An Econometric Evaluation of the Nifty Index and Its Sectoral Indices

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Abstract— In the contemporary landscape of financial research, the study of the stock market's efficiency in the context of risk management has garnered significant attention. This examination holds particular relevance in emerging markets like India, where the Indian stock market and its various sectors play pivotal roles. Consequently, our research delves into the intricate dynamics between sectoral indices and the Nifty fifty index, a barometer of the National Stock Exchange of India representing the broader market. The sectoral indices offer a true gauge of sector-specific growth, while the Nifty fifty index encapsulates the overall market performance.

The study undertakes a comprehensive analysis of distinct sectoral indices and their associations with the overarching Nifty index. To facilitate this investigation, we collected daily closing prices for these indices from January 2009 to December 2021, sourced from the National Stock Exchange's official website. Our analysis harnesses econometric tools to glean insights into these relationships.

The initial stages of our analysis, involving correlation and regression analyses, reveal a robust interdependence between the Nifty index and sectoral indices. To corroborate these findings, we employ cointegration tests, followed by Granger Causality tests, offering empirical support for the observed relationships.

Keywords— Cointegration, Granger Causality, Nifty fifty index, Sectoral indices.

I. INTRODUCTION

The Indian stock market, a dynamic emerging market since 1875, has piqued the interest of researchers seeking to understand and forecast its intricate co-movements, with the aim of enhancing India's economic and social standing. This dynamism extends to various sectors within the market, significantly contributing to India's economic development. Sectoral indices, as a barometer for sector-specific performance, and the Nifty index, representing the market as a whole, are closely intertwined. Analyzing their relationship, as pursued by K. Ramya in 2021, offers valuable insights for policymakers and regulatory bodies to formulate sector-specific policies, promoting economic and social progress.

Procedure

A. Data Collection

This study utilizes daily closing prices of 13 sectoral indices and the Nifty index from Jan 2009 to Dec 2021, collected from the NSE website, to analyze the relationship between these indices, focusing on time series analysis due to the need for a sufficient number of observations. The sectoral indices studied include Nifty Auto, Nifty Bank, Nifty Energy, Nifty Consumer Durables, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Oil & Gas, Nifty Pharma, Nifty Private Sector Bank, Nifty PSU, and Nifty Realty, along with the Nifty Fifty index.

B. Methodology adopted

In order to evaluate the data structure and the performance of the sectoral indices and nifty index, firstly the descriptive analysis was carried out. Further to test the stationarity of the data Augmented-Dickey Fuller (ADF) test was performed and finally Granger-Causality test was undertaken along the Johansen cointegration approach to analyze the long-run and determine the cause-and-effect relationship between the sectoral indices and the Nifty index

II. RESULTS AND DISCUSSION

A. Descriptive Statistics

Descriptive statistics of the closing prices of the sectoral indices and the Nifty index are represented in Table 1 below.

Descriptive statistics is used to understand the nature and structure of the collected data. It could be observed that the sectoral indices and Nifty index are not normally distributed since Jarque-Bera statistics suggest that all the indices under study are significant at a 1% level of significance. The value of standard deviation (S.D.) in the table represents the volatility of the sectoral indices and the nifty. It could be observed that the S.D. of the Nifty index is lower (2924.910) as compared to all the sectoral indices under study. The Nifty Realty sectoral index is less volatile (2930.722) as compared to the other sectoral indices. The highest volatile sectoral index observed is Nifty FMCG (9205.933).

