758
7	0.016397	90.29588	0.367085	0.083546	4.0064	0.212755
8	0.016397	90.29579	0.367095	0.08355	4.006399	0.21278
9	0.016397	90.29572	0.367096	0.083551	4.006406	0.212782
10	0.016397	90.29572	0.367096	0.083551	4.006406	0.212782
Variance Decomposition of RENGLAND:						
Period	S.E.	RCHINA	RENGLAND	RINDIA	RJAPAN	RUS
1	0.010679	0.014123	45.37203	0	0	0
2	0.012124	0.132931	36.66494	0.033932	12.149	3.080234
3	0.012256	0.158041	35.99372	0.19645	11.8895	3.261229
4	0.012278	0.157463	35.92417	0.217894	11.88543	3.303648
5	0.012285	0.157327	35.88771	0.217845	11.92226	3.315196

6	0.012286	0.157312	35.88466	0.217842	11.92488	3.315113
7	0.012286	0.157322	35.8837	0.217978	11.92478	3.315113
8	0.012286	0.157323	35.88348	0.217978	11.9247	3.315146
9	0.012286	0.157323	35.88347	0.217983	11.9247	3.315144
10	0.012286	0.157323	35.88346	0.217984	11.9247	3.315144
Variance Decomposition of RINDIA:						
Period	S.E.	RCHINA	RENGLAND	RINDIA	RJAPAN	RUS
1	0.014238	1.315484	0.911034	76.11122	0	0
2	0.015665	1.398812	0.753732	62.8718	11.10127	0.025585
3	0.015775	1.431685	0.830037	62.2057	10.96162	0.182155
4	0.015796	1.428568	0.855037	62.03802	11.0095	0.1899
5	0.0158	1.428518	0.856505	62.01032	11.03126	0.195997
6	0.015801	1.428429	0.856741	62.00641	11.03099	0.196088
7	0.015801	1.428411	0.856789	62.00562	11.03085	0.196135
8	0.015801	1.428405	0.856794	62.00534	11.03109	0.196135
9	0.015801	1.428404	0.856795	62.00532	11.03109	0.196135
10	0.015801	1.428404	0.856795	62.00531	11.03109	0.196135
Variance Decomposition of RJAPAN:						
Period	S.E.	RCHINA	RENGLAND	RINDIA	RJAPAN	RUS
1	0.014821	0.737174	1.812884	0.161482	74.9944	0
2	0.015017	0.724529	1.786569	0.164571	73.07668	0.060175
3	0.015103	0.717137	1.810345	0.162697	72.30899	0.059502
4	0.015129	0.717888	1.804144	0.164514	72.23789	0.098214
5	0.015133	0.718001	1.807847	0.166064	72.20501	0.102783
6	0.015134	0.717941	1.808035	0.166055	72.19835	0.102807
7	0.015134	0.717932	1.808027	0.166066	72.19793	0.102819
8	0.015134	0.71793	1.808035	0.166078	72.1977	0.102861
9	0.015134	0.71793	1.808035	0.166078	72.19769	0.102865
10	0.015134	0.71793	1.808035	0.166078	72.19769	0.102865
Variance Decomposition of RUS:						
Period	S.E.	RCHINA	RENGLAND	RINDIA	RJAPAN	RUS
1	0.012677	0.075868	2.805494	0.003603	1.749434	19.98724
2	0.013396	0.077431	2.549688	0.011499	8.147899	18.71599
3	0.01345	0.078357	2.730222	0.138558	8.090289	18.59656
4	0.013475	0.080274	2.727973	0.148397	8.237991	18.53083
5	0.013476	0.080283	2.727693	0.150339	8.238436	18.52642
6	0.013477	0.080314	2.727905	0.151533	8.238077	18.52466
7	0.013477	0.080322	2.72789	0.151547	8.238015	18.52452
8	0.013477	0.080322	2.727903	0.151571	8.238007	18.52448
9	0.013477	0.080322	2.727904	0.151573	8.238015	18.52448
10	0.013477	0.080322	2.727903	0.151573	8.238014	18.52448
Cholesky Ordering: RCHINA RENGLAND RINDIA RJAPAN RUS						

The Variance Decomposition Analysis as presented in Table 8 entails following-

1. In the case of Shanghai Stock Exchange (China), return of China in Lag 1 depends 98.711% on its own. In Lag 2 it depends again on its own with 91.34999%. The Table8 reveals that in the case of Shanghai Stock Exchange there is some visible impact of China.
2. In the case of London Stock Exchange (England), return of England depends 45.372% on its own. In Lag 2 it again depends on its own or on Japan and USA. The above table reveals that there is an impact of USA on London Stock Exchange from period 2 to 10.
3. In the case of Bombay Stock Exchange (India), the return of India depends 76.11122% on its own. In Lag 2 it depends on its own or on Japan. The Table reveals that there is some visible impact of India and Japan on Bombay Stock Exchange from periods 2 to 10.

