CHAPTER 6

STOCK MARKET RISK: AN EMPIRICAL INVESTIGATION (I)

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6.1 INTRODUCTION

6.1.1 Indian capital market

Capital markets have become more important in the age of globalisation and deregulation. Regulators, participants, and investors are all responsible for the capital market's smooth operation. In India, the last decade has been a golden age for the securities industry. It is becoming a far more vital source of capital for businesses than traditional financial intermediaries, and it is set to dominate India's corporate finance future. Reforms in the securities market, particularly the establishment and empowerment of SEBI, market-determined resource allocation, screen-based nation-wide trading, dematerialization and electronic transfer of securities, rolling settlement and the ban on deferral products, sophisticated risk management, and derivatives trading, have greatly improved the regulatory framework and trading efficiency. The Indian market is currently equitable to many industrialised economies with reference to a variety of quality indicators.

During the last few years, the securities market has altered drastically. Infrastructure improvements, adoption of best worldwide practises, and the introduction of competition have all helped to strengthen the industry. As the regulatory framework has evolved and market surveillance has increased, the market has become safer and investors have been better protected. SEBI's major reforms over the last few years have improved the securities market's integrity, transparency, and efficiency. Computerized trading and a "order matching" system have been deployed by all 23 stock exchanges, resulting in cheaper transaction costs, faster trade execution, and more liquidity. In several shares, spreads have narrowed by a factor of ten, while volume has surged by a factor of a hundred.

6.1.2 Stock market

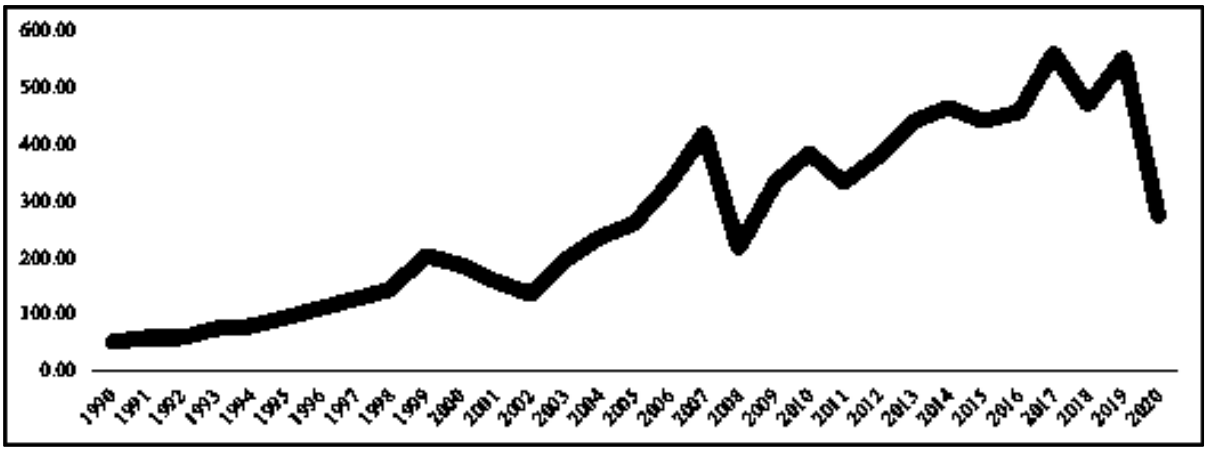
The health of a country's economy is thought to be reflected in stock markets. Their movements are heavily influenced by major economic, financial, political and social elements. By allocating funds and serving as the backbone of payment systems, financial institutions and markets play a key role in the economy. Financial intermediaries have a unique position when it comes to managing public funds. As a result of these factors, governments have enacted a slew of legislation aimed at boosting or maintaining public trust in the financial system.

