Dynamic Interaction Between Nifty 50 and Nifty Sectoral Indices: An Empirical Study on Indian Stock Indices

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Abstract

This study aims to determine the cointegrating and causal relationship between Nifty 50 and Nifty sectoral indices. Historical index data of the select indices were collected from the National Stock Exchange (NSE) database for the period Jan 2014 - Dec 2018. Appropriate Econometric tools - Augmented Dickey-Fuller (ADF) test, Phillips and Perron (PP) test, regression model, Granger causality test, and Johansen cointegration test were used to analyze the data. The findings of the study imply that the movements of Nifty sectoral index prices could determine the flow of stock index prices, i.e., Nifty 50 and vice versa during the period of the study which could also help the policymakers and financial planners in providing financial awareness to investors and clients in decision making.

Keywords: Nifty 50, Nifty Sectoral Indices, Indian Stock Indices, Granger Causality, Johansen Cointegration

Introduction

The stock market prices are considered as an essential indicator of a country's economic and social status and are seen as a leading indicator of real economic activity. The countries with better economic growth have better stock market performance (Duca 2007).Economic growth plays a vital role in the stock market development in both developing and developed economies. The development of the stock market does not solely depend upon the macroeconomic indicators because the sectoral contribution towards the market growth also causes significant development in the stock market. The stock market suffers from various typical weaknesses of an emerging market such as high market volatility, lack of transparency, and infrastructure bottlenecks, which led most of the researchers to study the cointegration and causality of macroeconomic variables on the broad stock indices. This study identified that the researches focusing on the aggregate effect of sectoral stock indices on the Nifty 50 index prices is of rarity.

The study focuses on the sectoral indices of Nifty namely, Nifty Auto, Nifty Bank, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Metal, Nifty Pharma, Nifty Pharma, Nifty Pharma, Nifty Private Bank, Nifty PSU Bank and Nifty Realty indices because the sectoral indices are designed to reflect the behaviour and performance of the respective sectors. Each index comprises of stocks that are listed in NSE. The list of stocks indexed in Nifty sectoral indices as of Nov 2019 is given in Annexure 1. These stocks for the index were selected based on detailed eligibility criteria structured by NSE. Therefore, it becomes vital to study the relationship between Nifty sectoral and Nifty 50 index prices. The aim of this study is to determine the cointegrating and causal relationship between the study variables and to find the impact of Nifty sectoral index prices on Nifty 50. This study is expected to offer valuable insights to investors to make informed decisions about sectoral stock indices and to help the policymakers and financial planners in providing financial awareness to investors and clients.

Literature Review

Several studies have been carried out in developed stock markets such as the United States (US), United Kindom (UK), Germany, and Japan; examples of pioneer studies are Fama (1981, 1990), Geske and Roll (1983), and Chen, Roll, and Ross (1986). These studies were found to vary in terms of the methodology adopted and the hypotheses. The literature that demonstrated the relationships between the stock indices are: Chiang and Doong (2001) analyzed the time-series behavior of stock returns for seven Asian stock markets by using Threshold Autoregressive GARCH. After testing the relationship between stock returns and unexpected volatility, the evidence showed that four out of seven Asian stock markets have significant results. Lee, Chen and Rui (2001) examined the time series features of stock returns and volatility, as well as the relation between return and volatility in four of China's stock exchanges. Variance ratio tests rejected the hypothesis that stock returns follow a random walk, and the study found evidence of long memory of returns. Application of GARCH and EGARCH models to the study provided strong evidence of time varying volatility and showed volatility is highly persistent and predictable.

Berben and Jansen (2005) investigated shifts in correlation patterns among international equity returns at the market level as well as the industry level using the weekly data from Germany, Japan, the UK, and the US in the period 1980 - 2000. A novel bivariate GARCH model for equity returns with a smoothly time-varying correlation and then derive a Lagrange Multiplier statistic from testing the constant correlation hypothesis was developed. The study found that correlations among the German, UK and US stock markets have doubled, whereas Japanese correlations have remained the same. Giot (2005) found that there was a negative and statistically significant relationship between the returns of the S&P 100 and the NASDAQ 100 stock indexes and their corresponding implied volatility indexes, VIX and VXN. For the S&P 100, the relationship is asymmetric, as negative stock index returns were more associated than positive returns with greater changes in VIX. VIX changes when negative stock index returns were observed were greater in low-volatility periods. The study also found that positive, forward-looking returns were to be expected for long positions triggered by extremely high levels of the implied volatility indexes.

