

# **An Analysis of Linkage between Selected Sectoral Indices of NSE with Nifty**

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## **Abstract**

An investor investing in Domestic country has interest in diversification of his investments in different sectors which can maximize his returns. This study aims to find out the linkage between the selected sectoral indices of NSE and Nifty of Indian stock market by using daily closing prices of indices from 1 April 2011 to 30 Sep. 2016. Johansen's co-integration and Granger causality test are used to find the linkage between these indices. Findings suggest that Nifty doesn't have any long term co-integration with the selected sectors i.e. Energy, IT, Realty and Bank during the selected period. But there was short term linkage between them during this period. Granger causality test shows that Movement of Nifty caused movement of Energy and Realty while banking index movement causes Nifty, Energy and Realty that why unidirectional causality was running between them. This short term linkage can be used by investors to make their short term investment strategies to invest. Unlinked sector can be used for diversification of stocks.

**Keywords** – Co-integration, Nifty, Sectoral Indices

## **Introduction**

There are various studies in the field of financial co-integration of stock market globally. Because of globalization and liberalization financial markets of different countries are co-integrated, but a domestic market itself composed of different sectors and these sectors are affected by various internal and external factors of the economy. For any new investor who starts investing from Domestic market, the study of co integration and co movement of different sectoral indices becomes important for stocks diversification at domestic level. It is crucial to know short term and long term relationship called co-integration among different sectors acting as alternative to invest for investors to take decisions like allocation of capital efficiently, reducing financial risks, maximising profits or returns etc. In India National stock exchange has its Nifty 50 composite index. There are different sectoral indices also like Auto, Bank, Energy, Financial Services, FMCG, IT, Media, Metal, Pharma, PSU Bank, Private Bank and Realty. From these sectors only 4 sectors namely Energy, IT, Realty and Bank are taken along with nifty to find whether these sectors are integrated with Nifty and each other. These 4 sectors are the core sectors of any economy that have major role in growth of economy.

## **Literature review**

Various studies on stock markets provide evidence of co-integration among them. **Squalli (2007)** investigated the co-integration and causality across 3 sectors (banking, insurance and services) and general index of Abu Dhabi Securities market (ADSM) and Dubai Financial Market (DFM). It was evidenced that sectors and general indices were co-integrated except Insurance and ADSM banking, services and general index were Granger cause their corresponding DFM indexes. **Menonet al. (2009)** examined the co-integration between Indian stock market(NSE) and 4 other leading markets that are America(NASDAQ), Hong-Kong(HSI), Singapore(STI) and China(SSE). It was conformed that there was no co integration of NSE for NASDAQ and HSI. There was strong co-integration between NSE and STI while there was some integration between NSE and SSE. **Masood et al. (2010)** investigated the co-integration and causal relationship between various stock exchanges of Baltic Countries like Estonia, Latvia and Lithuania. It was found that there was long-run bidirectional causal relationship between Baltic bench, Riga and Tallin and this integration contributed to stability of exchange rate of these countries. **Singh (2010)** examined the integration of China and India with US, UK, Japan and Hong Kong. It was conformed that both markets were correlated with all 4 markets and had at least a unidirectional causality to them. **Yuksel&Guleryuz (2010)** investigated the relationship between 3 sector indices of Istanbul stock exchange (ISE) and ISE 100 Index itself. It was found that there was no co integration among sector indices except Finance vs ISE 100, industry, finance, ISE 100 and finance, industry, service, ISE 100 and confirmed no bivariate and multivariate short/long run relationship b/w them. **Subha&Nambi (2010)** examined the co integration between Indian BSE and American NASDAQ and S&P 500 and found that Indian stock market was not dependent on both American stock exchanges means absence of co-integration during study period. **Joshi (2011)** examined the dynamics of co-movement of stock markets of USA, Brazil, Mexico, China and India and conformed that stock markets were integrated. **Ranpuraet al. (2011)** examined short run causal linkage and co-movement of Indian stock market with 10 other developed and developing markets. It was found that Sensex provided highest risk adjusted returns and it had highest correlation with BVSP. Sensex was affected by HangSang, STI, DJIA, FTSE and DAX and it caused SCI, BVSP, NIKKEI, KOSPI and AORD. **Assidenou (2011)** investigated the co-integration between 11 capital market Indices by dividing them in 3 groups *i.e* OECD, Pacific and Asia group during the Financial and banking crises originate in US and conformed that these markets were co integrated during crisis period and could not avoid the influence from outside markets. **Subhaniet al. (2011)** investigated the co-movement among South Asian countries that included KSE (Pakistan), BSE (India), DSE (Bangladesh) and Nepal stock exchange and conformed that there was co-integration among 4 countries but bivariate co-integration test revealed that KSE was co integrated with only DSE not with BSE and Nepal stock exchange. **Ali et al.(2011)** investigated the co movement of Pakistan's equity market with Markets of India,

