Is there Information Diffusion in India from Asian Stock Markets? A Quantile Regression Approach

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Abstract

Digitalization and globalization trim down boundaries of time and distance and increase financial assimilation among the economies of the world. Present research scrutinizes the extent, construction and dimension of interconnection and alliances between India and emerging Asian stock markets of China, Japan, Indonesia, Taiwan, Saudi Arabia, and South Korea by means of quantile regression technique and Granger causality test. Results of quantile regression approach prove that South Korean, Japanese, Indonesian and Taiwanese stock markets significantly influence Indian stock markets in lower and upper quartiles. Bidirectional causality is observed between stock markets of India - South Korea, India -Japan and India - Saudi Arabia. Unidirectional causality is observed between bourses of India - China, India - Indonesia and India - Taiwan. Present study distinct itself from other studies as it applies quantile regression which has many merits over the traditional OLS technique. The results of our study have implications for the policy makers, investors, academicians and researchers as it provides valuable insight into the interdependence of stock markets in the same region which are developing and are also marred by informational efficiencies and behavioral biases.

Keywords: Market interdependence, Granger Causality Test, volatility spillovers, Information Transmission, quantile regression.

Introduction

Economic connections and associations among the countries all over the world are established and recognized through business operations, investments and financial markets. Digitalization and globalization trim down limitations of time and distance and increase financial integration among the economies of the world. Economic efficiency marked by financial expansion, stability, risk sharing, optimum resource allocations were improved by financial integration among the nations. (Katsikas, 2007; Khuong, Nguyen and Bellalah, 2008; Hussainey, Oscar Mgbame and Chijoke-Mgbame, 2011) On the other hand economic integration among the financial markets also augmented the potential for cross-border transmission of shocks consequently paving way for instability in stock markets. (Jorion and Schwartz, 1986; French, Schwert and Stambaugh, 1987; Hamao, Masulis and Ng, 1990) The prospect of this exploration is to discover the level of cointegration and information transmission between the Asian stock markets and its degree of Influence on the Indian stock markets using Granger causality tests and Quantile Regression Approach. To conduct this study seven major Asian stock market indices have been chosen namely Sensex of India, Shanghai Composite Index of China, Nikkei 225 of Japan, Jakarta Composite index of Indonesia, Taiwan weighted Index of Taiwan, Tadawul All Share Index of Saudi Arabia and Kospi 100 of South Korea. These are the top seven Asian countries according to Gross Domestic product as per the list sourced by

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International Monetary Fund in the year 2017. The study of interdependence of the economies which are growing and also opening up is valuable in many respects as it throws light on the interdependence of stock markets at different quantile levels which will help the portfolio managers in constructing the portfolios which will provide them diversification and also secure them from any risk coming from the overseas stock markets. Due to rising interdependence amongst the economies all around the world it is further imperative to understand and examine the nature, quantum and direction of feedback effect. Our study intends to answer all those questions which emerge due to the growing interdependence between the stock markets in present era of globalization and liberalization.

In this backdrop, we intend to execute our study. The next part of our study is related with review of literature which will be immensely helpful in understanding the present level of knowledge in the area, methodology used by different researchers, empirical results obtained and research gaps in the literature. The subsequent part of the study explains the objectives of the study, data sources; methodology used in the study and after that analysis of the outcomes have been presented. Final part of the manuscript deals with conclusions and policy implications.

Review of Literature

Globalization, Digitalization, and privatization among different sectors have led to an enormous flow of information all over the world. Information transmission leads to volatility and returns spillovers across international stock markets. Stock market information and its transmission are observed among major Asian stock markets (Ahn, Bae and Chan, 2001; Hashmi and Xingyun, 2001; Mukherjee and Mishra, 2008; Joshi, 2011; Chow, 2017). Study of information diffusion, instability of stock markets, volatility spillovers and association among Asian Stock markets has become an area of major research. Many researchers have examined stock market return and spillover effect in major Asian stock markets (Calvi, 2010; Natrajan, 2014; Jebran, 2016). Volatility spillovers have also been examined among the US and Asian stock market. (Yang, 2013; Thao, Daly and Ellis, 2013). Globalization, economic regulations, financial innovations, Regional economic integration, and speedy reforms are not the only factors that influence information transmission and stock markets linkages; it is also influenced by financial economic crisis and digitalization in almost all the sectors these days. In the course of the last decennium, researchers have scrutinized and investigated the impact of various trade and industry crises on stock markets all over the world using Quantile Regression Approach. (Mensi, Hammoudeh, Reboredo and Nguyen, 2014; Rejeb and Arfaoui, 2016; Ilyas, 2017). World's largest financial deadlock which originated from the United States after mid-2007 adversely affected the world of commerce globally. The global financial meltdown of 2008 manifested by globalization and digitalization encompass a noteworthy, mammoth and continuous impact on the network of Asian stock markets (Kumar and Khanna, 2018; Wang, 2014; Aswani, 2017). Stock markets of Asia responded immediately to the financial crisis of 2008 as stock returns were critically affected. Many researchers have examined the shock of comprehensive economic turmoil on the precariousness of stock markets return by comparing pre and post-crisis era (Dungey and Martin, 2007; Chen, 2009; Yilmaz, 2010; Engle, Gallo and Velucchi, 2012; Singhania and Anchalia, 2013). The literature also provide a valuable input that different methodologies have been applied by researchers for studying the respective interdependence of different stock markets of the world. But the studies using quantile regression for examining interdependence of the stock markets are not much and moreover such studies in context of Asia and India are scarce. Therefore, the study proposes to fill this huge gap by attempting an empirical analysis of select Asian stock markets and dependence of India on them.