Li, Yang, Hsiao and Chang (2005)determined the issue of co-movement between stock markets in major developed countries and those in Asian emerging markets using the concept of cointegration. The study found that there exists a co-movement between some of the developed and emerging markets, but some emerging markets do differ from the developed markets with which they share a long-run equilibrium relationship. Phylaktis and Ravazzolo (2005) examined the stock market linkages of a group of Pacific-Basin countries with the US and Japan by estimating the multivariate cointegration model in both the autoregressive (AR) and moving average (MA) forms over the period 1980 - 1998. The results for the 1980s indicated that the relaxation of foreign ownership restrictions was not sufficient to attract foreign investors' attention, and those other factors must have affected the portfolio diversification decision. The results of the 1990s suggested that the relaxation of the restrictions might have strengthened international market interrelations.

A study by Hasan and Javed (2009) explored the long-term relationship between Pakistan equity prices and monetary variables and provided evidence of a long-run relationship and unidirectional Granger causality between the equity market and monetary variables. Dimitriou and Simos(2011) empirically investigated the relationship between expected stock returns and volatility in the twelve EMU countries as well as five major out of EMU international stock markets for the period 1992 - 2007 using GARCH models. The study found a weak relationship between expected returns and volatility for most of the markets and also identified unravels significant evidence of a negative relationship in almost all markets.

Data

The analytical method of research was adopted for this study as the cause and effect of Nifty 50 movements are explained with Nifty sectoral indices using the historical data of the indices, i.e., secondary data. The data were collected from the National Stock Exchange (NSE) database for five years from Jan 2014 to Dec 2018. The selections of indices were based on the availability of data and the requirement of a good number of observations, which are essential for studies on time series. The indices

considered for the study are Nifty 50 (broad index) and Nifty sectoral indices namely Nifty Auto, Nifty Bank, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Metal, Nifty Pharma, Nifty Pharma, Nifty Pharma, Nifty Private Bank, Nifty PSU Bank and Nifty Realty. The unit of measurement of all the study variables is index prices. The acronym of the study variables used in the analyses and tables in this research are Nifty 50 →N50; Nifty Auto →NAuto; Nifty Bank→NBank; Nifty Financial Services → NFinServ; Nifty FMCG →NFMCG; Nifty IT →NIT; Nifty Media→NMedia; Nifty Metal →NMetal; Nifty Pharma →NPharma; Nifty Private Bank →NPrivate; Nifty PSU Bank →NPSU and Nifty Realty → NRealty. The list of stocks indexed in Nifty 50 and Nifty sectoral indices as of Nov 2019 are given in Annexure 1.The methodology of the study is provided in the following section.

Methodology

This research study is based on the standard method of causality and cointegration tests. Specifically, the empirical framework of this study involves various steps. First, by using the Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) tests, each series is tested for unit roots. Secondly, the regression model was framed to forecast future responses. Thirdly, to assess their causal nexus empirically, Granger causality test was used, and finally, to test for cointegration among the stock indices, the maximum likelihood approach was performed using the Johansen cointegration approach. The analyses for this study were conducted using Eviews 7 software.

Objective And Hypotheses

The objective of this study is as follows:

❖ To determine the short-run and long-run relationship between Nifty 50 and Nifty sectoral indices.

The following hypotheses are set to test the above objectives empirically:

❖ H01: There is no significant short-run relationship existing between Nifty 50 and Nifty sectoral indices.

❖ H02: There is no significant long-run relationship existing between Nifty 50 and Nifty sectoral indices.

Analysis And Interpretation

This section discusses the preliminary analysis, which includes descriptive statistics and unit root tests. Subsequently, the results from the detailed system analysis are presented, which include the regression model, the Granger causality test, and the Johansen cointegration test.

Descriptive Statistics: The descriptive statistics of the select stock indices for the study period are presented in Table 1. The result shows that there is a large difference between the minimum and maximum values of the indices. It is also identified that there are fluctuations in the movement of prices and have grown rapidly during the study period.

