International Journal of Management Research and Development (IJMRD), ISSN 2248 – 938X(Print)
ISSN 2248 – 9398(Online), Volume 1, Number 2
May-October (2011), pp. 62-71

http://www.prjpublication.com/IJMRD.asp

IJMRD

© PRJ PUBLICATION

CO-INTEGRATION AND CAUSALITY ANALYSIS OF DYNAMIC LINKAGES BETWEEN INDIA AND DEVELOPED EQUITY MARKETS: POST GLOBAL RECESSION PERIOD

Dr. MOHD. ASIF KHAN

ABSTRACT

This paper examines the relationship between Indian stock market and equity markets of developed world for the post global recession period i.e. from March 2010 to March 2013 by using Johansen Multivariate Cointegration analysis and Granger Causality Test. Johansen and Juselius Multivariate Cointegration analysis indicates that markets are integrated and there exist a long term relationship between these markets. However pairwise Cointegration analysis shows that Indian stock market is not cointegrated with equity market of Germany, Japan and U.S.A, therefore funds managers of Germany, Japan and U.S.A can get the benefits of portfolio diversification by investing in the Indian stock market for long term, while it is cointegrated with Australia, France U.K and Hong-Kong, so, the stock market of India does not qualify as a diversification opportunity for international portfolio managers of these countries. Granger Causality Test analysis short run relationship between stock markets of Japan, France, Germany, U.K, Hong-Kong and Australia and the stock market of India. So, any development in these countries should be considered for policy making about stock market of India.

Keywords: Stock Market, Johansen Multivariate Cointegration, Integration, Diversification.

1. INTRODUCTION

Today's world is going in a new direction due to the globalization factor. Financial world is reshaping itself. New market structures and practices are need of time due to financial liberalization and elimination of traditional regulatory barriers and advancement of technology .We are marching towards a globally integrated financial world. Emerging equity markets are attracting the attention of global fund managers because these offer opportunity for portfolio diversification. The benefits and costs of international portfolio diversification need to be considered by anyone holding a financial Portfolio. Similarly, the firm that is considering raising new resource needs to address the requirements of the global marketplace.

Since from last two decades, globalization is most visible feature in financial markets. In globally integrated financial markets, investors and policy makers are interested in taking advantage of efficiency enhancing aspects of market interaction. An efficient monitoring and controlling of this process of market interaction is necessary to avoid the undesirable destabilizing effects. Interdependence of markets, businesses, regions, and continents has increased the interest of academician exploring international market linkages.

The globalization of economic activity, the increased world wealth, and the reduction in transaction costs associated with the information revolution all direct investors to consider the newly emerging financial markets. Interaction of financial markets is one of the most extensively discussed topics of financial literature. Various factors contributed in this dimension. These include cross border movement of funds, the technological innovations in communications, scientific trading and settlement systems, and the introduction of innovative financial products. Globalizations also played a pivotal role in increase the interest in the study of dynamic inter-linkages among financial markets.

So this study is aimed to understand the dynamic inter-linkages between India stock market and the equity markets of developed world after global recession period. These countries include USA, UK, France Germany, Japan Hong-Kong and Australia. If these markets are not integrated then benefits of portfolio diversification can be reaped by investors of these countries. Moreover, policy makers and regulators in these countries should not worry about any contagious effects.

2. LITERATURE REVIEW

The majority of previous studies indicate that there is a long run relationship among the financial markets in the world. Floros et al. (2005) investigated the long run and short run relationships among stock prices in US, Japan and UK. He found that there is a long run relationship among the mature markets. He also showed that there is a Granger bidirectional causality between Nikkei 225—FTSE-100, and unidirectional causalities between S&P 500—FTSE-100 and S&P 500 –Nikkei 225.

Taylor and Tonks (1989) found the long run relationship between UK, Germany, Netherlands and Japan stock markets. Yet, they could not find any cointegration for US. Kasa (1992) analyzed the relationship of mature markets, namely US, Japan, UK, Canada and Germany based on monthly data. He applied to Johansen estimation technique and reported that there are four cointegrating vectors indicating a common stochastic trend among the markets. Blackman, Holden and Thomas (1994) searched the improvement of cointegration. They utilize Engle-Granger approach and find that comparing to 1970s cointegration has increased in 1980s. Thus, this tells us that the scope for diversification has decreased during the concerned time. Choudhry (1997) investigated the Latin American stock markets and US stock market using cointegration technique. Corhay et al. (1994) and Chan and Lai (1993) studied cointegration for US and Asia Pacific markets.