China, Indonesia, Singapore, Taiwan, Malaysia, Japan, USA and UK and revealed that Pakistan's stock market was cointegrated with all stock markets except UK, USA, Singapore, Taiwan and Malaysia. There was unidirectional causality running from Japan, Taiwan and Malaysia to Pakistan. **Patel & Patel (2012)** examined the causal relationship between BSE, FTSE, Hang Seng, JKSE, NIKKEI, CSE, SMI, SSE and TSEC and conformed BSE was not affected by any of the market while BSE caused to FTSE, Hang Seng, JKSE, CSE and TSEC. **Deepak & Sandeep (2013)** examined the integration between BSE, NIFTY, HANG SANG Index, S&P 500 and KLSE composite index and conformed that all indices were co-integrated and one way and two way integration or causality between indices considerably changed over time from more to less. **Sharma & Dixit (2013)** examined the relation and impact between NYSE and Nifty and found that correlation between them was very low and impact of NYSE on nifty was very weak. **Nkechukwuet al. (2013)** investigated the effect of 2 macroeconomic variables that are GDP and Money supply on Nigerian stock market (NSM) and found that GDP had long term negative effect and Money supply had long term positive effect on stock market prices. Unidirectional causality was running from stock prices to GDP whereas there was no causality was running between stock prices and money supply. **Rajhans & Singh (2013)** examined the short term dynamic integration of BSE with developed markets S&P 500(US) and FTSE 100 (UK). It was conformed that there was unidirectional relationship b/w BSE and FTSE100 while bidirectional relationship b/w BSE and S&P 500. Positive and negative impact of shocks with their persistence from 2 -4 days was confirmed by Impulse response. BSE Variance explained by S&P 500 by 21%. **Cao et al. (2013)** examined the China's stock market CSI300 and its 10 sectoral indices to check their mutual relationship. It was conformed that Financial, industrials and energy had high correlation with whole market compared to IT, Utilities, telecommunication, Healthcare and consumer staples. **Noor et al. (2014)** examined the co integration among 10 sectors of BSE. Based on multivariate co integration test it was conformed that there was long run equilibrium among sectors but it was absent based on bivariate co integration analysis except Bankex-IT & Consumer durable- reality. There was unidirectional causality was running from Auto, Bankex, Cap. Goods, Power, Metal & Realty to other sectors. So for portfolio diversification short term duration and less co integrated sectors were suggested. **Sharma (2014)** investigated the relationship between the CNX Nifty and 5 sectoral indices (Auto, Bank, Energy, IT & Metal) and conformed that there was no co-integration between sectoral indices and Nifty index further Granger causality was not observed among many pairs except few pairs. **Shezadet al. (2014)** examined the causal and dynamic linkage of KSE-100 index (Pakistan) with stock markets of Japan, China, Malaysia and Taiwan and it was conformed that KSE-100 had not long term relationship with 4 markets but these markets had short term relationship to KSE except Malaysia. **Ibrahim & Musah (2014)** investigated Causality and co-integration between Brazilian stock market (Bovespa) and a listed