Table 1 - Descriptive Statistics

Particulars	N50	NAuto	NBank	NFinServ	NFMCG	NIT	NMedia	NMetal	NPharma	NPrivate	NPSU	NRealty
Mean	8817.88	9003.48	19878.74	8179.74	22549.46	11411.30	3586.13	2808.29	10293.63	10922.11	3185.53	233.21
Median	8552.85	8841.85	18823.15	7695.40	21063.80	11097.90	3558.33	2805.15	10359.90	10566.74	3185.43	210.68
Maximum	11738.50	12096.90	28320.00	11838.70	32915.55	16254.90	5642.70	4195.75	13851.15	16088.90	4419.25	372.25
Minimum	6000.90	4942.40	10402.10	4312.50	16336.10	8675.10	1655.15	1495.60	7611.60	5147.47	1968.00	28.25
Std Deviation	1321.94	1675.85	4502.20	1890.22	3954.7	1521.22	479.37	660.82	1479.90	2747.64	501.17	52.24
Skewness	0.18	-0.34	0.07	0.19	0.64	1.14	0.06	-0.02	0.05	0.05	-0.14	0.56
Kurtosis	2.26	2.51	2.09	2.05	2.29	3.88	2.01	2.04	2.17	3.03	2.69	2.43
Jarque-Bera	34.70[**]	36.35[**]	43.06[**]	53.75[**]	108.84[**]	306.08[**]	51.57[**]	47.12[**]	36.20[**]	45.74[**]	8.85[**]	51.31[**]
Observations	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233

** Significant at the 1% level

The skewness is positive (right-skewed) for select indices, namely Nifty 50, Nifty Bank, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Pharma, Nifty Private Bank and Nifty Realty which means that the mean is greater than the mode. The skewness is negative (left-skewed) for indices, namely Nifty Auto, Nifty Metal and Nifty PSU Bank, which means that the mean is less than the mode. This further suggested that the movements of the select indices are related to one another and are found to be systematic. The kurtosis coefficient values for Nifty IT was found to be positive and greater than 3, which indicates that the distribution to be leptokurtic. The kurtosis coefficient values for all the select indices except Nifty IT were positive and found to be less than 3, which indicated that the distribution to be platykurtic with fewer and less extreme outliers. Subsequently, the Jarque-Bera test statistics suggest that all the select indices namely Nifty 50, Nifty Auto, Nifty Bank, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Metal, Nifty Pharma, Nifty Pharma, Nifty Pharma, Nifty Private Bank, Nifty PSU Bank and Nifty Realty were statistically significant at 1% level and were not normally distributed.

Testing the Data for Stationarity: The results for the ADF and PP unit root tests for checking the stationarity of the data are presented in Table 2.

Table 2 - Results of ADF and PP Unit Root Tests (with constant and trend)

Study Variables	ADF Unit Root Test		PP Unit Root Test	
	Level	First Difference	Level	First Difference
N50	-1.29	-32.56***	-1.30	-32.48***
NAuto	-2.23	-32.84***	-2.23	-32.80***
NBank	-1.13	-33.51***	-1.14	-33.48***
NFinServ	-0.84	-33.90***	-0.83	-33.88***
NFMCG	-0.53	-34.05***	-0.47	-34.08***
NIT	-1.10	-34.23***	-1.10	-34.23***
NMedia	-1.78	-33.54***	-1.76	-33.54***
NMetal	-1.18	-34.36***	-1.18	-34.35***
NPharma	-2.04	-32.13***	-2.01	-32.13***
NPrivate	-1.10	-33.86***	-1.10	-33.84***
NPSU	-2.53	-34.03***	-2.55	-34.02***
NRealty	-1.66	-32.42***	-1.52	-32.40***

***Significant at the 1% level

From Table 2 results, it is identified that all the select indices were found to be stationary at first difference series. Hence, all the time series data are statistically significant and integrated at order I(1). Therefore, it is understood that the sample data taken for this study are stationary, i.e., predictable.

Time Series Regression: It is a statistical method used in this study to forecast the future response of the Indian stock index prices based on past data of select economic indicators. The result of time series regression is presented in Table 3.