Table 1: Descriptive Statistics

	AUTO	BANK	CONSUME..	ENERGY	FINANCIAL..	FMCG	IT	MEDIA	NIFTY	OIL_GAS	PHARMA	PSU_BANK	PVT_BANK	REALTY
Mean	6849.587	18295.21	8361.546	12041.51	8030.300	20171.12	11544.98	1968.224	6943.440	3629.097	8243.820	2993.404	9599.448	275.2649
Median	7589.000	17262.00	7222.090	9536.300	7059.150	19918.00	10543.00	1797.300	7589.000	3012.090	8512.900	3076.500	9409.900	249.1000
Maximum	12061.80	41238.30	19944.85	25148.70	19651.10	41619.95	38701.00	3642.700	12061.80	8216.850	14812.40	5375.800	21404.25	632.6500
Minimum	1037.910	3339.700	882.1200	5364.800	1382.520	4550.700	2002.000	610.4700	1037.900	1412.170	1968.690	1087.200	1129.900	128.2500
Std. Dev.	2930.722	8636.140	5058.171	4661.827	4196.170	9205.933	6847.230	638.5568	2924.910	1365.735	3286.421	761.0961	5127.794	101.6683
Skewness	-0.078655	0.513218	0.400438	0.810583	0.651585	0.112879	1.724601	0.519720	-0.079828	0.987579	-0.039862	-0.149354	0.318025	1.228136
Kurtosis	1.729146	2.221131	1.739822	2.604090	2.503712	1.990255	6.309358	2.534533	1.734683	3.364871	1.964471	3.148876	1.824043	3.656792
Jarque-Bera	220.0419	222.6755	299.0253	373.5280	260.8133	143.5698	3064.602	173.4160	218.1566	541.1110	144.6244	14.94418	239.7394	907.6728
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000599	0.000000	0.000000
Sum	22048821	58892295	26915816	38761628	25848535	64930839	37163298	6335713.	22029002	11692064	26536956	9635766.	30869432	886077.6
Sum Sq. Dev.	2.76E+10	2.40E+11	8.23E+10	6.99E+10	5.67E+10	2.73E+11	1.51E+11	1.30E+09	2.75E+10	6.18E+09	3.43E+10	1.86E+09	8.46E+10	33262701
Observations	3219	3219	3219	3219	3219	3219	3219	3219	3219	3219	3219	3219	3219	3219

Source: Author's Calculation using Eviews 11

B. Correlation Analysis

The extent of the relationship between the sectoral indices and the Nifty index is evaluated using correlation analysis. The correlation analysis is represented in Table 2. It is observed that all the sectoral indices have a positive correlation with the Nifty index except the Nifty Realty sectoral index (- 0.1594) and Nifty PSU index (-0.0701) which are negatively correlated. The highest correlation with the Nifty index is detected for the Nifty Auto sector index (0.998) and the least with the Nifty IT sector index (0.694) respectively.

Table 2: Correlation analysis

Source: Author's Calculation using Eviews 11

C. Regression Analysis

Regression analysis is used to forecast based on the past values of the variables under study. Also, it explains the extent of the relationship and the variance proportion of the dependent variable i.e. overall Nifty index, and independent variables i.e. sectoral indices under study. The regression analysis is depicted in Table 3 below. The R squared value (0.998) in the table suggests that 99 percent of the Nifty fifty index is explained by the sectoral indices under study. Hence, this model is statistically significant since the value of R squared should be greater than 0.60 [4]. Also, the F-statistic value (166332.0) is also highly significant which suggests that coefficients are constant and could be used for forecasting the Nifty fifty value with the help of sectoral price indices.

Table 3 : Regression Analysis of Nifty Index and Sectoral Index

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-95.90560	21.28727	-4.505303	0.0000
AUTO	0.922923	0.004941	186.7737	0.0000
BANK	0.121150	0.010278	11.78688	0.0000
CONSUMER_DURABLES	-0.025306	0.002502	-10.11593	0.0000
ENERGY	-0.001261	0.001610	-0.783428	0.4334
FINANCIAL_SERVICES	-0.031277	0.004566	-6.850771	0.0000
FMCG	-0.003931	0.001582	-2.485171	0.0130
IT	-0.019208	0.001869	-10.27777	0.0000
MEDIA	0.216492	0.013374	16.18722	0.0000
OIL___GAS	0.094766	0.010321	9.182108	0.0000
PHARMA	0.022786	0.002508	9.084281	0.0000
PSU_BANK	-0.085979	0.008061	-10.66608	0.0000
PVT_BANK	-0.139200	0.015853	-8.780647	0.0000
REALTY	-0.673569	0.047842	-14.07910	0.0000

R-squared	0.998310	Mean dependent var	6843.440
Adjusted R-squared	0.998304	S.D. dependent var	2924.910
S.E. of regression	120.4700	Akaike info criterion	12.42502
Sum squared resid	46514202	Schwarz criterion	12.45145
Log likelihood	-19984.07	Hannan-Quinn criter.	12.43449
F-statistic	145671.9	Durbin-Watson stat	0.129885
Prob(F-statistic)	0.000000		

Source: Author's Calculation using Eviews 11

D. Unit Root Test

The results of ADF test are provided in Table 4. It is identified that all the indices under study are non-stationary at the level and become significant when the first difference is performed. Therefore, all the sectoral indices including the nifty index are integrated at I(0), and this is used for further analysis.