Energy company Petrobras (LBAP) and co-integration was conformed. It was also found that unidirectional causality was running from Bovespa to petrobras. **Naidu &Subbarayudu (2014)** examined the co-integration among BRICS Nations that are Brazil, Russia, India, China and South Africa and found that there was no co integration from 1997 to 2014 but there was 1 co-integrating vector from 2009 to 2014. Bivariate causality was absent among these countries during study period except Sensex & JSE and Sensex &Bovespa. **Dasgupta (2014)** investigated the integration and dynamic linkages of Indian stock market with BRIC Countries that are Brazil, Russia, India and China and concluded that there was no long run relationship between BRIC markets but as per Granger test it was conformed between India and Brazil, short run causality was also running between these two markets. Indian market was dominant in impacting other BRIC stock markets.**Nashier (2015)** examined the integration among the stock markets of BRICS (Brazil, Russia, India, China and South Africa) and U.S. and U.K. and evidenced for both the short term and long term relationship between these markets. This integration limits the benefits of diversification and speculation across different markets.**Ozlen (2015)** investigated long run relation between Turkish stock market and 3 developed markets (German, US and UK) and found that there was 5 sectors out of 11 that were showing co-integration with selected internal and external factors and markets therefore couldn't be considered for portfolio diversification.

### **Research objective and hypothesis**

The Main object of this study is to check the Long term and short term integration between sectors and Nifty. Further to analyse which index is driving force for another means fluctuations in one sector affect the fluctuation of another sector.

Hypothesis is generated accordingly.

### **Data description and research methodology**

Data for this study has been taken from the NSE website. Daily closing prices of relevant sector indices have been used from 1-4-2011 to 30-09-2016. Natural logged prices and log returns are used for testing purpose.

Logged prices- $\ln(P_t)$

$$R_t = \ln(P_t/P_{t-1})$$

Where:

$R_t$  is return of the day  $t$ ,  $\ln$  is Natural log,  $P_t$  is closing price of index on day  $t$ ,  $P_{t-1}$  is closing price of index on day  $t-1$ .

### **Statistical Tools**

**Descriptive Statistics** – used to check mean returns and standard deviations and distribution of data.

**Unit root test** – To check stationarity of data. ADF test of unit root with constant and trend have the following equation:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^p (\delta_j \Delta Y_{t-j}) + e_t$$

Where:

t is the time index,  $\alpha$  is an intercept constant,  $\beta$  is the coefficient on a time trend,  $\gamma$  is the coefficient presenting process root. p is the lag order of the first-differences autoregressive process and  $e_t$  is residual term.

$H_0 = \gamma = 0$  contains unit root or non stationary ( $\gamma = 0, \beta \neq 0$ )

$H_1 = \gamma < 0$  is stationary ( $\gamma < 0, \beta \neq 0$ )

If absolute value of test statistics is greater than critical value then Null hypothesis get rejected it means series is stationary. If series is not stationary than 1<sup>st</sup> difference of series is taken to make it stationary.

**Correlation matrix**- To check correlation in indices.

$$\rho_{X,Y} = \frac{COV(X,Y)}{\sigma_X \sigma_Y}$$

**Johansen Co-integration test**- To check the long run relationship of indices. Two variables are said to be co-integrated when a linear combination of two or more variables is stationary despite variables are individually non stationary implying that there is a long term relationship existing between them. 2 variables X and Y integrated at order one I(1) and having residuals Integrated I(0) are regressed against each other as:

$Y_t = \alpha + \beta X_t + \varepsilon_t$ . If residuals are not stationary at I(0) then Variables X and Y are not co-integrated. Johansen (1991) method can be explained by following autoregressive representation for vector Y.

$$Y_t = A_0 + \sum_{j=1}^p A_j Y_{t-j} + \varepsilon_t$$

Johansen co-integration test with the following equation by using VAR. Vector autoregressive process can be turned into a vector error correction model as-

$$\Delta Y_t = A_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \Pi Y_{t-i} + \varepsilon_t$$

$$\Gamma_i = - \sum_{j=i+1}^p A_j \quad \text{and} \quad \Pi = -I + \sum_{i=1}^p A_i$$

$\Delta$  is 1<sup>st</sup> difference lag operator,  $Y_t$  is a (p\*1) random vector of time series with I (1).  $\Gamma$  is (p\*p) matrix of parameters.  $\Pi$  is long run coefficient matrix and denotes the rank. Johansen's method estimates rank of  $\Pi$  matrix. If  $r=p$  (means  $\Pi$  has full rank) then all elements of  $Y_t$  are stationary I (0). In this case  $\Pi$  is decomposed as  $\Pi=\alpha\beta$ , where  $\alpha$  and  $\beta$  are (p\*r) matrix of full rank.  $\alpha$  matrix is adjustment coefficient and  $\beta$  matrix contains co-integration vectors.