Table 3 - Estimation of the Regression Model

Independent Variables	Coefficient	Std. Error	t Statistics	R Square	Adjusted R Square	F Statistics
Constant	903.11	39.78	22.70***			
NAuto	0.11	0.01	17.92***			
NBank	0.06	0.02	2.63***			
NFinServ	0.27	0.03	10.55***			
NFMCG	0.06	0.00	22.28***			
NIT	0.10	0.00	34.48***	0.998	0.998	58518.68**
NMedia	-0.14	0.01	-11.31***			
NMetal	0.24	0.01	32.12***			
NPharma	0.06	0.00	17.99***			
NPrivate	-0.02	0.03	-0.68			
NPSU	0.02	0.02	0.96			
NRealty	1.39	0.09	15.16***			

***Significant at the 1% level

The regression output consists of four important information: (a) the R2 value which is based on the sample and represents the proportion of variance in Nifty 50 index prices that can be explained by the Nifty sectoral indices and it indicates the fitness of the regression model. For a model to be fit, the R2 value is said to be 0.60 or above. In this study, the estimated parameters of the equation obtained were found to be statistically significant, with a R2 value of 0.998, as shown in Table 3.

The predictor variables explained about 99.8 percent of the change in Nifty 50 index prices. An adjusted R2 value corrects the positive bias to provide a value that could be expected in the population. The adjusted R2 value of the model is 0.998, which is found to have zero variation from the R2 value. The F value of the model is 58518.68, which indicated that the model is statistically significant at the 0.01 level, and the coefficients for the constant and independent variables, i.e., Nifty sectoral indices are the information used to construct a model and forecast the dependent variable, i.e., Nifty 50 index prices. The regression equation derived from the results:

$$N50_t = 903.11 + 0.11\,(NAuto) + 0.06\,(NBank) + 0.27\,(NFinServ) + 0.06\,(NFMCG)$$
$$+ 0.10\,(NIT) - 0.14\,(NMedia) + 0.24\,(NMetal) + 0.06\,(NPharma)$$
$$- 0.02\,(NPrivate) + 0.02\,(NPSU) + 1.39\,(NRealty) + e$$

Testing for Granger Causality: Granger causality test is used in this study to determine the causality between the study variables, i.e., to check whether Nifty 50 is useful in forecasting the Nifty sectoral indices and vice versa and also helps in determining the short-run equilibrium relationship. The results of the Granger causality test for Nifty 50 and Nifty sectoral indices are given in Table 4.

Table 4 - Results of Granger Causality Test (Nifty 50 and Nifty SectoralIndex Prices)

Null Hypotheses	F Value	Results
NAuto does not Granger Cause N50	0.15	Accept
N50 does not Granger Cause NAuto	1.65	Accept
NBank does not Granger Cause N50	4.00**	Reject
N50 does not Granger Cause NBank	0.85	Accept
NFinServ does not Granger Cause N50	3.90**	Reject
N50 does not Granger Cause NFinServ	1.68	Accept
NFMCG does not Granger Cause N50	1.95	Accept
N50 does not Granger Cause NFMCG	0.67	Accept
NIT does not Granger Cause N50	2.24	Accept
N50 does not Granger Cause NIT	3.66**	Reject
NMedia does not Granger Cause N50	0.23	Accept
N50 does not Granger Cause NMedia	2.53	Accept
NMetal does not Granger Cause N50	2.88	Accept
N50 does not Granger Cause NMetal	3.78**	Reject
NPharma does not Granger Cause N50	7.79***	Reject
N50 does not Granger Cause NPharma	2.21	Accept
NPrivate does not Granger Cause N50	2.99**	Reject
N50 does not Granger Cause NPrivate	0.88	Accept
NPSU does not Granger Cause N50	0.82	Accept
N50 does not Granger Cause NPSU	0.91	Accept
NRealty does not Granger Cause N50	0.45	Accept
N50 does not Granger Cause NRealty	1.96	Accept

Note: Appropriate lag length was determined by the Akaike information criterion.
***Significant at 1% level, **Significant at 5% level