Masih and Masih (1997) investigated the dynamic relation between South Asian countries, Taiwan, South Korea, Singapore, Hong Kong and developed countries US, Germany, UK, and Japan. They found cointegration between these two. Wu and Su (1998) did another study about Asia and US. They found cointegration among the US, Japan, UK and Hong Kong stock markets. Jochum, Kirchgitssner and Platek, (1999) analyzed the long run relationship between Eastern European stock markets for the period 1995-1998 and the 1997/98 Crisis in Emerging Markets. They found cointegration for these markets before the

crisis using the Johansen methodology. In the third quarter of 1997, the long run equilibrium is gone and there was massive changes in short run behavior of the markets. Goh (2005) looked at the dynamic relationship among the five ASEAN markets, namely, Singapore, Malaysia,Indonesia, Thailand and the Philippines. They found that the cointegration among the stock indices before the crisisbut not during the crisis. Short-run linkages of Malaysia with the other markets have weakened after the crisis.

However, some researchers could not find cointegration among the stock indices for different countries. Arhanapalli and Doukas (1996) could not find the long term relationship among Asian markets based on daily data by using Johansen estimation technique. Kanas (1998) could not find any cointegration between US and Germany, UK, France, Switzerland, Italy and Netherlands using Johansen technique either. Rirchards (1995) could not confirm Kasa's findings and concluded no cointegration using the same data. Richards imply that there cannot be cointegration because this means stock prices can be predictable. Fernandez-Serrano and Sosvilla-Rivero (2001) could not confirm any cointegration for stock indices of Japan, Taiwan, South Korea, Singapore and Hong Kong using the Johansen technique for the period 1977-1999.

This paper is important in the literature since India is the emerging stock market and represent the success in the region to attract foreign direct investments and to benefit from the globalization. We expect that there will be some connection between India and the developed equity markets. Furthermore, there is no study done about these countries' stock indices during the concerned period i.e. post global recession period. This will be another contribution of cointegration to the literature.

3. DATA DESCRIPTION AND METHODOLOGY

This empirical study is based on daily closing values of the stock market indices of 07 important equity markets of the developed world. Daily closing prices S&P500 Index (USA), FTSE 100 (UK) index, CAC 40 index (France), DAX index (Germany), Nikkei 225 index (Japan), HANGSENG (Hong-Kong) and AORD index (Australia) for the period March 1, 2010 to March 30, 2013 has been taken from Yahoo Finance. The continuously compounded rate of return is calculated by using the following formula:

$$Rt = \ln (Pt/Pt-1)*100$$

Where:
Rt = Return on day't';
Pt = Index closing value on week't'
Pt-1 =Index closing value on week't-1'
ln= Natural log.

There are several methods for testing the flow of information and co-movement of prices in stock markets across the countries. In this study the emphasis is given to test the inter-market relationship among the stock market in Pakistan with that of equity markets of developed world, via; (i). Descriptive statistics; (ii). Correlation matrix, (iii) Co integration tests, and (iv) Granger causality test

Cointrgration analysis requires that time series should be integrated of same order. Stationarity of time series has been examined by using unit root tests. Augmented Dickey-Fuller Test and Phillips- Perron Test have been employed for said purpose.

The Augumented Dickey Fuller test examines the presence of unit root in an autoregressive model. A simple AR (1) model is
$yt = \rho yt - 1 + ut$, where yt is the variable of interest, t is the time index, ρ is a coefficient, and ut is the disturbance term. The regression model can be written as
$\Delta yt = (\rho - 1)\, yt - 1 + ut = \delta yt - 1 + ut$,

Where, Δ is the first difference operator. This model can be estimated and testing for a unit root is equivalent to testing. $\delta = 0$.

A financial time series is said to be integrated of one order i.e, I (1), if it becomes stationary after differencing once. If two series are integrated of order one, there may have a linear combination that may be stationary without differencing. If said condition fulfills then these are called cointegrated.

The Johansen (1988) and Johansen and Juselius (1990) procedure test the presence of long run relationship between the variables. Johansen and Juselius propose two likelihood ratio tests for the determination of the number of cointegrated vectors. One is the maximal eigenvalue test which evaluates the null hypothesis that there are at most r cointegrating vectors against the alternative of r + 1 cointegrating vectors. The maximum eigen value statistic is given by,

$$\lambda max = - T \ln (1 - \lambda r+1)$$

Where λ r+1,…,λn are the n-r smallest squared canonical correlations and T = the number of observations.