Following statistics are used:

The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The test statistic is given by-

$$J_{trace} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$$

The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of (r + 1) cointegrating vectors. Its test statistic is given by-

$$J_{max} = -T \ln(1 - \hat{\lambda}_{r+1})$$

Where, T is the sample size,  $\hat{\lambda}_i$  is estimated eigen values or characteristics roots obtained from the estimated  $\Pi$  matrix or i<sup>th</sup> largest canonical correlation and r is number of co- integration vectors.

(H0: r=0) no co-integration

(H1: r>0) co-integration exists

If both statistics are greater than critical values then reject the null hypothesis of no co-integration.

**Granger causality test-** to check the short term relationship between selected indices. Here 2 series X and Y which are integrated of order one I(1) are regressed using the following equation.  $Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \dots + \alpha_i Y_{t-i} + \beta_1 X_{t-1} + \dots + \beta_i X_{t-i} + \mu_t$ , where  $X_t$  and  $Y_t$  are variables or Indices.  $\mu_t$  is error term.

If residuals of this regression are stationary at level I (0) it means X and Y are co-integrated. It is a bivariate analysis and checks whether Y causes X or X causes Y.

$$X_t = \lambda_0 + \sum_{i=1}^n \delta_i Y_{t-i} + \sum_{i=1}^n \lambda_i X_{t-1} + \varepsilon_{2t}$$

$$Y_t = \beta_0 + \sum_{i=1}^n \alpha_i X_{t-i} + \sum_{i=1}^n \beta_i Y_{t-1} + \varepsilon_{1t}$$

H0= Y does not causes X or X does not causes ( $\alpha_i=\delta_i=0$ ), if  $\delta_i$  is statistically significant while  $\alpha_i$  is not then it means Y causes X or vice versa. But if both are significant than bidirectional causality is running between them. F statistics are for Joint null hypothesis that  $\beta_1= \beta_2=..... \beta_i=0$  against alternate hypothesis  $\beta_i \neq 0$ . If F statistics is greater than critical value or  $p < 0.05$  null hypothesis get rejected.

### Findings and discussions

**Descriptive statistics-** Table 1 provides the view of descriptive statistics. We can see that among 4 sectors banking sector provides the highest return followed by IT, accordingly Nifty shows the same result while Realty sector shows lowest return. Highest Volatility is shown by Realty followed by Bank, IT and Energy. Nifty shows very less volatility in returns. All sectors along with Nifty except bank are negatively skewed. Kurtosis more than 3 and JB p-value less than 0.05 shows that returns are deviated from normality.

**Table 1**  
**Descriptive Statistics**

	Nifty	Energy	IT	Realty	Bank
Mean	0.0003	0.0000	0.0003	-0.0003	0.0004
Median	0.0003	0.0002	0.0003	0.0005	0.0004
Maximum	0.0374	0.0532	0.0892	0.0809	0.0904
Minimum	-0.0610	-0.0868	-0.1249	-0.1174	-0.0715
Std. Dev.	0.0104	0.0128	0.0133	0.0223	0.0153
Skewness	-0.1726	-0.2956	-0.9039	-0.2399	0.1041
Kurtosis	4.7001	5.0163	13.5363	4.4280	5.0471
Jarque-Bera	170.7849	250.5487	6485.5110	128.7942	240.2794
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	1362	1362	1362	1362	1362

**ADF test-** Table 2 shows the result unit root of logged prices at level and 1<sup>st</sup> difference. At level absolute value of t-statistics < critical value at 1% significance level so that Null hypothesis (H0) of not stationary series get accepted. At 5% H0 is accepted except Energy. But at 1<sup>st</sup> difference t statistics > critical values at 1% and 5% significance level so null hypothesis get rejected and series becomes stationary. It means data series is integrated at order 1 that is I (1).

