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Integration between Indian Stock Market and Developed Stock Markets

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Abstract

The present study investigates the stock market integration amongst important global stock markets, namely, Australia, Canada, France, Germany, India, UK and USA to examine the short-run and long-run relationships with Indian stock market and selected developed stock markets based on time series data for the period between 2001 (January 2) and 2021 (December 31). This study also examines the possibility of portfolio diversification between the Indian stock market and the developed stock markets. Low correlation is observed between Indian stock market and France stock market that indicates the possible gains from international diversifications. Johansen cointegration test confirms a precise long-term equilibrium connection amongst all the stock markets as a widespread strength. Granger causality test results based on VECM show that both Indian stock market and USA stock market are associated in the long-run but it would take long time to return to equilibrium and Indian stock market is associated with France, Germany and USA stock markets in the short-run, which entails that investors can earn reasonable benefits from international portfolio diversification in the short- run but benefits from international portfolio diversification in the long-run are restricted.

Keywords: Stock Market Integration, Stock Market Return, Portfolio Diversification, Johansen Cointegration Test, Granger Causality Test.

INTRODUCTION

Now-a-days the dynamics of share markets, their upheavals, heightened activities and their ensuing integration are gaining major importance with globalization perspective. The Indian stock exchanges hold a place of prominence not only in Asia but also at global stage. The

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variations in the Indian stock market have high impact on cross border capital flows in the form of foreign direct investment and foreign institutional investment and the response of Indian stock market to international stock market signals. In this background, perceptive of association, connectedness and impact of different stock exchanges on each other is extremely significant (Jayashree, 2014; Chougule et al., 2013; Deepak and Sandeep, 2013; Mukherjee, 2007; Hansda and Ray, 2002; Masih and Masih, 1997). The key of investments is to expand as well as grasp a healthy expanded portfolio in diverse stocks, not merely in India however to have a global diversification (Patel and Shah, 2016; Deepak and Sandeep, 2013; Sharma, 2011). In the present scenario of global economy an important area of study is to investigate interrelation between different stock indices worldwide. The association amongst various stock markets has enormous impact on investment for the reason that diversification theory presumes that prices of various stock markets do not move up as investors could purchase shares in foreign and domestic markets looking for plummeting their risk by international diversification (Tahir et al., 2013; Wong et al.,2005; Grubel, 1968). In the midst of the introduction of globalization, international financial markets and economies are progressively more integrated due to free flow of capital as well as worldwide trade. Globalization has moreover improved co-movement in stock price indices, a thwart in global markets.

This co- movement encourages susceptibility to market blows. As a result, blows created in one market are not only influencing its own market however, are too transmitted to erstwhile equity markets. Therefore, any information concerning the economic fundamentals of one economy gets transmitted to erstwhile markets and accordingly influences other's stock markets (Bhatia and Binny, 2014; Chand and Thenmozhi, 2013; Sharma, 2011; Wong et al., 2004) and so global village markets are getting more and more sensitive. Prior to investing in an asset, investors integrate information in relation to price movements as well as unpredictability in the similar asset in addition to associated assets listed in diverse countries. This topic is of significant concern for portfolio investors for the reason that better integration amongst international markets entails sturdy co-movements among markets, in this way invalidating a lot of gain by way of diversification across borders (Kanakarajammal and Paulraj, 2016; Singh and Kaur, 2015; Dasgupta, 2014; Sriram, 2014;Bhatia and Binny, 2014; Jebran, 2014; An, 2012; Chen et al., 2006).

The paper is organized as follows; Section 2 reviews the literature on the causal associations between Indian stock market and global stock markets. Section 3, exemplifies the data and methodology. Section 4 presents results as well as analysis and in section 5 conclusions are summed sum up.

LITERATURE REVIEW

While investment choices are made, investors may prefer various kinds of international diversification than domestic diversification for getting maximum benefits (Levy and Sarnat, 1970; Wong et al., 2004). Maximum benefits accrue from international diversification as stock market returns are affected in foreign economy through its business cycles, government policies, fluctuations in exchange rates and reduction in market risk (Grubel and Fadner, 1971; Bodie, et al., 1999; Wong et al., 2004).