This regulatory emphasis reflects a fear that financial intermediary failures and chaotic incidents in financial markets will erode public confidence in the financial system, perhaps leading to a major withdrawal of funds from financial intermediary firms. Obviously, such a catastrophe would result in the financial system collapsing, causing not only investors but also the entire economy to suffer. Government regulation of the securities markets, on the other hand, displays a concern for the safety of investors whose money is invested directly in the securities markets or entrusted to professionally managed financial intermediation.

Peripatetic stock prices and their volatility, which have now become endemic characteristics of securities markets, heighten the concern. Volatility now has a new property: quick transmissibility across markets, thanks to the increased interconnectivity of national currency, commodity, and stock markets with global markets, as well as the existence of common actors.

The stock markets of the emerging world account for a disproportionately large share of the global stock market boom. While the total value of outstanding publicly traded equities climbed from roughly 6 trillion dollars in 1986 to more than 32 trillion dollars in 2000, the total value of outstanding publicly traded stocks in December 2011 was nearly 47 trillion dollars. The total market capitalisation of all publicly traded companies in the world was $51.2 trillion in January 2007, rising to $57.5 trillion in May 2008, then dipping below $50 trillion in August 2008 and sitting just above $40 trillion in September 2008. It had crossed the US$49 trillion threshold by March 2010.

Figure 6.1: World market capitalization



Source: The world bank data

Emerging markets now account for more than three times their share of global stock market capitalization. In addition, the total value of stock transactions in emerging economies increased from 2% of global totals in

1986 to 14% in 2001. The fast rise of emerging countries coincided with a surge in international financial flows, particularly in those markets. In this perspective, it's worth emphasising that in a well-functioning and rational stock market, changes in stock prices reflect both changed expectations about future company earnings and changes in the discount rate at which these expected earnings are capitalised. The global market capitalization in US dollars over a 30-year period.

The Indian Stock Market had a very active decade in the 1990s. Since 1992, one of the most significant events has been the decision to enable Foreign Institutional Investors (FIIs) to trade directly on the Indian stock markets. It is widely acknowledged that their presence has aided in the advancement of our markets' increasing sophistication. However, it is believed that FIIs' trading conduct reflects a form of myopia, resulting in excessive volatility in domestic stock markets. To put it another way, these investors are myopic, speculative, and transfer significant sums of money in and out of the country's financial markets without regard for fundamentals.

The trading patterns of these individuals may cause undue volatility in the stock market of India, which has substantial consequences for macroeconomic management. By existing counter-productive corporate takeovers, the stock market's development might stifle economic growth. Even in mature economies, equity issues account for only a modest portion of business capital.

In addition, the stock market has been criticised of causing undue economic instability. Stock market liquidity, it is claimed, allows speculators to change their portfolios quickly and cheaply in response to changes in mood, rumours and fads, and so on, and that this causes a departure of stock market asset values and underlying fundamentals, and that both of these events may cause excessive volatility in stock market returns.

Due to the inherent volatility and arbitrariness of the stock market pricing process, it is vital to acknowledge that it is a poor indicator of optimal investment allocations in developing countries. The goal of this thesis is to use fundamental statistical methods to investigate the trend, form, correlation, and beta risk of the benchmark indices, sectoral, and thematic indices of the Indian stock market, namely the Bombay stock exchange and the National stock exchange. Further, the study also studies the characteristics of the return’s distribution i.e., volatility and other stylized facts of the benchmark indices. Lastly, the study digs deeper into the correlation of various sectoral and thematic indices with the benchmark index with the help of a sophisticated tool called the copula.

The data analysis is divided into three chapters. The first part in the sixth chapter discusses the basic statistical analysis which include the trends of prices and returns of various indices. It also includes descriptive statistics, histogram, beta risk, correlation and the runs test. The second part of the seventh chapter concerns using the unit root test to check for data stationarity and the Granger causality test to check for causation. It also focuses on studying the nature of volatility with respect to persistence, conditional volatility, and news sensitivity with the help of ARCH LM test and GARCH (1,1) model on the Indian stock indices. It also compares the various components of conditional volatility present in the Indian stock market. The SGARCH, EGARCH, GJRGARCH, APARCH, and FIEGARCH models are used to achieve this aim, and they are applied to the Indian stock market's benchmark indices S&P Sensex and Nifty50 and their sectoral and thematic indices. The third part in the eight chapter displays the granger causality among the benchmark indices of BSE, NSE and their sectoral and thematic indices. It also includes copulas which are discussed in detail in this chapter.