The second test is based on the trace statistic which tests the null hypothesis of r cointegrating vectors against the alternative of r or more cointegrating vectors. This statistic is given by:

$$\lambda trace = -T \sum \ln (1 - \lambda i)$$

In order to apply the Johansen procedure, a lag length must be selected for the VAR. A lag length of is selected on the basis of the Akaike Information Criterion (AIC).

Granger representation theorem provides that if two variables are cointegrated then Granger causality must exist in at least one direction, which is a consequence of the relationships described by the ECM. Error Correction Model enables us to capture both the short-run dynamics and long-run relationships between the indices.

4. EMPIRICAL RESULTS

Descriptive statistics for the stock indices returns are given in Table 1. These include the distribution of mean, standard deviation, skewness and kurtosis etc. A careful examination reveals that S&P 500 U.S offers the highest return 0.04% per day at a reasonable risk level, while Germany (DAX) and Japan (NIKKEI) offering second highest return. India and U.K are offering low returns around 3% per annum and France market is offering negative returns. All of the markets are negatively skewed except India and France.

Table 1: Descriptive Statistics

	RTNAORD	RTNBSE	RTNCAC	RTNDAX	RTNFTSE	RTNHENG	RTNNIK	RTNSP
Mean	0.000006	0.012231	-0.00376	0.029903	0.014138	0.006803	0.026248	0.038216
Median	0.000305	0	0.004117	0.041082	0	0	0	0.038915
Maximum	0.034368	3.518089	9.220798	5.210379	5.032269	5.518693	5.52232	4.631738
Minimum	-0.043	-4.21288	-5.63464	-5.99466	-4.77923	-5.82703	-11.1534	-6.89583
Std. Dev.	0.009566	1.059612	1.527628	1.405489	1.092364	1.230456	1.298092	1.13274
Skewness	-0.2897	0.077198	0.09197	-0.12688	-0.13556	-0.28061	-0.86203	-0.42791
Kurtosis	4.402807	3.63357	6.01552	5.336138	5.060517	5.710135	10.42962	7.119857
Jarque-Bera	76.49809	14.12181	303.0989	183.3743	143.4345	254.3695	1931.784	587.975
Probability	0	0.000858	0	0	0	0	0	0
Sum	0.048095	9.74812	-2.99508	23.83283	11.26776	5.422161	20.91988	30.45808
Sum Sq Dev	0.072843	893.7318	1857.584	1572.418	949.835	1205.162	1341.295	1021.347
Observations	797	797	797	797	797	797	797	797

Fig: 1 Graph of Markets Movements

Table 2: Correlation Matrix

	BSE	AORD	CAC	DAX	FTSE	HENG	NIK	SP
BSE	1	0.743547	0.727972	0.645724	0.606729	0.865509	0.488343	0.259961
AORD	0.743547	1	0.884655	0.651744	0.704474	0.866764	0.800881	0.297982
CAC	0.727972	0.884655	1	0.604953	0.575935	0.879757	0.617	0.115567
DAX	0.645724	0.651744	0.604953	1	0.905838	0.697511	0.593143	0.811943
FTSE	0.606729	0.704474	0.575935	0.905838	1	0.677321	0.655589	0.830027
HENG	0.865509	0.866764	0.879757	0.697511	0.677321	1	0.57619	0.274351
NIKKEI	0.488343	0.800881	0.617	0.593143	0.655589	0.57619	1	0.423102
S&P500	0.259961	0.297982	0.115567	0.811943	0.830027	0.274351	0.423102	1

Table 2 presents the result of correlation analysis and indicates that India stock market is strongly correlated with all the developed equity markets except U.S.

Correlation analysis is weak technique as it does not discuss the cause and effect relationship. In order to take a better picture of the affairs we perform Cointegration analysis that tests the flow of information and co-movement of prices in stock markets across the countries.

Cointegration analysis requires time series should be integrated of same order so in first step stationarity of the index series has been tested. Tables 3 reveal that that the time-series are not stationary at levels. However first differences of the logarithmic transformations of the series are stationary. So, we say that the series are integrated of order one I (1)

Table 3 : Unit Root Test

Variables	**Augmented Dickey-Fuller Test Intercept**	
	Level	**Ist Difference**
BSE	-2.08057	-27.4935
AORD	-1.86597	-27.7897
CAC 40	-2.40111	-27.8125
DAX	-1.71085	-26.1715
FTSE 100	-2.20832	-27.416
Heng-Seng	-2.02516	-28.1913
NIKKEI 225	-0.34371	-28.7307
S&P 500	-1.0409	-17.6953

Having satisfied with the results of ADF stationarity test, we proceed to conduct the Johansen's cointegration test for that, the order of the Vector Autoregressive Model (VAR) should be determined by either the Akaike Information Criteria (AIC) or the Schwarz