The yet another purpose of this piece of research is to investigate the impact of Asian stock markets on Indian stock markets in the digitalized Era marked by the financial meltdown in 2007 to 2009 for a study period from January 2000 to April 2018.

Research Methodology, Data collection, and Objectives of Study

This segment details the approach to research used to quantify information connections among top seven

Asian economies according to Gross Domestic Product. To determine information flow association and to achieve imminent into the forecasting process cointegration technique, Granger causality and quantile regression approach have been used.

Data Collection

Data for daily indices of 7 Asian stock markets have been amassed from Bloomberg for a time epoch of 18 years beginning from 20th January 2000 and lasting up to 26 April 2018.

Table 1: Specimen Bourses and Their Indices: 20/1/2000 to 26/4/2018

Asian Nation	Stock Market Index
India	Sensex
China	Shanghai Composite Index
Japan	Nikkei 225
Indonesia	Jakarta Composite Index
Taiwan	Taiwan Weighted Index
Saudi Arabia	Tadawul All Share Index
South Korea	Kospi 200

Objectives of Study

1. To study the dependence of Indian stock markets on sample Asian stock markets using a Quantile Regression Approach.
2. To study information transmission among Indian and sample Asian stock markets using Granger Causality test.

Descriptive Statistics

Descriptive statistics comprises of summary of measures of central tendency for understanding the basic nature of data, skewness for exploring the asymmetric nature of data, Kurtosis and Jarque Bera measure for identifying peakedness of the data and normality of the series respectively have been reported.

Unit Root Test

The daily closing values have been made more reliable and lesser skewed by computing returns of daily closing index values for all the sample stock markets by using the following equation:

$$R_t = \ln p_t - \ln p_{t-1} \quad ...(1)$$

Further, to ensure the stationarity of data the study has employed Augmented Dickey-Fuller (ADF) Test. This test has a null hypothesis that the series has a unit root or in other words is not stationary. We have tested the stationarity of the data with ADF test at a 1% level of significance. It may also be submitted that unit root test has been applied on return series and not on the values of indices for all the time series used in the study.

Granger Causality Test

The direction of causality is determined between two-time series variables using Granger Causality technique. Cause and Effect relationship is determined by causality. A variable T is causal to Z if T is the cause of Z or if Z is the cause of T.

Linear Autoregressive model of two variables X and Y is given by the following equations

$$X(t) = \sum_{j=1}^{p} A_{11}, jX(t-j) + \sum_{j=1}^{p} A_{12}, jY(t-j) + \epsilon_1(t) \quad ...(2)$$

$$Y(t) = \sum_{j=1}^{p} A_{21} jX(t-j) + \sum_{j=1}^{p} A_{22}, jY(t-j) + \epsilon_2(t) \quad ...(3)$$

Here p is the highest numerical interval annotations. X and Y are the time series variables. ϵ_1 and ϵ_2 are the residuals.

Quantile Regression

To obtain robust and accurate results Quantile regression technique that is an extension of linear regression analyses is used in research. To conduct this study we have confined our analysis to three quartiles lower quantile at 0.05 middle quantile at 0.50 and upper quantile at 0.95, theoretically there are seven quartiles.

The equation for quantile regression as used in the study is given below:

$$Qiy(Z/x) = info\{b|Fiy(b/ox) \geq Z\} = \sum k\omega k(Z)xk = x\omega(Z) \quad ...(4)$$

Where the dependent variable is denoted by iy and is presupposed to be linearly dependent on *x*.