6.2 OBJECTIVES OF THE CHAPTER

The major objective of this part of statistical analysis is as follows:

1. To study the trends in the prices and returns distribution of the benchmark indices viz, S&P BSE Sensex and Nifty50.

2. To study the trends in the prices and returns distribution of the selected sectoral as well as thematic indices of the Bombay stock exchange and the National stock exchange.

3. To study the descriptive statistical analysis of the S&P BSE Sensex, Nifty50, sectoral indices of Bombay stock exchange and sectoral as well as thematic indices of the National stock exchange.

4. To conduct the Jarque Bera test to check for normality in the S&P BSE Sensex, Nifty50, sectoral indices of Bombay stock exchange and sectoral as well as thematic indices of the National stock exchange.

5. To carry out beta analysis to study risk associated with the sectoral indices of Bombay stock exchange and sectoral as well as thematic indices of the National stock exchange as compared to the overall market.

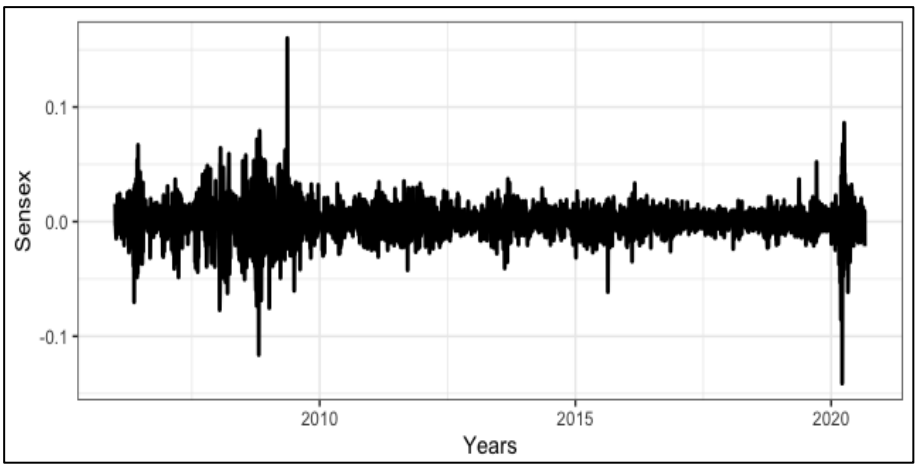
6. To investigate correlation between sectoral indices of Bombay stock exchange and sectoral as well as thematic indices of the National stock exchange and the benchmark indices viz, S&P BSE Sensex and Nifty50 respectively.

6.3 TREND OF PRICES AND RETURNS OF BSE SENSEX AND NIFTY50

Figure 6.2: S&P BSE Sensex movement from 2006 to 2020

Source: bseindia.com

Figure 6.3 S&P BSE Sensex returns from 2006 to 2020



Source: Authors estimation

The Sensex was established in the 1990s and has had remarkable growth since then. To be more specific, after the year 2000, this astonishing rise was accelerated. The first time the Sensex index crossed the "6000 marks" was in 2002. This was primarily due to IT businesses, and the Sensex has steadily increased since then. In

addition, the Sensex finished at 39,056.65 on April 2nd, 2019. (Crossing 39,000 points for the 1st time). This development is mostly due to India's significant expansion in GDP (Gross Domestic Product).