Table 4: Augumented Dickey-Fuller Test (ADF) of Nifty Index and Sectoral Index

Indices	ADF t statistics	
	At level	**First Difference**
Nifty	-1.465	-53.71***
Auto	-1.473	-53.55***
Bank	-0.619	-53.36***
Energy	-1.215	-55.04***
Consumer Durables	-0.566	-55.49***
Financial Services	-0.162	-23.3***
FMCG	-0.417	-56.54***
IT	2.742	-42.02***
Media	-1.859	-54.93***
Oil & Gas	0.129	-54.7***
PSU Bank	-3.215	-52.5***
PVT Bank	-3.076	-53.2***
Pharma	-0.936	-54.64***
Realty	-1.782	-51***
Test Critical Values:		
Levels	*t-statistic*	
1% level	*-3.432193*	
5% level	*-2.86224*	
10% level	*-2.567187*	
*** significant at 1% level*		

Source: Author's Calculation using Eviews 11

E. Co-integration Analysis

Unlike correlation analysis which determines the strength of relation between the random variables, co-integration specifies to analyze this relation more generously for the non-stationary data. Table 5 represents the results obtained for the cointegration between the Nifty index and the sectoral indices. Three cointegrating vectors by the Mackinnon-Haug-Michelis are recognized and Maximum Eigen value suggested for two cointegrating vectors which suggest to reject the null hypothesis and conclude that there exists long-run relationship between the sectoral indices and the Nifty index[4]. Hence, sectoral indices could be used further for the forecasting of Nifty Fifty index and vice versa by analyzing the short-run relationship along with long-term using Granger Causality test.

Table 5: Cointegration Analysis of Nifty Index and Sectoral Index

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.055391	674.5195	NA	NA
At most 1	0.041301	491.3724	NA	NA
At most 2	0.022790	355.8127	358.7184	0.0639
At most 3	0.018404	281.7193	306.8944	0.3178
At most 4	0.016924	222.0166	259.0294	0.6070
At most 5	0.013182	167.1575	215.1232	0.8804
At most 6	0.010179	124.5076	175.1715	0.9604
At most 7	0.006915	91.62591	139.2753	0.9781
At most 8	0.006033	69.32491	107.3466	0.9516
At most 9	0.005125	49.87774	79.34145	0.9050
At most 10	0.004319	33.36388	55.24578	0.8298
At most 11	0.003224	19.45197	35.01090	0.7409
At most 12	0.002811	9.073301	18.39771	0.5726
At most 13	8.27E-06	0.026577	3.841465	0.8704

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.055391	183.1472	NA	NA
At most 1	0.041301	135.5596	NA	NA
At most 2	0.022790	74.09345	79.97865	0.1504
At most 3	0.018404	59.70268	73.94036	0.5014
At most 4	0.016924	54.85914	67.91026	0.4606
At most 5	0.013182	42.64981	61.80550	0.8200
At most 6	0.010179	32.88174	55.72819	0.9616
At most 7	0.006915	22.30100	49.58633	0.9992
At most 8	0.006033	19.44717	43.41977	0.9964
At most 9	0.005125	16.51386	37.16359	0.9863
At most 10	0.004319	13.91190	30.81507	0.9441
At most 11	0.003224	10.37867	24.25202	0.8822
At most 12	0.002811	9.046724	17.14769	0.4908
At most 13	8.27E-06	0.026577	3.841465	0.8704

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Calculation using Eviews 11

F. Granger Causality Test

Granger Causality is used to determine the short-run relationship between the sectoral indices under study and the overall Nifty index. Also, the existence of a relationship reveals whether the sectoral indices could be used for the forecasting of the Nifty fifty index and vice versa.

Table 6 includes the results obtained for the Granger Causality test. It is identified that there is unidirectional causality between Nifty Fifty and Nifty Auto, Nifty Fifty and Nifty Energy, Nifty Fifty and Nifty FMCG, Nifty Fifty and Pharma. Therefore, the null hypothesis i.e. there is no short-run relationship between the Nifty Fifty index and the sectoral index is rejected. It is detected that the sectoral index that causes an impact on the Nifty Fifty index is Nifty Auto. The sectoral indices namely, Nifty Energy, Nifty FMCG, and Nifty Pharma are impacted by the change in the Nifty Fifty index. Nifty Fifty, Nifty Consumer Durables, and Nifty Energy sectoral indices are identified to have a bidirectional causality relationship. Other sectoral indices namely, Nifty Bank, Nifty Financial Services, Nifty IT, Nifty Media, Nifty Oil and Gas, Nifty PSU, Nifty Private Bank, and Nifty Realty have no relationship with the Nifty Fifty index.

