INTEGRATION OF SECTORAL INDICES FROM NSE AND BSE: AN APPLICATION OF CO-INTEGRATION ANALYSIS

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ABSTRACT

Contributing to the meager published literature on interrelationships amongst stock market sectors of an economy, Our study examines co-integration of NSE (National Stock Exchange) sectoral stock indices and BSE sectoral indices (Auto, Bank, Energy, Financial Services, FMCG, IT, Metal and Realty). The data correspond to daily closing prices for 8 sectoral indices of the Indian stock market, covering the period between 1st January, 2011 to 30th October 2016 The study concludes on the sectoral indices from NSE and BSE where bi-variate co-integration test suggest that there is a diversification opportunity available for investor in FMCG, IT and Metal index. Further the multivariate analysis shows that among all BSE and NSE sectors, they are co-integrated that means portfolio will not be benefited due to long term relationship among NSE and BSE sectoral indices.

Keywords: Co-integration, Sectoral Indices, NSE, BSE, Portfolio

I. INTRODUCTION

Financial markets have drastically accelerated during the last decades in terms of global business. Further increasing co-movements of financial assets like equity, mutual funds, debt funds and many more observed and researched in the literature extensively. Moreover, the relationship between stock market returns and macroeconomic variables have been observed too much. However, due to the enormous increase of integration of stock markets, the possibility to diversify portfolio has decreased significantly. Researcher tries to deal with problem by analyzing the possibility of diversification opportunity across emerging markets and emerged markets through Co-integration analysis. The study tries to deal with sectoral indices from NSE and BSE due to which domestic portfolio diversification is beneficial for the investors. Integrated securities tend to reduce

the diversification opportunities and visa versa. So now let us understand the concept of co-integration in general.

The concept of co-integration was first introduced by Granger (1981) and elaborated further by Engle and Granger (1987), Engle and Yoo (1987), Phillips and Ouliaris (1990), Stock and Watson (1988), Phillips (1986 and 1987) and Johansen (1988, 1991, 1995), among others. Working in the context of a bivariate system with at most one co-integrating vector, Engle and Granger (1987) give the formal definition of co-integration among two variables as follows:

When two time series that have unit roots co-integrate, meaning that there is a stationary linear combination between them; and this is a nice property to have because it allows us to find equilibrium relationships between two series that have trend behavior. Katrina Juselius (The Co-integrated VAR model, 2006) defines the role of co-integration analysis in the following way: "co-integration identifies stationary linear combinations between non stationary variables so that an I (1) model can be reformulated exclusively in stationary variables". In economics, we are always trying to find equilibrium relationships, and that is exactly what co-integration allow us to do with two series that otherwise could not be modeled because of the individual non stationary properties on them.

There are certain steps to be followed to carry out co-integration analysis and few precautions needs to take care of regarding statistical and mathematical properties of time series data. They are as follows:

The steps for Johansen Co-integration Analysis:

Step 1: Testing the order of integration of the variables

Step 2: Setting the appropriate lag length of the model

Step 3: Choosing the appropriate model regarding the deterministic components in the multivariate system

Step 4: Determining the rank or the number of co-integrating vectors

Methods 1:

$\lambda \text{ max.}(r, r+1) = - T \ln (1 - \lambda r+1)$ ..... Equation (13)

Method 2:

λ trace (r) = - T $(1 - \lambda r+1)$ …….…….. Equation (14)

Step 5: Testing for Weak Exogeneity

II. REVIEW OF LITERATURE

Interdependencies or integration of various markets and financial variables were studied just on the basis of short-run correlation analysis till Engle and Granger came up with the long term relationships which is called co-integration. Since then various works have been done in this direction to improve and develop the theory of co-integration. Johansen and Katrina Juselius introduced improved methodologies for estimating and testing multivariate co-integrations. Moreover, most of the literature documented till date is on inter-linkages between macroeconomic variables and stock markets and further world co-integration also observed. Here the researcher found few studies on sectoral stock price co-integration as follows:

Maysami R. C. Et. Al. (2004) worked on Co-movement among sectoral stock market indices and co-integration among dually listed companies. They examines the price movement of stocks listed dually in Singapore and US using Johansen's VECM and concluded that existence of long run co-integrating relationship both between the US and Singapore electronic sectors in general and more specially among the three dually listed companies stocks. Further the result point to a disequilibria in the prices of dually listed stocks, leading to the conclusion that short run arbitrage opportunities may exist.