The direction of causality is found to be unidirectional and significant in the following cases: Nifty Bank→Nifty 50; Nifty Financial Services→Nifty 50; Nifty 50 →Nifty IT; Nifty 50→Nifty Metal; Nifty Pharma →Nifty 50 and Nifty Private Bank→Nifty 50. Therefore, Hypothesis H01, there is no significant short-run relationship existing between Nifty 50 and Nifty sectoral indices is rejected and inferred that causality and the short-run relationship is found between Nifty 50 and Nifty sectoral index prices. It is also found that the sectoral indices namely, Nifty Bank, Nifty Financial Services, Nifty Pharma and Nifty Private Bank indices have had an impact on Nifty 50 index prices, whereas, Nifty IT and Nifty Metal index prices had a significant impact due to changes in the Nifty 50 index prices during the short-run period.

Testing for the Existence of a Long-run Equilibrium Relationship: Johansen's cointegration test is applied to find the stationary linear combination and long-run cointegrating equilibrium among the study variables. The results of the trace test and maximum eigenvalue test are presented in Table 5.

Table 5 - Results of Johansen's Cointegration Test (Nifty 50 and Nifty Sectoral Index Prices)

H_0	N50		5% Critical Value	
	Trace Value	Maximum Eigen Value	Trace Value	Maximum Eigen Value
$r = 0$	353.33**	65.00	334.98	76.58
$r \leq 1$	288.33**	58.08	285.14	70.54
$r \leq 2$	230.25	51.91	239.24	64.50
$r \leq 3$	178.34	44.54	197.37	58.43
$r \leq 4$	133.80	36.12	159.53	52.36
$r \leq 5$	97.68	26.74	125.62	46.23
$r \leq 6$	70.94	22.00	95.75	40.08
$r \leq 7$	48.93	15.17	69.82	33.88
$r \leq 8$	33.76	12.63	47.86	27.58
$r \leq 9$	21.13	10.04	29.80	21.13
$r \leq 10$	11.09	7.49	15.49	14.26
$r \leq 11$	3.60	3.60	3.84	3.84

Note: P Values were estimated by MacKinnon-Haug-Michelis (1999)
** Significant at the 5% level

The result of the cointegration tests indicates the existence of a long-run equilibrium relationship among the study variables. Two cointegrating vector equations were found between Nifty 50 and Nifty sectoral index prices. Therefore, Hypothesis H_{02} as there is no significant long-run relationship existing between Nifty 50 and Nifty sectoral indices is rejected and inferred that there exists a long-run equilibrium relationship between the study variables, which means that the select variables can be forecasted by past (historical) values of other variables considered for the study.

Conclusion

The present study is an attempt to analyze and estimate the impact of Nifty sectoral indices on Nifty 50 index prices. The variables used for the study were stationary at their first difference with the order of integration I(1). It was found that Granger causality, i.e., the short-run relationship existed between the study variables. Therefore, it can be concluded that this study partially supports the 'Complementarity Hypothesis' propounded by McKinnon's (1973). Further, it could also be inferred that the long-run cointegrating relationship existed between Nifty 50 and Nifty sectoral index prices. The managerial implications of the present study are that the movements of Nifty sectoral index prices could determine the flow of stock index prices, i.e., Nifty 50 and vice versa, during the period of the study. The study also establishes that all the policies regarding Nifty sectoral indices have immediate changes in the behavior of Nifty 50. Further, the study provides implications to policymakers regarding lead indicators of the stock market to formulate suitable policies and strategies in the future. It could identify the lead sectoral indices that have a significant impact on Nifty 50 index prices, which could also help the policymakers and financial planners in providing financial awareness to investors and clients in decision making.

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Stocks Listed in Nifty 50 and Nifty Sectoral Indices