The topic of interdependence amongst the stock markets has all the time been a theme of debate and research. Several studies have been performed to examine stock market associations,

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integration or interdependence. Hansda and Ray (2002), Kumar and Mukhopadhyay (2002), Chi et al., (2006) and Srikant and Aparna (2012) observed the interdependence between the Indian stock market and the US stock market based on time series data using econometrics analysis. Samadder et al. (2016) concluded that there is very much similarity and non-linear correlation between Dow-Jones and Sensex and Dow-Jones and Nifty. Empirical results confirmed that unidirectional causality is running from the US stock market to Indian stock market. Wong et al., (2004) investigated the association between main developed countries stock markets and Asian promising stock markets from the perspectives of international portfolio diversification based on time series data obtained from Datastream for the period between 1981 (January 1) and 2002 (December 31) using financial econometrics techniques. As observed from empirical results there was co-movement between several developed and promising stock markets; however, several promising stock markets do diverge from the developed stock markets in the midst of which developed markets share a long-term symmetry association. In addition, it was examined that there has been rising interdependence between the majority developed and promising stock markets since the 1987 stock market collapse. This interdependence strengthened after the Asian financial disaster (1997). With this experience of rising co- movement between developed stock markets and promising stock markets, the benefits of global diversification turn intois restricted.

Mukherjee (2007) investigated the comparison between Indian stock market and international stock markets in terms of Tokyo stock exchange, Korean stock exchange, Hong Kong stock exchange, Russian stock exchange and New York stock exchange based on time series data between (January 1) and 2006 (July 31) using correlation statistics, exponential trend as well as the risk-return testing. Empirical results demonstrated that Indian markets were integrated with international stock markets significantly. Raj and Dhal (2008) observed the financial integration of Indian stock market with most important regional as well as international stock markets based on time series data for the period from March 1993 to January 2008 using econometrics. They revealed that the influence of international and regional markets on Indian stock market in the short-run and long-run existed. They also demonstrated that both U S and UK stock markets differential stock on the Indian stock market in the reverse direction, along with a structural shift in India's financial integration with selected international stock markets. Singh and Singh (2010) investigated the associations of Chinese and Indian stock markets by means of developed stock markets in terms of USA, UK, Japan and Hong Kong based on daily time series data between January 2000 and December 2009 using the correlation test, Granger causality test and error correction model. Empirical results illustrated that Indian stock market is linked and unilateral causality with four most important markets. They recommended that the benefits of several short-run diversifications were restricted. Panda and Acharya (2011) observed the stock market integration from the perspectives of international diversification of Indian stock market and other most important developed stock markets in terms of USA, U.K., Japan, Hong Kong, Singapore, Malaysia, Taiwan, South Korea and China based on daily stock price indices data for the period between January 2, 2001 and November 28, 2008 using financial econometrics. The results confirmed that Indian market was associated with US financial market but not associated with other financial markets.

Saha and Bhunia (2012) investigated the co-movement between Indian stock market and South

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Asian stock markets based on daily stock price indices between August 2002 and August 2011 using cointegration and Granger causality tests methods. They confirmed that all the markets were associated in the short-run and long-run as well as diversification opportunities existed for investors in the short run. They recommended that more opportunities would be available for investors to obtain the diversification benefits and gains in Indian as well as in important South Asian stock markets. Tripathi and Sethi (2012) observed the short-term and long-term interdependencies between Indian stock market and superior promising stock markets in terms of Brazil, Taiwan, Hungary, Poland, Mexico and South Africa for the period between 1992 (January 1) and 2009 (December 31) using financial econometrics. They demonstrated that the short-term and long-term interdependencies existed between Indian stock market and superior promising stock markets as well as unidirectional causality were observed amongst them. Palamalai et al. (2013)

Without a doubt the afore-mentioned investigations are not honestly analogous due to various differing time periods as well as research methodologies being used with various time periods in addition to dissimilar stock market indices as determinants of the relevant stock markets. That's why these studies make unlike conclusions concerning the associations between the Indian stock market and the most important developed stock markets.

Research Questions

- Is there any short-term and long-term relationship between the Indian stock market as well as the developed stock markets? What nature of relationship subsists?
- Is there any diversification prospect between the Indian stock market and the developed stock markets?