Maysami R. C. Et. Al. (2004) worked on relationship between macroeconomic variables and stock market indices. Co-integration evidence was found from stock exchange of Singapore's all S sector indices. They consider STI as the main index and rest of three sectoral indices taken as finance index, property index and the hotel index. The study concludes that the Singapore's stock market and the property index form co-integrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

One of empirical study carried out by Yuksel E. and Guleryuz G. (2010) on how are the sectoral indices are related to ISE 100 index. The study was carried out on Istanbul stock exchange. The aim of this study is to investigate the relationship between different indexes belonging to ISE. The analysis is based on econometric methods to examine the contemporaneous behaviors of ISE 100 index and sector indexes and their relations. Engle and Granger test confirmed these results so that there is no bivariate and multivariate short-run/long-run relationship among the stock market indices suggesting portfolio diversification benefits in ISE.

The Long-Run Relationship between Stock Indices and Economic Factors in the ASE: An Empirical Study by Spyridis T. Et. Al. (2010). They focused on the examination of long-run relationships between specific stock indices and a number of economic factors in the Athens Stock Exchange (ASE) during the period between 1989 and 2006. They said that Investors can construct their portfolios by taking into consideration specific relationships between variables since there are factors that seem to have an explanatory power on the behavior of stocks leading to a possible inefficiency of the Greek market.

Krishnankutty R. and Tiwari A. K. (2011) worked on whether the Bombay Stock exchange sectoral indices of Indian Stock Markets are co-integrated. They have used fractional co-integration test and identified whether sectoral indices of Bombay stock exchange have diversification benefits. No evidence of co-integration in the sectoral indices of Bombay stock Exchange and hence concluded that there is benefit to domestic investors for sectoral diversification in the Bombay Stock Exchange Sectoral indices of Indian stock market.

Ayhan K. Et. Al. (2014) tested for co-integration and causality between sectoral indices and euro exchange rate in Turkey. In this study, the relation between the foreign exchange rate (Euro) in Turkey and 22 indices in Istanbul Stock Exchange (ISE) as well as the direction of this relation are analyzed with econometric techniques. They concluded that it is possible for financial decision makers to predict changes to happen in Euro by following the indices with which Euro is found to have long-term causality relations.

Vishal Deo (2014) investigated co-integration between some Indian stock indices. The study tried to investigate the possibility of co-integration between

four indices of Indian stock market viz. CNX Small Cap, CNX Mid Cap, CNX Nifty, and CNX Nifty 500. All these indices have different market capitalization and it will be of great interest to study their co movement over a long period of time. Results confirm the presence of at least one co-integrating relationship between the four indices.

Research conducted by Joshi P. and Giri A. K. (2015) on examining the relationship between sectoral stock market indices and sectoral Gross Domestic Product. The empirical study is been carried out from India. VECM and Variance decomposition is used to test the long run and short run causality and to predict the long run exogenous shocks. They confirm the long term co-integrating relationship between sectoral GDP and sectoral prices in India.

The dynamic linkages among the sectoral indices have been studied on the Egyptian Stock Market by Ahmed WMA. (2016). the main thrust of this study is to investigate both the long-term and lshort-term links among sectors of the Egyptian equity market. The empirical analysis is carried out using Johansen's multivariate co-integration analysis and Granger's causality analysis. The results of co-integration analysis indicate that there exists a single co-integrating vector within the sample sector indices. The Granger's causality analysis shows that the short-term causal relationships between the sector indices are substantially limited and, where they exist. By and large, an important implication of these findings is that there is still possibility to obtain gains from portfolio diversification in the short run. Nonetheless, investors with long-term horizon might not be able to benefit from diversifying into the various sectors of the Egyptian market.