**Table 2**  
**Augmented Dickey-Fuller (ADF) unit Root Test**

Indices	At Level		At 1st Difference	
	t-statistics	P-value	t-statistics	P-value
Nifty	-3.1103	0.1042	-33.8649	0.0000
Energy	-3.4423	0.0463	-35.3683	0.0000
IT	-2.2323	0.4706	-34.7020	0.0000
Realty	-3.1023	0.1061	-33.3989	0.0000
Bank	-2.9234	0.1553	-33.0986	0.0000
	1% level	-3.964797	1% level	-3.964802
Test critical	5% level	-3.413113	5% level	-3.413116
values	10% level	-3.128567	10% level	-3.128568

**Correlation test-** Table 3 shows the result of correlation. It shows that Nifty has strong correlation (above 0.75) with Energy and Bank showing value 0.81 and 0.88 respectively, while moderate correlation (above 0.60 but below 0.75) was shown by Nifty and Realty (0.72), Energy and Realty (0.63), Energy and Bank (0.68) and Realty and Bank (0.70).

**Table 3**  
**Correlation Matrix**

	Nifty	Energy	IT	Realty	Bank
Nifty	1.00				
Energy	0.81	1.00			
IT	0.53	0.29	1.00		
Realty	0.72	0.63	0.25	1.00	
Bank	0.88	0.68	0.28	0.70	1.00



**Table 4**  
**VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7666.155	NA	8.45E-12	-11.30798	-11.28875	-11.30078
1	22002.6	28545.93	5.66e21*	-32.43189*	-32.31650*	-32.38868*
2	22026.06	46.53705	5.67E-21	-32.42961	-32.21807	-32.3504
3	22047.63	42.63719	5.70E-21	-32.42455	-32.11686	-32.30934
4	22061.17	26.65885	5.80E-21	-32.40764	-32.00379	-32.25642
5	22081.28	39.44174*	5.84E-21	-32.40041	-31.90041	-32.2132
6	22098.2	33.07194	5.91E-21	-32.38849	-31.79234	-32.16527
7	22115.39	33.45077	5.98E-21	-32.37695	-31.68464	-32.11773
8	22130.93	30.15598	6.06E-21	-32.363	-31.57454	-32.06778

\* 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

**Johansen Co-integration test** – Multivariate Johansen co-integration test is sensitive to lags so lags are selected on the basis of Unrestricted VAR model before proceeding to Johansen co-integration test. Table 4 shows the VAR lag selection criteria. On the basis of it lag 1 is taken for testing purpose where all information criteria of AIC, SC and HQ are showing minimum values. Now in table 5 part a shows trace statistics and part 2 shows Maximum Eigen Value statistics. In both parts trace statistics and Max-Eigen statistics respectively are less than critical values and p-values are more than 5% that is 0.05 so Null hypotheses (H0) of No long run co-integration between variables get accepted. Thus there is no long term relationship between Nifty and these 4 sectors.

But there may be short term relationship between these indices so Granger causality bivariate test has been applied to these indices returns.

**Table 5**

**Unrestricted Cointegration Rank Test (Trace) Part-a**

Hypothesized No. of CE(s)	Trace		0.05 Critical Value	Prob.**
	Eigenvalue	Statistic		
None	0.0204	67.4251	69.8189	0.0765
At most 1	0.0135	39.3104	47.8561	0.2481
At most 2	0.0100	20.8313	29.7971	0.3683
At most 3	0.0047	7.1274	15.4947	0.5629
At most 4	0.0005	0.6537	3.8415	0.4188
Trace test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigen value)Part-b				
Hypothesized No. of CE(s)	Max-Eigen		0.05 Critical Value	Prob.**
	Eigenvalue	Statistic		
None	0.0204	28.1147	33.8769	0.2083
At most 1	0.0135	18.4791	27.5843	0.4558
At most 2	0.0100	13.7039	21.1316	0.3898
At most 3	0.0047	6.4737	14.2646	0.5532
At most 4	0.0005	0.6537	3.8415	0.4188
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

**Granger causality test-** Table 6 shows the result of Granger causality test. It shows that Null hypothesis of (variable A does not granger causes variable B) get rejected in 5 cases accordingly unidirectional causality is running between them. It means-  
 Movement of Nifty causes Movement of Energy and Realty.  
 Movement of Bank indices causes the movement of Nifty, Energy and Realty.  
 While in remaining cases Null Hypothesis get accepted.Means –  
 Nifty does not cause Bank and IT only.