Fiy(b/x) is the function of iy given *x* and is conditionally distributed $Y(t)$, $t \in [0,1]$ represents the quantile regression coefficient which determines the dependence of Indian stock markets on selected sample stock markets in lower, middle and upper quantiles.

Dossier Breakdown

Descriptive Statistics

Table 2: Descriptive Statistics: 20/1/2000 to 26/4/2018

	R_SENSEX	R_SHANGHAI	R_NIKKEI	R_KOSPI	R_JAKARTA	R_TADAUL	R_TAIWAN
Mean	0.070977	0.029255	6.86E-05	0.03758	0.082653	0.053563	0.005673
Med.	0.107074	0.057904	0.000483	0.06840	0.138064	0.128914	0.038846
Max.	17.26119	14.78458	0.106891	16.4115	20.70342	16.59024	13.60969
Min.	-18.10774	-13.23935	-0.191495	-17.2625	-16.79675	-17.66450	-10.43488
Std. Dev.	2.065354	2.151517	0.019836	2.0696	1.911979	1.941666	1.811538
Skew.	-0.335271	-0.225647	-0.813833	-0.47800	-0.460985	-0.995131	-0.088056
Kurtosis	15.27593	8.385236	11.19262	12.5140	18.89914	15.65324	8.866676
Jarque-Bera	16361.77	3161.380	7552.426	9897.30	27455.74	17760.11	3729.093
Prob.	0.000000	0.000000	0.000000	0.00000	0.000000	0.000000	0.000000
Obs.	2598	2598	2598	2598	2598	2598	2598

Source: Authors' Calculations

Measures of Central tendency along with statistics of Jarque Bera and Kurtosis of the time series data of sampled Asian stock markets have been presented in Table 2. In agreement with the results of earlier studies lowest average returns has been observed for Japanese stock markets which is (0.000006) on a daily basis, and same is highest in case of Indonesian stock markets which stands at (0.082653), in a digitalized epoch. Volatility has been measured with the help of standard deviation in the daily return data series. Standard deviation for the Shanghai Composite Index is (2.15) which is highest among all the markets and the lowest standard deviation is observed in the Nikkei 225 index which is (0.019). Volatility is almost equal in South Korea and India (2.06). For this reason, we may articulate that the investments in securities listed under the Nikkei 225 index are secure. Data is negatively skewed when the mean and median are less than the mode. Sample bourses are negatively skewed for market returns which are by and large not considered good as it leads to higher risk. Normality of the time series data is checked through Jarque-Bera test. According to the calculated Jarque-Bera values of sample bourses values are large enough to reject the null hypothesis of a normal distribution. To comprehend the shape of distribution kurtosis statistic is used, the calculated values of kurtosis is greater than 3 for all the data series hence series are leptokurtic. This signifies and predicts larger fluctuations for investors.

Unit Root Test

Table 3: A result of Unit root Test: 20/1/2000 to 26/4/2018

Stock Markets	Stationarity	P-Value of ADF Statistic
Sensex	Stationary	0.0001
Shanghai Composite Index	Stationary	0.0001
Nikkei 225	Stationary	0.0001
Jakarta Composite Index	Stationary	0.0001
Taiwan Weighted Index	Stationary	0.0001
Tadawul All Share Index	Stationary	0.0001
Kospi 200	Stationary	0.0001

Source: Authors' Calculations

To make effective and accurate forecast of interdependence with the help of quantile regression it is imperative to ensure the stationarity of the return data else results will not be reliable and regression coefficients shall be spurious. For this, the study employs ADF unit root test. Calculated values of unit root test are shown in Table 3. ADF Test proves that return series of all the indices are normally distributed and statistical properties of these series are stable. Hence we may assume that mean-variance and autocorrelation are all constant over time.

Results of Granger-Causality Test

Table 4: Results of Granger Causality Test: 20/1/2000 to 26/4/2018

Pair	Null Hypothesis	F- Statistic	Probability	Causality Direction
1	China does not Granger cause India India does not Granger cause China	2.6512 1.6906	0.0708*** 0.1846	Unidirectional
2	South Korea does not Granger cause India India does not Granger Cause South Korea	3.5585 11.0203	0.0286** 0.0000*	Bidirectional
3	Japan does not Granger cause India India does not Granger Cause Japan	6.6937 13.7345	0.0013* 0.0000*	Bidirectional
4	Indonesia does not Granger cause India India does not Granger Cause Indonesia	2.0790 10.2542	0.1253 0.0000*	Unidirectional
5	Taiwan does not Granger cause India India does not Granger Cause Taiwan	52.1335 0.9737	0.0000* 0.3778	Unidirectional
6	Saudi Arabia does not Granger cause India India does not Granger Cause Saudi Arabia	2.2988 3.5894	0.1000*** 0.0277**	Bidirectional

Source: Authors' Calculations *, **, *** means results are significant at 1%, 5%, 10% level of significance

Table 4 examines the causal relationships among market pairs, obtained by conducting the Granger Causality test. From the above results following observations are wrapped:

(a) In connection with India and China, Chinese stock market returns contain useful information to predict Indian stock market returns but Indian stock markets are not useful in predicting Chinese stock market returns.