III. DATA and METHODOLOGY:

The study examines co-integration of NSE (National Stock Exchange) sectoral stock indices and BSE sectoral indices (Auto, Bank, Energy, Financial Services, FMCG, IT, Metal and Realty) through Johansen co-integration test. To carry out the analysis on mentioned objectives, the sample is taken from 1st January, 2011 to 30th Oct., 2016. The necessary daily closing price data have been sourced from official website of NSE BSE. To conclude the above objectives and data collected, various time series econometrics models were applied to study the long term equilibrium relationship between NSE sectoral index price and BSE

sectoral Index price. All the selected time series are converted into natural logarithmic form for smooth conduction of analysis. The whole analysis was carried out in EVIEWS 9. Following are some tools used for the analysis of the study.

- Unit Root Test (ADF Test)
- Unrestricted VAR Model for Lag Order Selection
- Johansen Co-integration Test (Bivariate and Multivariate)
- VECM (Vector Error Correction Model)

IV. EMPIRICAL ANALYSIS

Results of ADF Test:

Ho: Unit root exists (Non Stationary Time Series)

Ha: Unit root does not exist (Stationary Time Series)

The table number 1 shows all the sectoral market indices are non-stationary because all ADF test statistics are higher than ADF critical value at level. On the contrary, all probability values are also greater than 0.05. So we fail to reject null hypothesis and interpret that unit root presence in the series. Moreover, unit root tests reject the same null hypothesis in the first-differenced form of the series which indicate that in first differenced form, all the series are stationary. Therefore, each sectoral market index is integrated in order one, or I (1). Further is the result of bi-variate and multivariate Johansen co-integration test which strongly demands that all variables must be in same order. Before moving to co-integration test, let's understand the process of lag selection because co-integration test is sensitive to lag order selection.

Lag Selection Criteria:

To perform Co-integration test the issue of finding optimum lag length is very important because we have standard normal error terms. The most common procedure in choosing the optimal lag length is to estimate a VAR model including all variables in levels. The study tested the VAR (2) model for optimal lag selection criteria. Further Lags to be selected where AIC value is minimum. So the chosen lag length for further co-integration analysis which is suggested

by AIC where the values are minimum mentioned in co-integration result. Finally the bi-variate and multivariate Co-integration test carried out with optimal lags as follows.

The above table number 2 represents the Johansen B-Variate Co-integration test between various pairs i.e. NSE sectoral indices and BSE sectoral indices. First column indicates the pair of variables. Second column we can see the VAR lag order selected by AIC for different pairs. Further it indicates null and alternative hypothesis. Looking to the probability value, all are less than 0.05 except FMCG, IT and Metal. That means we fail to reject the null and interpret that there exists co-integration between pairs.

The table number 3 shows the results for co-integration and it reveals that there is one co-integrating relationship between sectoral indices for all NSE and sectoral indices for all BSE under study. Both the Trace and Max-Eigen statistics indicate one co-integrating ranks which can be seen from probability values. We reject the null at one co-integrating equation for which probability values are less than 0.05. So further we can develop VECM Model as follows.

From the above table 4 we can see alpha and beta value which is been sourced from Vector Error Correction Model estimates. Alpha value indicates short term adjustment coefficients and beta indicates long term relationship between the groups of all NSE sectoral indices. The long term relationship can be written as follows if it is normalized on Nifty Auto Index.

NA_t = 26.3133 (NB_t) - 0.7203 (NE_t) - 29.6124 (NF_t) + 1.3489 (NFM_t) + 0.4118 (NIT_t) - 0.9938 (NM_t) + 0.7138 (NR_t)

Form this equation the beta value of Nifty bank and Nifty Finance is very high that means the long term adjustments are very quick as compared to other sectors under study.