4. In the case of Tokyo Stock Exchange (Japan), return of Japan depends 74.9944% on its own. In Lag 2 it again depends on its own. There is some visible impact of Japan on its own stock exchange i.e. Tokyo Stock Exchange from periods 2 to 10.
5. In the case of New York Stock Exchange (US), the returns of US in Lag 1 depends 19.98724% on its own or on England. In Lag 2 it depends again on its own or on England and Japan. The Table reveals that there is significant visible impact of US, England and Japan on New York Stock Exchange from periods 2 to 10.

Table 9 *Mean Equation*

Markets	**Coefficient**	**Standard Error**	**z-statistics**
Japan	0.000304	0.000227	1.33712
US	0.000246	0.000166	1.485513
England	0.000155	0.00016	0.973159
India	0.000842	0.000214	3.930967
China	6.43E-05	0.000256	0.251447

Table 10 *Variance Equation*

ARKET	AIC	SIC	RESID(-1)^2		RESID(-1)^2*(RESID(-1)<0)		GARCH(-1)		GARCH = C(2)+ C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)
			COEFFICIENT	PROBABILITY	COEFFICIENT	PROBABILITY	COEFFICIENT	PROBABILITY	
JAPAN	-5.8899	-5.8789	0.0523	0.0000	0.0910	0.0000	0.8784	0.0000	-0.0001
US	-6.4076	-6.3966	-0.0150	0.0368	0.1273	0.0000	0.9360	0.0000	0.0000
ENGLAND	-6.4761	-6.4651	-0.0101	0.2486	0.1608	0.0000	0.9136	0.0000	0.0000
INDIA	-5.8484	-5.8374	0.0602	0.0000	0.1161	0.0000	0.8619	0.0000	-0.0001
CHINA	-5.6035	-5.5925	0.0434	0.0000	0.0134	0.0315	0.9401	0.0000	0.0000

1. In Japan, it is observed from the best fit estimated GARCH equation, that the value of RESID (-1)0.05227, is smaller in magnitude, which implies that the shocks to conditional variance take lesser time to die out. It becomes imperative to observe that the GARCH (-1) value 0.878444, is large enough in magnitude, to imply that volatility reacts intensely to the market movements.
2. In US, it is observed, it is observed from the best fit estimated GARCH equation, that the value of RESID (-1) -0.014991 is smaller in magnitude, which implies that the shocks to conditional variance take lesser time to die out. It becomes imperative to observe that the GARCH (-1) value 0.93604, is large enough in magnitude, to imply that volatility reacts intensely to the market movements.
3. In England, it is observed, it is observed from the best fit estimated GARCH equation, that the value of RESID (-1)-0.010066, is smaller in magnitude, which implies that the shocks to conditional variance take lesser time to die out. It becomes imperative to observe that the GARCH (-1) value 0.913598, is large enough in magnitude, to imply that volatility reacts intensely to the market movements.
4. In India, it is observed, it is observed from the best fit estimated GARCH equation, that the value of RESID (-1) 0.060218, is smaller in magnitude, which implies that the shocks to conditional variance take lesser time to die out. It becomes imperative to observe that the GARCH (-1) value 0.861864, is large enough in magnitude, to imply that volatility reacts intensely to the market movements.
5. In China, it is observed, it is observed from the best fit estimated GARCH equation, that the value of RESID (-1) 0.043418, is smaller in magnitude, which implies that the shocks to conditional variance take lesser time to die out. It becomes imperative to observe that the GARCH (-1) value 0.9401, is large enough in magnitude, to imply that volatility reacts intensely to the market movements.

6. Conclusion

The study concludes that the annual returns from the stock exchanges from 3.8740%, to 16.4708%. The average annual return is maximum among the annual returns at Bombay Stock Exchange (India), New York Stock Exchange (US), Shanghai Stock Exchange (China), London Stock Exchange LSE (England), and Tokyo Stock Exchange (Japan). The application of correlation suggests that the association between Japan and US, England, China, and India is significant. Similar results were found with the association between US and Japan, England, India , China; England and Japan, US, India, China; India and Japan, US, England, China; China and Japan, US, England, India which appears to be significant. In RJAPAN the p-value for

US and China is less than 0.05. In RUS the p-value for RJAPAN is less than 0.05. Similarly, in RCHINA, the p-value for RJAPAN is less than 0.05.There is significant cause and effect relations among all these Stock Exchanges. Further the results of Variance Decomposition Analysis show that the extents to which the returns at stock markets under study are influenced by the returns at each other differ significantly.

7. References

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