(b) India and South Korea provide useful information to forecast returns, information transmission is bidirectional between the two stock markets

(c) India and Japan also offer constructive information to anticipate returns. So, Information Transmission is bidirectional in these countries.

(d) In India and Indonesia, information transmission is unidirectional as India offers constructive information to Indonesia but Indonesia does not tender return information to India.

(e) In case of India and Taiwan, Taiwanese stock markets tender information to Indian markets but Indian stock markets do not endow with information to Taiwanese stock market which proves that information transmission between the stock markets is unidirectional.

(f) Lastly in the case of India and Saudi Arabia information transmission is bidirectional. But information flow from Saudi Arabia is significant at 10 percent level of significance whereas from India it is significant at 5 percent.

Results of Quantile Regression

Table 5: Results of Quantile Regression: 20/1/2000 to 26/4/2018

	Q 0.05	Q 0.50	Q 0.95
β R_Shanghai	0.007432	0.048724*	0.091326*
	(0.8558)	(0.0082)	(0.0012)
β R_Kospi	0.175178*	0.190446*	0.205378*
	(0.0000)	(0.0000)	(0.0000)
β R_Nikkei	19.13187*	12.70931*	16.78596*
	(0.0005)	(0.0000)	(0.0000)
β R_Jakarta	0.377613*	0.257096*	0.277807*
	(0.0000)	(0.0000)	(0.0000)
β R_Taiwan	0.214920*	0.154255*	0.105582**
	(0.0000)	(0.0000)	(0.0101)
β R_Tadaul	-0.004181	0.032818	-0.003317
	(0.9079)	(0.2028)	(0.9551)
□	-2.574710* (0.0000)	0.067036* (0.0087)	2.343491* (0.0000)
Pseudo R^2	0.245295	0.167164	0.203097

Source: Author's Calculations (figures in parenthesis are p-values) *, **, *** means results are significant at 1%, 5%, 10% level of significance