Table 6: Granger Causality Test of Nifty Index and Sectoral Index

Null Hypothesis:	Obs	F-Statistic	Prob.
AUTO does not Granger Cause NIFTY	3214	5.08493	0.0001
NIFTY does not Granger Cause AUTO		1.90769	0.0897
BANK does not Granger Cause NIFTY	3214	1.26873	0.2745
NIFTY does not Granger Cause BANK		0.50411	0.7734
CONSUMER_DURABLES does not Granger Cause NIFTY	3214	7.93725	2.E-07
NIFTY does not Granger Cause CONSUMER_DURABLES		5.90568	2.E-05
ENERGY does not Granger Cause NIFTY	3214	3.10328	0.0085
NIFTY does not Granger Cause ENERGY		4.21529	0.0008
FINANCIAL_SERVICES does not Granger Cause NIFTY	3214	0.89400	0.4840
NIFTY does not Granger Cause FINANCIAL_SERVICES		0.97564	0.4311
FMCG does not Granger Cause NIFTY	3214	0.50797	0.7705
NIFTY does not Granger Cause FMCG		3.08683	0.0088
IT does not Granger Cause NIFTY	3214	0.73897	0.5942
NIFTY does not Granger Cause IT		1.89733	0.0915
MEDIA does not Granger Cause NIFTY	3214	1.07519	0.3720
NIFTY does not Granger Cause MEDIA		0.75267	0.5840
OIL___GAS does not Granger Cause NIFTY	3214	1.77265	0.1150
NIFTY does not Granger Cause OIL___GAS		1.48111	0.1925
PHARMA does not Granger Cause NIFTY	3214	2.36918	0.0372
NIFTY does not Granger Cause PHARMA		1.03299	0.3963
PSU_BANK does not Granger Cause NIFTY	3214	1.73822	0.1224
NIFTY does not Granger Cause PSU_BANK		1.94008	0.0845
PVT_BANK does not Granger Cause NIFTY	3214	1.26802	0.2748
NIFTY does not Granger Cause PVT_BANK		0.77848	0.5651

Source: Author's Calculation using Eviews 11

III. FINDINGS

In order to understand the relationship between the overall Nifty index and its sectoral indices, firstly the descriptive statistics was examined which implied that the data under study is non-normal in nature. Secondly, the correlation analysis was carried out which implied that all the sectoral indices under study have positive correlation with Nifty index except Nifty Realty sectoral index. Thirdly, the regression analysis was considered to understand how good the model fits under study that could be used for the forecasting of Nifty index with the sectoral indices and vice versa.

This model was found to be significant at one percent level of significance with R squared value of 0.998. Further, in order to discover that if there exists a long term relationship between the overall Nifty index and the sectoral indices, the unit root test followed by the cointegration test was carried out. Unit root suggested that all the indices under study including Nifty Fifty are non-stationary and are of I (1). Hence, this was found sufficient condition to carry out cointegration test which implied that there is long-term relationship between the sectoral indices and the Nifty fifty index under study.

Lastly, the Granger Causality test was used to analyze the short-run relationship between the Nifty index and the sectoral indices. It was found that out of all 13 indices including Nifty index under study, Nifty Auto, Nifty Energy, Nifty FMCG, Nifty Consumer durables and Nifty Pharma are the sectoral indices which had short-run relationship with the Nifty Fifty index and other indices were found to be insignificant.

IV. CONCLUSION

The study was undertaken to understand the relationship between the sectoral indices and the Nifty index of NSE since the Nifty index is mostly confounded with the different weightage of the sectoral indices. It was observed that sectoral indices under study and the overall Nifty index had non-normality characteristic data. The correlation analysis suggested that there is a high correlation between most of the sectoral indices and the Nifty Fifty index. Further, to analyze this correlation more precisely, the unit root test, the cointegration followed by the causality test was carried out. The results suggested that there is a long-run relationship between the sectoral indices and the overall Nifty index.

The causality test implied that there are few sectors that were found to have a significant causality relationship with the Nifty index in the short-run of the study period. Hence, it could be said that other sectoral indices that have a significant causality relationship with the Nifty index can be included as the further scope of the present research. Indian stock markets have played a significant role in its sectorial growth and ultimately the economic development of India. Hence, the results obtained could help the policymakers and regulators of the Indian stock market to frame the policies and reforms with respect to sectors to work them efficiently in the Indian as well as global context respectively. The investors could obtain better strategies to invest with respect to sectors and their performance with the Nifty index respectively.

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