Information Criteria (SIC). The AIC is selected in this paper. The result of table 4 shows that 3 lag lengths are chosen for the equity market indices in the sample

Table 4: VAR Lag Length Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	11636.17	NA	2.27E-23	-29.4384	-29.3911	-29.4202
1	21535.22	19572.55	3.48E-34	-54.3373	-53.9115	-54.1736
2	21846.62	609.4079	1.86E-34	-54.9636	-54.15930*	-54.65444*
3	21922.63	147.2096	1.81e-34*	-54.99400*	-53.8112	-54.5394
4	21974.04	98.52615	1.86E-34	-54.9621	-53.4008	-54.362
5	22012.3	72.54513	1.99E-34	-54.897	-52.9572	-54.1513
6	22054.37	78.9191	2.11E-34	-54.8414	-52.5232	-53.9503
7	22095.37	76.07912	2.23E-34	-54.7832	-52.0864	-53.7466
8	22151.81	103.5937*	2.28E-34	-54.7641	-51.6888	-53.582
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Table 5: Multivariate Cointegration Analysis (Trace Statistics)

Hypothesized		Trace	0.05	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.057403	164.8337	159.5297	0.0248
At most 1	0.043925	117.8955	125.6154	0.1342
At most 2	0.037114	82.2299	95.75366	0.294
At most 3	0.03052	52.2007	69.81889	0.5405
At most 4	0.020904	27.59035	47.85613	0.831
At most 5	0.010659	10.81649	29.79707	0.9654
At most 6	0.002773	2.307714	15.49471	0.9897
At most 7	0.00013	0.103204	3.841466	0.748
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Maximum likelihood based Johansen (1988; 1991) and Johansen-Juselius (1990) procedure is used to determine the presence of cointegrating vectors in a set of non stationary time series. The first test is based on the trace statistic which tests the null hypothesis of r cointegrating vectors against the alternative of r or more cointegrating vectors. Table 5 present the results of multivariate Cointegration analysis. Trace test indicates 1 cointegrating equation at the 0.05 level. It means markets are integrated after global recession period.

Table 6: Bivariate Co Integration Analysis between India and Developed Equity Markets

Indices	Hypothesis	Eigen Value	Trace Statistics	Critical Value at 5%
BSE - AORD		0.020448 0.005467	20.67854 4.3362	15.49471 3.841466
BSE - CAC		0.014623 0.005174	15.81556 4.118804	15.49471 3.841466
BSE - FTSE		0.007362 0.006355	10.92966 5.062206	15.49471 3.841466
BSE - DAX		0.009259 0.003631	10.2743 2.88837	15.49471 3.841466
BSE - NIKKEI		0.01532 0.001587	13.53628 1.262392	15.49471 3.841466
BSE-Heng Seng		0.023726 0.00852	25.89203 6.802807	15.49471 3.841466
BSE - S&P 500		0.008145 0.000734	7.067598 0.582323	15.49471 3.841466

Table 6 shows that there is short run relationship between stock markets of Japan, France, Germany, U.K, Hong-Kong and Australia and the stock market of India. So, any development in these countries should be considered for policy making about stock market of India.

Table 7: Granger Causality Test (Lag 3)

Null Hypothesis:	Obs	F-Statistic	Prob.
LCAC does not Granger Cause LBSE	**795**	5.62357	0.0008
LBSE does not Granger Cause LCAC		1.40698	0.2394
LDAX does not Granger Cause LBSE	**795**	5.08454	0.0017
LBSE does not Granger Cause LDAX		0.50762	0.6771
LFTSE does not Granger Cause LBSE	**795**	5.70519	0.0007
LBSE does not Granger Cause LFTSE		1.13659	0.3334
LHENG does not Granger Cause LBSE	**795**	2.72681	0.0431
LBSE does not Granger Cause LHENG		9.34483	4.00E-06
LNIK does not Granger Cause LBSE	**795**	0.36187	0.7806
LBSE does not Granger Cause LNIK		5.65091	0.0008
LSP does not Granger Cause LBSE	**795**	22.5743	5.00E-14
LBSE does not Granger Cause LSP		0.00893	0.9988
LAORD does not Granger Cause LBSE	**795**	1.09293	0.3513
LBSE does not Granger Cause LAORD		11.4721	2.00E-07

According to representation theorem, if two variables are cointegrated then Granger-causality must exist in at least one direction. Results of Granger causality are reported in Table 7. Rejection of the null hypothesis at 5% indicates that there exist bidirectional granger causality from India to Hong Kong and unidirectional causality from India to Japan and Australia while Germany, France and U.K causes India stock market in short term. So any change occurs in Germany, France U.K stock market will affect the Indian stock market.