Objectives

(i) To investigate the short-term and long-term relationship between the Indian stock market and the developed stock markets.

(ii) To search unidirectional and bidirectional causality between the Indian stock market and the developed stock markets.

(iii) To look at diversification prospects for investors.

Data and Methodology

For the study purpose, secondary data for seven stock markets are analyzed; ASX200 (Australia-ASX), GSPTSE (Canada- CSX), CAC40 (France-FSX), DAX (Germany-GSX), SENSEX (India-ISX), FTSE100 (UKSX) and NASDAQ (USA-USSX). Data source of these data is yahoo finance. Time interval for computation is taken from 2nd January, 2001 to 31st December, 2021. Number of data points in this interval is different for different indices; 4053 (ASX), 4078 (CSX), 4089 (FSX), 4071 (GSX), 3973 (ISX), 4037 (UKSX) and 4019 (USSX). Eviews 7 package program has been used for arranging the data and conducting econometric analyses using Augmented Dickey-Fuller (ADF) unit root test, Johansen's (1995) cointegration test and Granger (1969) causality test based on error correction model.

Testing for Unit root test

The ADF unit root test is applied to check the immobile of the present study along with it to find the direction of integration between the variables.

The Augmented Dickey – Fuller unit root test is grounded on the Null hypothesis *(H_0):* Unit root is existent in yt this point outs that yt is not *I(0)*, i.e., is not integrated of order at level *(0)*, which

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implies yt is un-stationary. If the premeditated Augmented Dickey – Fuller unit root test statistics is fewer than null hypothesis is prohibited, or else null hypothesis is acknowledged. If the facts is identified non-stationary at a level, the Augmented Dickey – Fuller unit root test is to be testing a unit root. In the above situation, stationary data to be co-integrated at first level *I(1).*

Johansen's Cointegration Test

Johansen cointegration test is an econometric variables test that predicts the long-term affiliation amongst 2 or more variables based on ADF test. The co-integration of Johansen defines the number of co-integrated vectors for whichever number of non-stationary variables of parallel level order and most cases at *I(1).* This implies that two or more variables are co-integrated if either of time series variables is immobile

The key point here is that if the variables are in long-term affiliation amongst Yt and Xt, the variables will grow in due moment and there will be a general tendency to link them. What we need is a linear blend of Yt and Xt that is a stationary variable *(I(0)* for a balance or long-run relationship to occur.

Johansen advises 2 trials statistics that is, λmax statistics and λtrace statistics to regulate the co-integrating rank (number of co-integrating associations). The trials statistcs institutes the rank of the π matrix built on its Eigen standards (and henceforth the number of co-integrating associations)

$(r)=-T\ (1-\lambda\ i)\ ki=r+1$ (1) λmax $(r,+1)=-T\ ln(1-\lambda\ r+1)$ (2)

A resolution concerning the presence of a long-term affiliation is built on the price of the trial statistic gained from model.

Granger Causality test

The Granger causality test is statistical hypotheses it calculates 1 variable have sufficient to predict other variable in a given period of time. Its capability to forecast the forthcoming values of the variables by using time series data of additional time series (Granter 1988). The current learning trails the Granger causality model in VAR framework.

$Yt = \alpha iYt{-}i + \beta iXt{-}i + \varepsilon 1t$

$Xt = \lambda iXt{-}i + \delta iYt{-}i + \varepsilon 2t$

Empirical Results

Descriptive Statistics

Table 1 describes statistical movements of logarithmic daily return of stock indices. For the whole sample period, the BSE-Sensex provides the highest mean, median and standard deviation compared to the other stock indices understudy. The results furthermore designate that BSE-Sensex is the most uncertain market with high level of market return amongst all the developed stock markets but USA-Nasdaq is the least uncertain with low level of stock market return, as supported by, (Alvi et al., 2015). It is also observed that almost all the selected series have non-symmetric distributions except FSX. Skewness and kurtosis measures provide insights about the underlying statistical distribution of stock indices. It is evident that skewness is negative and kurtosis is positive for all seven markets during the period under study. On the other hand, it exhibits more or less a similar pattern of statistical distribution. The Jarque-Bera statistics, defined over skewness and kurtosis measures, is very high for all seven stock markets, signifying that stock indices differ significantly from the normal distribution.