Bank does not cause IT only.

IT does not cause Nifty, Energy, realty and bank movement.

Energy does not cause Nifty, IT, Realty and bank.

Realty does not cause Nifty, Energy, IT and bank.

So investors can make their invest strategies to diversify across these unlinked sectors for short term.

**Table-6**  
**Granger Causality Test Results**

Null Hypothesis:	Obs	F-Statistics	Prob.	Remarks	Causality Direction
ENERGY does not Granger Cause NIFTY NIFTY does not Granger Cause ENERGY	1361	1.2450 4.2423	0.2647 0.0396	Accept Reject	Unidirectional
IT does not Granger Cause NIFTY NIFTY does not Granger Cause IT	1361	0.0030 0.4071	0.9567 0.5236	Accept Accept	
REALTY does not Granger Cause NIFTY NIFTY does not Granger Cause REALTY	1361	0.3101 6.9171	0.5777 0.0086	Accept Reject	Unidirectional
BANK does not Granger Cause NIFTY NIFTY does not Granger Cause BANK	1361	4.9173 0.6855	0.0268 0.4078	Reject Accept	Unidirectional
IT does not Granger Cause ENERGY ENERGY does not Granger Cause IT	1361	0.5629 0.6307	0.4532 0.4273	Accept Accept	
REALTY does not Granger Cause ENERGY ENERGY does not Granger Cause REALTY	1361	3.6820 3.1670	0.0552 0.0754	Accept Accept	
BANK does not Granger Cause ENERGY ENERGY does not Granger Cause BANK	1361	8.7074 1.0418	0.0032 0.3076	Reject Accept	Unidirectional
REALTY does not Granger Cause IT IT does not Granger Cause REALTY	1361	1.8414 0.8278	0.175 0.3631	Accept Accept	
BANK does not Granger Cause IT IT does not Granger Cause BANK	1361	0.4753 0.0431	0.4907 0.8357	Accept Accept	
BANK does not Granger Cause REALTY REALTY does not Granger Cause BANK	1361	9.7946 1.5499	0.0018 0.2134	Reject	Unidirectional

### Practical implications and conclusion

This study is done to test the long term and short term co-integration among 4 sectors (Energy, IT, Realty and Bank) and Nifty from 1-4-2011 to 30-9-16 by taking logged prices and logged returns. On the basis of tests it was conformed that there was no long term relationship between Nifty and these 4 sectors. But there was unidirectional causality was running between few

sectors and Nifty means movement of Nifty causes Movement of Energy and Realty, Movement of Bank indices causes the movement of Nifty, Energy and Realty. Bank and Nifty causes movement of other specified sectors shown in table.

While remaining were not co-integrated by view of short term also. An investor can diversify his stocks among these unlinked sectors for short term as well as long term.