S.No.	Indices	Number of Companies	List of Companies
1	N50	50	Adani Ports and Special Economic Zone, Asian Paints, Axis Bank, Bajaj Auto, Bajaj Finance, Bajaj Finserv, Bharat Petroleum Corporation, Bharti Airtel, Bharti Infratel, Britannia Industries, Cipla, Coal India, Dr. Reddy's Laboratories, Eicher Motors, GAIL (India), Grasim Industries, HCL Technologies, HDFC Bank, Hero MotoCorp, Hindalco Industries, Hindustan Unilever, Housing Development Finance Corporation, ICICI Bank, ITC, Indian Oil Corporation, IndusInd Bank, Infosys, JSW Steel, Kotak Mahindra Bank, Larsen & Toubro, Mahindra & Mahindra, Maruti Suzuki India, NTPC, Nestle India, Oil & Natural Gas Corporation, Power Grid Corporation of India, Reliance Industries, State Bank of India, Sun Pharmaceutical Industries, Tata Consultancy Services, Tata Motors, Tata Steel, Tech Mahindra, Titan Company, UPL, UltraTech Cement, Vedanta, Wipro, Yes Bank and Zee Entertainment Enterprises
2	NAuto	15	Amara Raja Batteries, Apollo Tyres, Ashok Leyland, Bajaj Auto, Bharat Forge, Bosch, Eicher Motors, Exide Industries, Hero MotoCorp, MRF, Mahindra & Mahindra, Maruti Suzuki India, Motherson Sumi Systems, TVS Motor Company andTata Motors
3	NBank	12	Axis Bank, Bank of Baroda, Federal Bank, HDFC Bank, ICICI Bank, IDFC First Bank, IndusInd Bank, Kotak Mahindra Bank, Punjab National Bank, RBL Bank, State Bank of India and Yes Bank
4	NFinServ	20	Axis Bank, Bajaj Finance, Bajaj Finserv, Bajaj Holdings & Investment, Cholamandalam Investment and Finance Company, Edelweiss Financial Services, HDFC Bank, HDFC Life Insurance Company, Housing Development Finance Corporation, ICICI Bank, ICICI Lombard General Insurance Company, ICICI Prudential Life Insurance Company, Indiabulls Housing Finance, Kotak Mahindra Bank, Mahindra & Mahindra Financial Services, Power Finance Corporation, REC, SBI Life Insurance Company, Shriram Transport Finance Co. and State Bank of India
5	NFMCG	15	Britannia Industries, Colgate Palmolive (India), Dabur India, Emami, Godrej Consumer Products, Godrej Industries, Hindustan Unilever, ITC, Jubilant Foodworks, Marico, Nestle India, Procter & Gamble Hygiene & Health Care, Tata Global Beverages, United Breweries and United Spirits
6	NIT	10	HCL Technologies, Hexaware Technologies, Infosys, Justdial, MindTree, NIIT Technologies, Tata Consultancy Services, Tata Elxsi, Tech Mahindra and Wipro
7	NMedia	15	Balaji Telefilms, D.B.Corp, Dish TV India, Hathway Cable & Datacom, Inox Leisure, Jagran Prakashan, Music Broadcast, Network18 Media & Investments, PVR, Saregama India Ltd, Sun TV Network, TV Today Network, TV18 Broadcast, Zee Entertainment Enterprises and Zee Media Corporation
8	NMetal	15	APL Apollo Tubes, Coal India, Hindalco Industries, Hindustan Copper, Hindustan Zinc, JSW Steel, Jindal Steel & Power, MOIL, NMDC, National Aluminium Co., Ratnamani Metals & Tubes, Steel Authority of India, Tata Steel, Vedanta and Welspun Corp
9	NPharma	10	Aurobindo Pharma, Biocon, Cadila Healthcare, Cipla, Divi's Laboratories, Dr. Reddy's Laboratories, Glenmark Pharmaceuticals, Lupin, Piramal Enterprises and Sun Pharmaceutical Industries
10	NPrivate	10	Axis Bank, City Union Bank, Federal Bank, HDFC Bank, ICICI Bank, IDFC First Bank, IndusInd Bank, Kotak Mahindra Bank, RBL Bank and Yes Bank
11	NPSU	12	Allahabad Bank, Bank of Baroda, Bank of India, Canara Bank, Central Bank of India, Indian Bank, Jammu & Kashmir Bank, Oriental Bank of Commerce, Punjab National Bank, State Bank of India, Syndicate Bank and Union Bank of India
12	NRealty	10	Brigade Enterprises, DLF, Godrej Properties, Indiabulls Real Estate, Mahindra Lifespace Developers, Oberoi Realty, Phoenix Mills, Prestige Estates Projects, Sobha and Sunteck Realty

Source: National Stock Exchange (NSE) as on Nov 2019

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