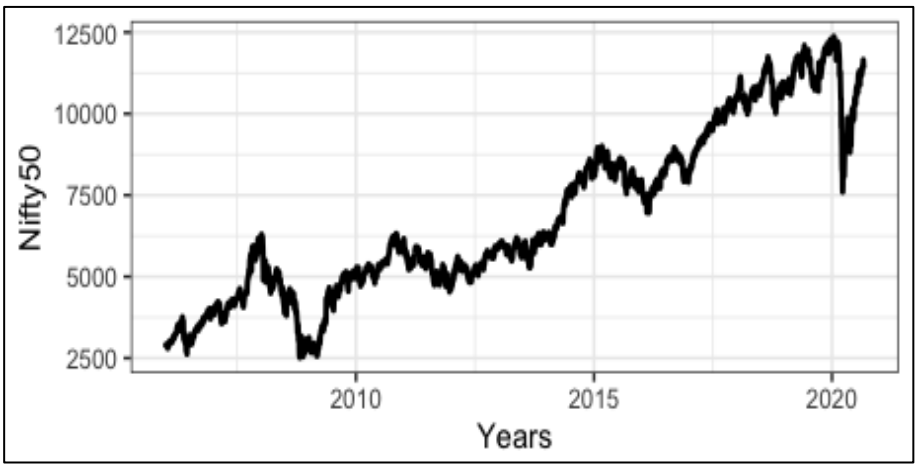
Sensex crash - The market crisis of 2008 is still remembered with trepidation throughout Sensex history, as are the difficult circumstances it produced for the global economy between 2008 and 2009. The Dow Jones industrial average dropped in intraday trading, causing a stock market crash in India. This disaster not only wreaked havoc on the Indian stock market, but it also resulted in a 1408-point drop (on January 21st, 2008). The next day after the loss, trading was halted for an hour as the index continued to fall. From January to November of 2008, the index continued to fall, causing a period of protracted market instability. In October of the same year, the stock market closed at 8509.56 points, the lowest level in ten years.

Because of the Satyam fraud, 2009 was a bad year for the already-fragile market. This terrible event caused the index to collapse about 750 points, worsening the situation and throwing the market into chaos. Quite recently the Sensex dropped 3934 points as a response to the Global pandemic in March 2020. However, after a few months it corrected itself to reach new highs of 50,000 and more in 2021. The BSE Sensex has had its share of ups and downs, but despite all of the fluctuations and plunges in recent years, it still maintains its status as India's premier "stock index."

On April 2019, the BSE Sensex celebrated its 40th anniversary. It is not only India's first real-time index, but it also symbolizes the country's stock markets in the public eye. It serves as a barometer for depicting India's economic progress and fluctuations. Information technology, financial services, consumer discretionary, healthcare, and energy are important component of BSE Sensex since the early 2000s.

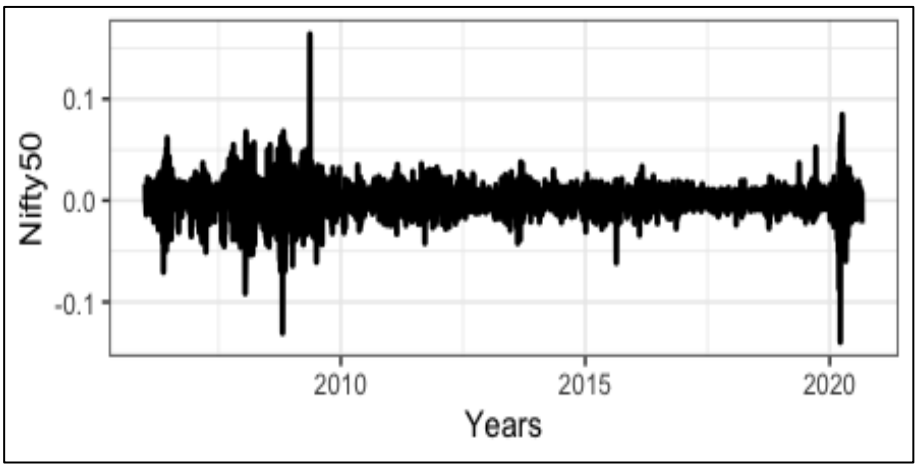
The most straightforward way to characterize the Sensex's 40-year trajectory is that it went from 100 points to about 50,000 points. However, this does not imply that everything went according to plan. The BSE Sensex experienced certain moments of rapid expansion, while other times were less pleasant. It took the Sensex 11 years to reach 1,000 points. There was no turning back after the 1000 mark was reached, and it crossed the next 3,000 points in less than a year.