Figure 1

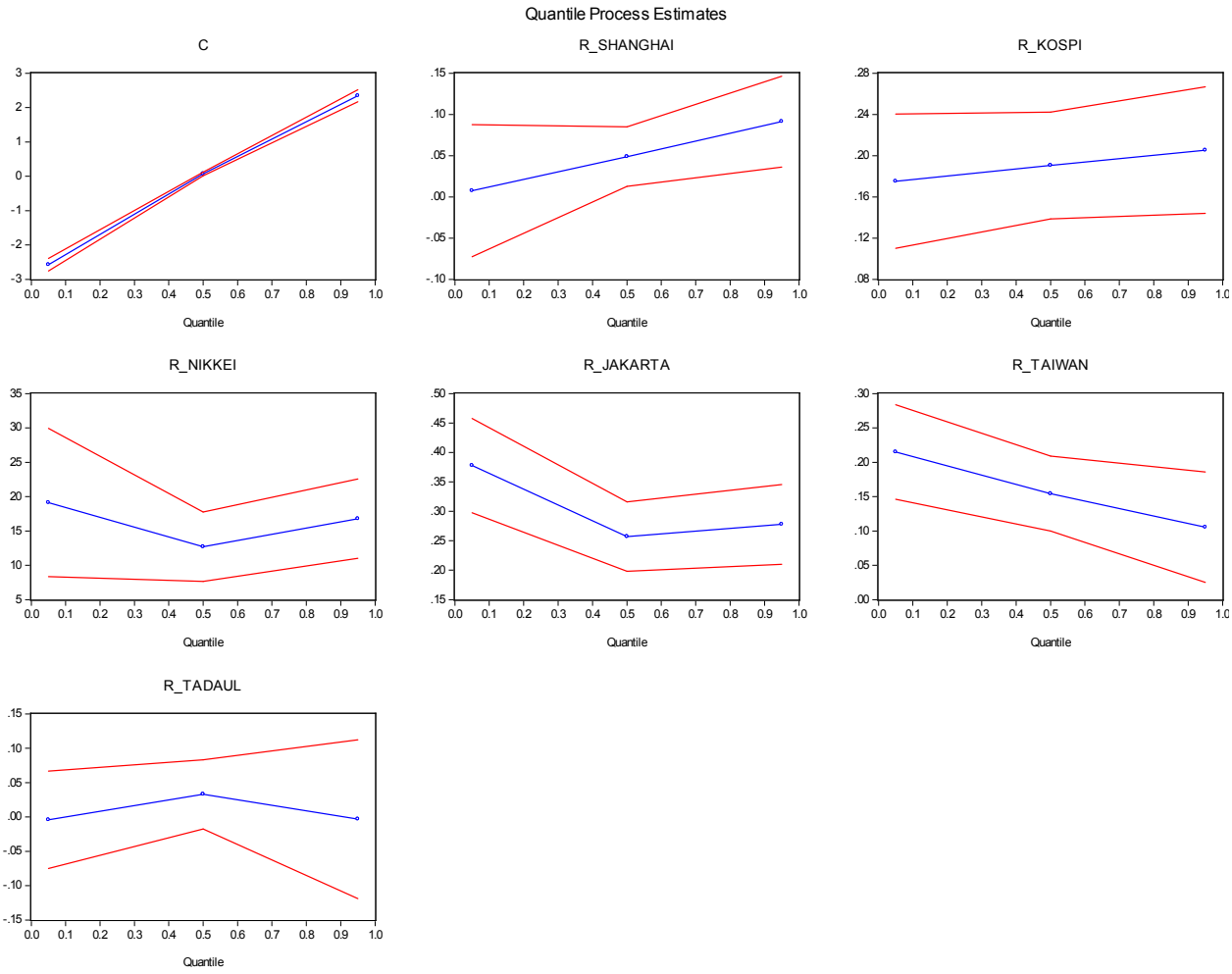

Table 5 shows the results of the quantile regression analysis. Here the Indian stock market is the dependent variable and China, South Korea, Japan, Indonesia, Taiwan, and Saudi Arabia stock markets are considered as independent variables. It can be observed from the Table 5 that the regression coefficients of South Korea, Japan, Indonesia and Taiwan stock markets are significant at all the quantiles i.e. lower, middle and upper thus these markets have significant influence on Indian stock markets under all the conditions. Saudi Arabian stock markets do not influence Indian stock markets in lower, middle as well as upper quartiles thus indicating that study of Saudi Arabian stock market is not useful in predicting the future values of Indian stock markets. Chinese stock markets on the other hand does not insert any influence on Indian stock market under lower quantile but the effect of China is found to be significant under middle and upper quantiles. This information is highly useful in effective forecasting of Indian stock market. It also provides a chance for portfolio diversification as markets of Saudi Arab are not related with each other. The results are also as per expectation and real trade data as India does not have much trade with Saudi Arab whereas the trade relations with rest of the nations are robust and interdependence is relatively more. All this is reflected in our results as well.

Further, values of regression coefficients for all the variables for all the three quantiles have also been shown in figure1 for visual explanation. The figure shows that the estimates of coefficients vary at different quantiles which means that market reacts to different independent variables in a peculiar way at different quantiles. This finding is also supported by the literature.

Conclusions

The study concludes the interdependence of Indian stock markets on sample Asian stock markets except Saudi Arab with which our dependence is not found to be significant as indicated by the empirical results obtained with the help of Quantile Regression at lower, middle and upper quantile levels. Research also shows information transmission among Indian and sample Asian stock markets as indicated by the results of Granger Causality test. The results of quantile regression are significant at three different levels for all the countries except China at lower quantile and Saudi Arab at all quantiles. The results of Granger Causality hints at bidirectional causality between stock markets of India - South Korea, India -Japan and India - Saudi Arabia. Unidirectional causality is observed between stock indices of India - China, India - Indonesia and India - Taiwan. The results of both techniques applied corroborate each other which suggests the robustness of the empirical results obtained.

Our results have useful implications for the regulators, portfolio managers, investors, researchers and academicians as it provides valuable insight about the interdependence of Indian stock markets with its other developing peers in the Asian region in the present era of digitalization, globalisation and liberalisation when interdependence of economies is growing on one another. The results are also useful for the portfolio managers as these will help them in identifying the markets with which there is comparatively lesser degree of integration of Indian stock market so as to seek the goal of diversification by investing the stock markets which have less degree of correlation with each other as it will help them in reducing their risk significantly. (Mensi et al, 2014; Aymen and Mongi, 2016; Ilyas, 2017)

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