5. CONCLUSION

This study empirically investigates the co movement of India's equity market with seven selected international stock markets (i.e. Australia, Germany, France, UK, USA, Hong Kong and Japan). Based on the results on daily stock indices it is found that among all the selected indices of different countries, Americas' equity market (S&P 500) earned highest average daily return with medium standard deviation. It is also evident from the results that there is no integration of the India stock market with the markets of Germany, Japan and U.S.A. This situation implies that stock market of India provides as an attractive diversification opportunity for international portfolio managers of these countries. However the stock market of India is integrated with Australia, France U.K and Hong-Kong, so, the stock market of India does not qualify as a diversification opportunity for international portfolio managers of these countries. It is also concluded that there is short run relationship between stock markets of Japan, France, Germany, U.K, Hong-Kong and Australia and the stock market of India. So, any development in these countries should be considered for policy making about stock market of India.

REFERENCES

1. Arshanapalli, B. and J. Doukas (1996), "Pacific Basin Stock Market Linkages", Research in International Business and Finance, Supplement (I), pp. 101-109.
2. Blackman, S., K. Holden, and W. Thomas (1994), "Long-term Relationships between International Share Prices", Applied Financial Economics4 (4), pp. 297-304.
3. Chan, K., and P. Lai (1993)"Unit Root and Cointegration Tests of World Stock Prices", In R-Stanley (ed.), International Financial Market Integration. Oxford: Blackwell.
4. Choudhry, T. (1997), "Stochastic Trends in Stock Prices: Evidence from Latin American Markets", Journal of Macroeconomics19 (2), pp. 285-304.
5. Corhay, A., A. Rad, and J.-P. Urbain (1994), "Co-movements and Dynamic Interrelationships in Pacific Basin Stock Markets", Research in International Business and FinanceI 1 (B), pp. 93-105.
6. Dornbusch, R., Y. C. Park and S. Claessens (2000), "Contagion: Understanding How It Spreads", The World Bank Research Observer15, pp. 177–97.
7. Floros, C. (2005), "Price Linkages Betweenthe US, Japan and UK Stock Markets", Financial Markets and Portfolio Management19, 2, pp. 169-178.
8. Fernandez-Serrano, J. L. and S. Sosvilla-Rivero (2001), "Modeling Evolving Long-run Relationships: The Linkages between Stock Markets in Asia", Japan and the World Economy 13(2), 145–160.
9. Granger, C. W. J. (1986), "Developments in the Study of Cointegrated Economic Variables", Oxford Bulletin of Economics and Statistics 48, pp. 213–228.

10. Goh, Kim_Leng, Y-C, Wong, K-L Kok (2005), "Financial Crisis and Intertemporal Linkages Across the ASEAN-5 Stock Markets", Review of Quantitative Finance and Accounting, 24, pp. 359–377.
11. Jochum, C., Kirchgitssner, G., and Platek, M. (1999), "A Long-Run Relationship between Eastern European Stock Markets? Cointegration and the 1997/98 Crisis in Emerging Markets", Review of World Economics135, pp. 454-479.
12. Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", Journal of Economic Dynamics and Control12, pp. 231–254.
13. Johansen, S. and K. Jusellius (1990), "Maximum Likelihood Estimation and Inference on Cointegration- with Applications to the Demand for Money", Oxford Bulletin of Economics and Statistics52, pp. 169–210.
14. Kanas, A. (1998), "Linkages Between the US and European Equity Markets: Further Evidence from Cointegration Tests", Applied Financial Economics8, pp. 607–614.
15. Kasa, K. (1992), "Common Stochastic Trends in International Stock Markets", Journal of Monetary Economics29 (1), pp. 95-124.
16. Masih A.M.M. and R. Masih (1997), "A Comparative Analysis of the Propagation of Stock Market Fluctuations in Alternative Models of Dynamic Causal Linkages", Applied Financial Economics7 (1), pp. 59-74.
17. Richards, A. (1995), "Co-movements in National Stock Market Returns: Evidence of Predictability, but not Cointegration", Journal of Monetary Economics36 (3), pp. 631-654.
18. Taylor, M. P. and I. Tonks (1989), "The Internationalization of Stock Markets and the Abolition of UK Exchange Control", Review of Economics and Statistics71, pp. 332–336.
19. Wu, C. and Y. Su (1998), "Dynamic Relations among International Stock Markets", International Review of Economics and Finance7, pp. 63–84