Figure 6.4: NSE Nifty50 movement from 2006 to 2020



Source: nseindia.com

Figure 6.5: NSE Nifty50 returns from 2006 to 2020



Source: Authors estimation

The foundation year was November 1995 (1,000 points) when Nifty50 was created in April 1996 at 1,107 points. The Nifty50 took over 18 years to reach 7,000 points, but only 6.8 years to reach 8,000 points. The most agonizing voyage was Nifty50's from 1,107 to 2000, which took a total of 2,167 trading days (almost 8.7 years). In the last 25 years, the Nifty50 has risen 14 times. In the last 25 years, Nifty50 has returned 11.1 percent compound annual growth rate (CAGR) on its journey from 1,107 to 15,000. While the results have been excellent, the journey has not been linear. Its members account for around 58 percent of India's overall market capitalization. Nifty50's market capitalization increased by 69 times to $117 trillion, according to a 19 percent compound annual growth rate.

Nifty50 crashes – Nifty50 has seen political unrest in 1996–98, the Asian financial crisis, the dot-com bubble, the global financial crisis, the Taper Tantrum, and the most recent COVID pandemic in the previous 25 years.

The worst year for Nifty50 was 2008, the year of the Global Financial Crisis (GFC), when it dropped 52%. Thereafter, in March 2020, Nifty50 had the second greatest fall as a response to global pandemic of about 1110 points.

The greatest year (76%) was 2009, when the stock market recovered from the GFC's lows and the UPA formed a stable government at the federal level. Nifty50 has generated yearly gains of above 20% in ten of the last ten years, and has had negative returns in seven of those years. Sectoral representation has evolved throughout time, reflecting changes in the economy. Nifty50 had no technological presence when it started in 1996, and was dominated by consumer, PSU banks, and other industries like oil & gas, NBFCs, cars, metals, and textiles.

With 0.4 percent weight, private banks only had one representative in the form of HDFC Bank. Private banks (25.5 percent) and technology are the top two sectors in 2021. (16.1 percent). Thirteen firms have been a part of the Nifty50's journey since its inception: HDFC Bank, RIL, HDFC, ITC, HUL, L&T, SBI, Tata Motors, Dr Reddy's Labs, Tata Steel, Grasim, Hero, and Hindalco.

6.3.1 Descriptive analysis of BSE Sensex and NSE Nifty50

The descriptive statistics of daily closing prices of S&P BSE Sensex and Nifty50 are summarized in table.