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Table 1: Descriptive Statistics

	ASX	CSX	FSX	GSX	ISX	UKSX	USSX
Mean	8.39	9.30	8.31	8.72	9.35	8.61	7.84
Median	8.43	9.39	8.31	8.73	9.65	8.65	7.76
Maximum	8.82	9.65	8.72	9.42	10.29	8.86	8.60
Minimum	7.90	8.64	7.78	7.69	7.86	8.09	7.01
Std. Dev.	0.21	0.25	0.18	0.35	0.72	0.16	0.37
Skewness	-0.34	-0.69	-0.01	-0.22	-0.63	-0.64	0.40
Kurtosis	2.03	2.22	2.32	2.47	2.02	2.50	2.37
Jarque-Bera	236.38	425.76	77.01	80.44	426.26	323.54	177.63
Observations	4052	4077	4088	4070	3972	4036	4018

Correlation Statistics

Correlation analysis of stock markets is important as correlation measures a crude estimation of linear dependency between two stock markets. The pair-wise correlations of logarithmic daily return data of stock indices in table 2 show that the pairwise correlation between almost all the stock markets are satisfactory indicating possible presence of cointegration among them except France stock market which followed symmetric trend. Low correlation is observed between Indian stock market and France stock market, which indicates the possible gains from international diversifications. At the same time, a very high correlation is observed between Indian stock market and other selected developed stock markets, as supported in, (Choudhary and Siag, 2015; Palamalai et al., 2013).

Table 2: Correlation Statistics

	ASX	CSX	FSX	GSX	ISX	UKSX	USSX
ASX	1.00						
CSX	0.93	1.00					
FSX	0.68	0.51	1.00				
GSX	0.84	0.88	0.55	1.00			
ISX	0.82	0.92	0.28	0.87	1.00		
UKSX	0.86	0.84	0.67	0.91	0.75	1.00	
USSX	0.73	0.81	0.41	0.93	0.82	0.84	1.00

Unit Root Test Result

Two or more time series with same order of integration variables are co-integrated if some linear combination of the variables is stationary. Cointegration is usually associated with systems of $I(1)$ or non-stationary variables, since any $I(0)$ or stationary variables are trivially cointegrated with other variables using a vector with coefficient 1 on the $I(0)$ component and coefficient 0 on the other components. So, the first step for analyzing cointegration is to check whether the time series variable is non-stationary or not. One of the ways to determine if the time series is non-stationary or not is to identify the presence of unit roots in each selected series. Presence of unit root in the tested series confirms non-stationary nature of the series. The other assumption is that all the series should compulsorily be integrated in the same order. For

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this, the Augmented Dickey-Fuller (ADF) test is conducted to the levels and first differences of each series. Lag lengths and model were chosen according to the Schwartz Information Criterion (SIC) and Bartlett Kernel &Newey-West Bandwidth. The critical values are computed based on MacKinnon (1996); an asterisk indicates 5 percentlevel of significance.

Table 3: ADF Test Results

		At level				First Difference			
Country	**Stock Index**	**p-value**	**t-stat value**	**c-value**	**Conclusion**	**p-value**	**t-stat value**	**c-value**	**Conclusion**
ASX	ASX200	0.65	-1.24	-2.86	Non- Stationary	0.00	-38.28	-2.86	Stationary
CSX	GSPTSE	0.57	-1.41	-2.86	Non- Stationary	0.00	-10.93	-2.86	Stationary
FSX	CAC40	0.35	-1.84	-2.86	Non- Stationary	0.00	-11.37	-2.86	Stationary
GSX	DAX	0.35	-1.85	-2.86	Non- Stationary	0.00	-30.35	-2.86	Stationary
ISX	SENSEX	0.91	-0.37	-2.86	Non- Stationary	0.00	-13.60	-2.86	Stationary
UKSX	FTSE100	0.31	-1.94	-2.86	Non- Stationary	0.00	-13.02	-2.86	Stationary
USSXN	NASDAQ	0.27	-2.03	-2.86	Non- Stationary	0.00	-14.08	-2.86	Stationary

The results of the Augmented Dickey-Fuller (ADF) test given in table 3 suggest that all the seven stock price indices in their natural logarithm return level are non-stationary series. In first difference form, however, these logarithmic daily returns of stock price indices are stationary. Thus, all the chosen stock price variables are first-order integrated series, or *I (1)* processes.