From the above table 6 the long term relationship can be written as follows if it is normalized on BSE Auto Index.

BA_t = 5.6869 (BB_t) + 0.4914 (BE_t) - 6.9708 (BF_t) - 0.2520 (BFM_t) - 0.1611 (BIT_t) - 0.2315 (BM_t) + 0.2729 (BR_t)

Form this equation the beta value of BSE bank and BSE Finance is very high that means the long term adjustments are very quick as compared to other sectors under study.

V. CONCLUSIONS

The study concludes on the sectoral indices from NSE and BSE where bi-variate co-integration test suggest that there is a diversification opportunity available for investor in FMCG, IT and Metal index. Further the multivariate analysis shows that among all BSE and NSE sectors, they are co-integrated that means portfolio will not be benefited due to long term relationship among NSE and BSE sectoral indices. Moreover, error correction from long term equilibrium relationship to short term dynamics among NSE sectoral indices 0.19% and among BSE sectoral indices 1.88% which seems to be very low. We can further identify the weak exogeneity for each sector to have a detailed portfolio diversification analysis. The study will be useful to retail as well as institutional investors to diversify their portfolio from one sector to another through co-integration instead of using correlation.

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Annexure:

Table 1 ADF Unit Root Test Statistics

Variables	Levels		First Difference	
	Test Stat	Prob.	Test Stat	Prob.
NSE Auto	-3.0051	0.1311	-33.5891	0.0000
NSE Bank	-2.7162	0.2301	-33.8345	0.0000
NSE Energy	-3.3639	0.0567	-36.1404	0.0000
NSE Finance	-2.8803	0.1692	-34.1697	0.0000
NSE FMCG	-1.8852	0.6617	-36.0887	0.0000
NSE IT	-2.4319	0.3627	-35.7604	0.0000
NSE Metal	-1.9989	0.6009	-35.4996	0.0000
NSE Realty	-3.1641	0.0922	-33.9731	0.0000
BSE Auto	-3.1516	0.0949	-33.6848	0.0000
BSE Bank	-2.6705	0.2492	-33.6656	0.0000
BSE Energy	-3.3785	0.0547	-36.5708	0.0000
BSE Finance	-2.7143	0.2309	-33.6745	0.0000
BSE FMCG	-1.9423	0.6315	-35.7012	0.0000
BSE IT	-2.5751	0.2919	-35.6841	0.0000
BSE Metal	-2.1704	0.5053	-35.6092	0.0000
BSE Realty	-3.2446	0.0762	-33.5790	0.0000

Source: E-views Output Critical Value is -3.41 @ 5% significance level

Table 2 Johansen Co-integration Test between NSE and BSE Sectoral Indices

Variable	VAR (Lag)	Ho	Ha	Trace Stat	Prob.	Max-Eigen	Prob.	Result
NSE Auto - BSE Auto	11	r = 0	r > 0	22.0984	0.0044	22.0693	0.0024	r = 1
NSE Bank - BSE Bank	15	r = 0	r > 0	22.5068	0.0037	21.8938	0.0026	r = 1
NSE Energy - BSE Energy	11	r = 0	r > 0	22.2446	0.0041	18.1901	0.0114	r = 1
NSE Finance - BSE Finance	11	r = 0	r > 0	34.3640	0.0000	34.1384	0.0000	r = 1
NSE FMCG - BSE FMCG	11	r = 0	r > 0	11.8107	0.1662	9.4833	0.2481	r = 0
NSE IT - BSE IT	9	r = 0	r > 0	5.1259	0.7953	4.5368	0.7988	r = 0
NSE Metal - BSE Metal	9	r = 0	r > 0	9.1900	0.3481	6.1168	0.5983	r = 0