## References

- Ali, S., Butt, B. Z., & Rehman, K. (2011). Comovement between emerging and developed stock markets: an investigation through cointegration analysis. *World Applied Sciences Journal*, 12(4), 395-403.
- Assidenou, K. E. (2011). Cointegration of major stock market indices during the 2008 global financial distress. *International Journal of Economics and Finance*, 3(2), 212.
- Cao, D., Long, W., & Yang, W. (2013). Sector Indices Correlation Analysis in China's Stock Market. Available at: [www.sciencedirect.com](http://www.sciencedirect.com), *Procedia Computer Science*, 17, 1241-1249.
- Dasgupta, R. (2014). Integration and dynamic linkages of the Indian stock market with BRIC-an empirical study. *Asian Economic and Financial Review*, 4(6), 715-731.
- Deepak, R., & Sandeep, M. (2013). Integration of Indian markets with select global markets: changing paradigms and dynamics. *International Journal of Innovative Research and Development* || ISSN 2278-0211, 2(12), 7-15.
- Subha, M. V., & Nambi, S. T. (2013). A study on cointegration between Indian and American stock markets. *Journal of Contemporary Research in Management*, 5(1), 105-113.
- Ibrahim, M., & Musah, A. Causality and Cointegration Analysis: Evidence from the Brazilian Stock Market. *European Journal of Business and Management*, 6(3), 130-142.
- Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society*, 1551-1580.
- Joshi P. (2011). "Market integration of Indian stock markets: A study of NSE". *International Journal of Research in Commerce, Economics and Management*, 1(6), 36-40.
- Masood, O., Bellalah, M., Chaudhary, S., Mansour, W., & Teulon, F. (2010). Cointegration of Baltic Stock Markets in the Financial Tsunami: Empirical Evidence. *International Journal of Business*, 15(1), 119-132.
- Rajiv Menon, N., Subha, M. V., & Sagar, S. (2009). Cointegration of Indian stock markets with other leading stock markets. *Studies in Economics and Finance*, 26(2), 87-94.
- Naidu, S. P. N., & Subbarayudu, Y. (2014). Co-integration in Capital Markets of BRICS nations. *Asia Pacific Journal of Research*, 1(20), 43-54.
- Nashier, T. (2015). Financial integration between BRICS and developed stock markets. *International Journal of Business and Management Invention*, 4(1), 65-71.

- Nkechukwu, G., Onyeagba, J., & Okoh, J. (2013). Macroeconomic Variables and Stock Market Prices in Nigeria: A Co-integration and Vector Error Correction Model Tests. *International Journal of Science and Research (IJSR)*, 4(6), 717-724.
- Noor, M. A., Ali, M. M. A. K. M., & Khan, M. A. (2014). Co-movement Analysis among different Sectors of Indian Stock Market. *International Journal of Research*, 1(4), 540-556.
- Ozlen S. (2015). Market Integration: A Sector Level Approach. *International Journal of Academic Research in Economics and Management Sciences*, 4(1), 47-59.
- Patel, R. J., & Patel, D. (2012). The study on co-movement & interdependency of Indian stock market with selected foreign stock markets. *International Refereed Research Journal*, 3(2), 9-13.
- Rajhans, R. K., & Singh, M. K. (2013). Integration of Indian Stock Market with Developed Markets: A Short-term Dynamic Analysis. *Global Journal of Management and Business Studies*, 3(4), 389-394.
- Ranpura, D., Patel, B. K., & Patel, N. (2011). Study of co movement and interdependence of Indian stock market with selected foreign stock markets. *Asian Journal of Research in Banking and Finance*, 1(3), 74-92.
- Sharma A. K. (2014). Relationship between the selected sectoral Indices and Nifty. *International Journal of Business and General Management*, 3(3), 117-123.
- Sharma, K., & Dixit (2013). Co-integration between NYSE and Nifty: An Analysis. *SIT Journal of Management*, 3(2), 39-50.
- Shezad, A., Jan, F. A., Gulzar, S., & Ansari, M. A. (2014). A study on co-integration of Pakistani stock market with selected Asian stock markets. *Journal of Management Info*, 4(1), 52-74.
- Singh, G. S. P. (2010). Chinese and Indian stock market linkages with developed stock markets. *Asian Journal of Finance & Accounting*, 2(2), 21-39.
- Squalli, J. (2007). Sectoral cointegration and causality analyses of the UAE financial markets. *Applied Financial Economics Letters*, 3(5), 327-334.
- Subhani, M. I., Hasan, S. A., Mehar, A., & Osman, A. (2011). Are the major South Asian equity markets co-integrated?. *International Journal of Humanities and Social Science*, 1(12), 117-121.
- Yuksel, E., & Guleryuz, G. (2010). How are the sector indexes are related to ISE 100 Index: An Empirical Study on Istanbul Stock Exchange. *MEC EuroOPT 2010 paper presented in 24<sup>th</sup> Mini EURO international Conference*. 355-361.