Johansen Cointegration Test Result

As unit root test result supports the fact that all the time series variables under consideration are non-stationary, there is a possibility of cointegration among them. Johansen's multivariate VECM has been performed involving the seven stock prices chosen in the study where linear deterministic trends (restricted) are also allowed. This test determines the rank (r) of the coefficient matrix based on Vector Auto Regression (VAR) model of the series, where the rank indicates existence of any cointegration, as well as the number of co-integrating vectors or relationships. For this purpose, two likelihood ratio tests are conducted, namely, the Trace Test (TT) and the Maximum Eigen Value test (MEV).

Table 4: Johansen Cointegration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.03	354.40	125.61	0.00
At most 1 *	0.02	214.46	95.75	0.00
At most 2 *	0.01	94.54	69.81	0.00
At most 3	0.00	45.50	47.85	0.08
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
At most 4	0.002	15.28	29.79	0.76
At most 5	0.001	4.98	15.49	0.81

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At most 6	8.94E-05	0.35	3.84	0.55
Trace test indicates 3 cointegrating eqn (s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Max-Eigen Value)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.03	139.94	46.23	0.00
At most 1 *	0.02	119.92	40.07	0.00
At most 2 *	0.01	49.03	33.87	0.00
At most 3	0.007	26.22	27.58	0.12
At most 4	0.002	10.29	21.13	0.71
At most 5	0.001	4.63	14.26	0.78
At most 6	8.94E-05	0.35	3.84	0.55
Max-eigenvalue test indicates 3 co-integrating eqn (s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 4, describes the result of Johansen's cointegration test. The Trace test indicates the existence of three co-integrating equations at 5% level of significance and the maximum eigenvalue test confirms this result. Thus, the selected variables of the study may have a long-run or equilibrium relationship.

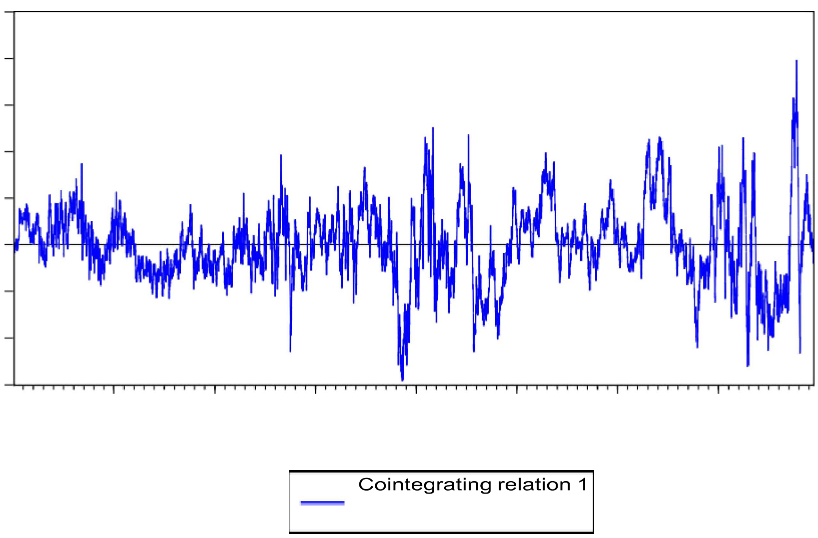

Fig. 1: Cointegrating Relation Among Stock Market Variables

Pairwise Granger Causality Test Results

Results of Granger Causality-Wald test performed based on vector error correction model with purpose of revealing whether there is a causality relationship between variables in each model are shown in table 5. Optimum lag length is measured through Akaike Information Criterion, which are three. The test is also performed in determining the direction of causation between these variables using the vector error correction model.