NSE Realty - BSE Realty	12	r = 0	r > 0	19.8105	0.0105	14.3855	0.0478	r = 2

Source: E-Views Output Critical Value for Trace Statistics 15.4947 @ 5%

Table 3 Johansen Co-integration Test among BSE and NSE all selected Sectors

Variable	VAR (Lag)	Ho	Ha	Trace Stat	Prob.	Max-Eigen	Prob.	Result
Selected NSE Sectors	1	r = 0	r > 0	166.608	0.0194	54.16	0.0324	r = 1
Selected BSE Sectors	1	r = 0	r > 0	362.816	0.000	242.86	0.0001	r = 1

Source: E-Views Output Critical Value for Trace Statistics 15.4947 @ 5%

Table 4 Alpha and Beta from VEC Estimates for All NSE Sectoral Indices

	D(NA)	D(NB)	D(NE)	D(NF)	D(NFM)	D(NIT)	D(NM)	D(NR)
A	-0.0019	-0.0007	0.0007	0.0014	0.0017	-0.0008	-0.0007	0.0009
B	1.0000	26.3133	-0.7203	-29.612	1.3489	0.4118	-0.9938	0.7138

Source: E-Views Output

Table 5 Differenced Lag Coefficients for All NSE Sectoral Indices

Lag Period	Vari-ables	D(NA)	D(NB)	D(NE)	D(NF)	D(NFM)	D(NIT)	D(NM)	D(NR)
1	D(NA)	0.0659	0.0302	-0.030	0.0427	0.0443	0.0605	-0.0143	-0.001
	D(NB)	0.0718	0.2836	0.0550	0.2763	-0.0271	-0.1411	0.0371	0.0736
	D(NE)	-0.0267	-0.0311	-0.028	-0.023	-0.0266	-0.0162	-0.0026	0.0445
	D(NF)	0.0338	-0.1512	0.0426	-0.168	0.0756	0.1668	0.1252	0.1086
	D(NFM)	0.0197	0.0059	0.0125	0.0076	0.0465	-0.0118	-0.0384	0.0191
	D(NIT)	-0.0091	0.0160	0.0166	0.0244	0.0165	0.0578	0.0199	0.0246
	D(NM)	-0.0459	-0.0319	-0.022	-0.029	-0.0520	-0.0424	-0.0376	-0.050
	D(NR)	0.0087	-0.0160	0.0238	-0.013	-0.0249	-0.0180	0.0249	0.0207

Source: E-Views Output

Table 6 Alpha and Beta from VEC Estimates for All BSE Sectoral Indices

	D(BA)	D(BB)	D(BE)	D(BF)	D(BFM)	D(BIT)	D(BM)	D(BR)
Alpha	-0.0188	-0.0340	0.0003	0.0007	-0.0089	-0.0019	-0.0232	-0.0320
Beta	1.0000	5.6869	0.4914	-6.9708	-0.2520	-0.1611	-0.2315	0.2729

Source: E-Views Output

Table 7 Differenced Lag Coefficients for All BSE Sectoral Indices

Lag Period	Variables	D(BA)	D(BB)	D(BE)	D(BF)	D(BFM)	D(BIT)	D(BM)	D(BR)
1	D(BA)	0.0739	0.0250	-0.0335	-0.0025	0.0289	0.0512	0.0267	0.0129
	D(BB)	0.0969	0.1636	0.0442	0.0494	0.0424	0.0068	0.1482	0.1734
	D(BE)	-0.0064	-0.0112	-0.0438	-0.0330	-0.0177	0.0174	0.0103	0.0084
	D(BF)	-0.0621	-0.1165	0.1141	0.1321	-0.0479	-0.0514	-0.1111	-0.1114
	D(BFM)	0.0155	-0.0241	0.0166	0.0232	0.0614	0.0020	-0.0533	0.0131
	D(BIT)	0.0058	0.0429	0.0121	-0.0154	0.0286	0.0672	0.0476	0.0275
	D(BM)	-0.0552	-0.0319	-0.0198	0.0068	-0.0510	-0.0480	-0.0476	-0.0237
	D(BR)	0.0140	-0.0097	-0.0219	-0.0365	-0.0235	-0.0151	0.0355	0.0458

Source: E-Views Output

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