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Table 5: Pair-wise Granger Causality Tests based on the Error Correction Model and Error CorrectionModel Test Results

Independent Stock Markets	Dependent Stock Markets						
	χ^2 Statistics						
	D(ASX)	D(CSX)	D(FSX)	D(GSX)	D(ISX)	D(UKSX)	D(USSXN)
D(ASX)	-	0.31	7.49	0.69	2.74	14.81*	2.11
D(CSX)	2.33	-	9.09*	1.36	2.03	19.06*	2.47
D(FSX)	14.31*	2.98	-	2.77	3.34	7.45	13.04*
D(GSX)	0.39	13.16*	10.31*	-	7.10	7.58	10.44*
D(ISX)	7.42	2.07	9.51*	18.97*	-	1.01	0.67
D(UKSX)	105.93*	12.54*	7.66	7.52	4.35	-	1.79
D(USSXN)	3.64	5.06	17.37*	12.03*	9.28*	5.37	-
Error Correction Term (ECT_{t-1})							
CE1	0.01	-0.01*	-0.01*	-0.01*	-0.02*	0.00	0.002
CE2	-0.01*	-0.01*	-0.02*	0.00	0.002	0.00	-0.01*
CE3	-0.01*	-0.02*	0.005	-0.01*	0.002	-0.01*	-0.005*

Note: *Significance at 5% level of significance, # Lag 3 has been estimated using AIC criteria.

The error correction term (ECT) (Z) assesses the speed for recognising long-run stability (Rastogi, 2013). The errorcorrection term of ASX, FSX, GSX and USSX dependent variable has two important ECTs, however, petite in scale, which indicates that there is a long-term correction to equilibrium in Australia, France and German stock markets but it would take long time to return to equilibrium. The error correction term of CSX dependent variable has three important ECTs, nonetheless, small in scale, which designates that there is a long-term correction to equilibriumin Canadian stock market but it would take long time to return to equilibrium. Again, the error correction term of ISX and UKSX dependent variable has only one important ECT, however, petite in scale, which indicates that there is a long-term correction to equilibrium in Indian stock marketand UK stock market but it would take long time to return to equilibrium.

During the period under study, France stock market and UK stock market would significantly Granger cause in the short-run on Australian stock market. Again, German stock market and UK stock market would significantly Granger cause in the short-run on Canadian stock market. Canada, German, Indian and American stock market would notably Granger cause in the short-run on France stock market. Germanstock market has a Granger cause with Indian stock market and American stock market in the short-run. But, on Indian stock market, only American stock market would Granger cause in the short-run. On UK stock market, Australian and Canadian stock market would Granger cause in the short- run. Finally, on American stock market, France and German would Granger cause in the short-run. In brief, It is observed that there is a bidirectional causality running between FSX □ USSX & GSX □ USSX and ASX □ UKSX & CSX □ USSX as well as unidirectional causality from ASX □FSX, CSX □ GSX, FSX □ CSX, FSX □ GSX, FSX □ISX, GSX □ ISX, ISX □ USSX.

Conclusion

The present study observes the integration of most important stock markets, namely, Australia, Canada, France, Germany, India, UK and USA to examine the short-run and long-run relationships between Indian stock market and selected developed stock markets using

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cointegration test and Granger causality test based on vector error correction model. Descriptive statistics shows that Indian stock market (BSE-Sensex) is the most uncertain market with high level of market return amongst all the developed stock markets and USA stock market (Nasdaq) is the least uncertain with low level of stock market return. Low correlation is observed between Indian stock market and France stock market, which indicates the possible gains from international diversifications. Johansen cointegration test confirms a precise long-term equilibrium connection amongst all the stock markets as a widespread strength. This result is consistent with Palamalai et al. (2013). Pair-wise Granger causality tests based on the error correction model and error correction test results discloses the interdependencies as well as vibrant relations between Indian stock market and major developed stock markets. The test results show that both Indian stock market and USA stock market are associated in the long-run but it would take long time to return to equilibrium and Indian stock market is associated with France, Germany and USA stock markets in the short- run, which entails that investors can earn reasonable benefits from international portfolio diversification in the short- run but benefits from international portfolio diversification in the long-run are restricted. These results are consistent with Ali et al. (2011), Rathod (2015), Mandaviya (2014), Palamalai et al. (2013) and Chittedi (2010).

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