Table 6.1: Descriptive analysis of BSE Sensex and NSE Nifty50

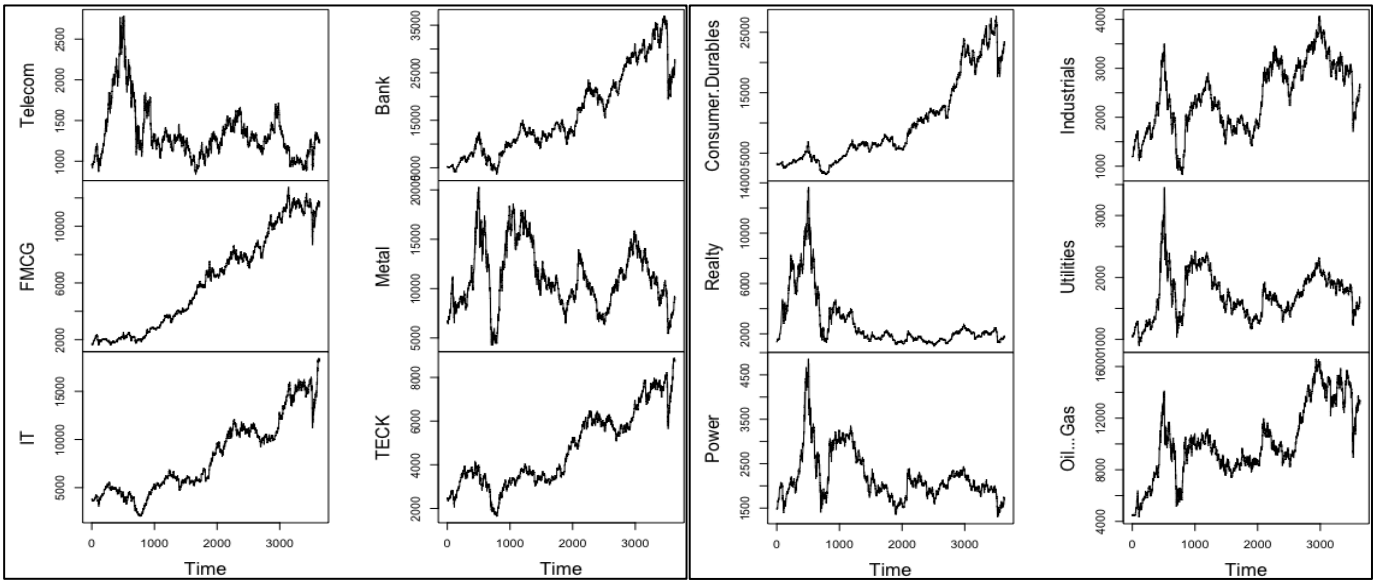
	BSE - Sensex		NSE – Nifty50	
	Prices	Returns	Prices	Returns
Number of observation	3633	3632	3633	3632
Missing Values	0	0	0	0
Minimum	8160.4	-0.14102	2524.2	-0.139
Maximum	41952.63	0.1599	12362.3	0.1633
1st Quartile	16601.2	-0.00587	4955.8	-0.0058
3rd quartile	28668.22	0.00695	8754.95	0.007
Mean	22860.52	0.00039	6880.83	0.0004
Median	19939.04	0.00075	5991	0.0007
Standard deviation	8636.71	0.01	2618.65	0.01
Skewness	0.448	-0.219	0.401	-0.31
Kurtosis	-0.882	11.56	-1.003	12.194

Source – Author's estimation

The above table represents the price and returns descriptive statistics for S&P BSE Sensex and Nifty50. With reference to the prices, the minimum of Sensex is 8160.4 while that of Nifty50 is 2524.2 points and maximum is 41952 and 12362 points, respectively. The mean value of Sensex is 22860 and that of Nifty50 is 5991. Standard deviation is 8638 for Sensex and 2618 for Nifty50. The skewness values are positive and nearby zero which means there seems to be no asymmetry in the value of skewness which tends to happen when a huge data set is considered. Similarly, the values of kurtosis is negative and nearby one for both the indices which means that the prices lie in the negative tail of the distribution. With reference to the returns, the mean of returns of BSE – S&P Sensex is 0.039% whereas the mean of returns of Nifty50 index is 0.04%. The standard deviation of both the indices are same which is 0.01. The skewness values for both the indices are negative hence the returns distribution portray a negative (left) skewed distribution in both the indices. Similarly, the kurtosis value is extremely high than normal, the excess kurtosis depicts a leptokurtic behavior of returns distribution. This confirms the presence of heavy tails which is one of the distribution properties in the stylized facts of returns distribution.

6.3.2 Trend of prices & returns of sectoral indices of Bombay stock exchange

Figure 6.6: Sectoral indices (BSE) movements from 2006 to 2020 … (1)

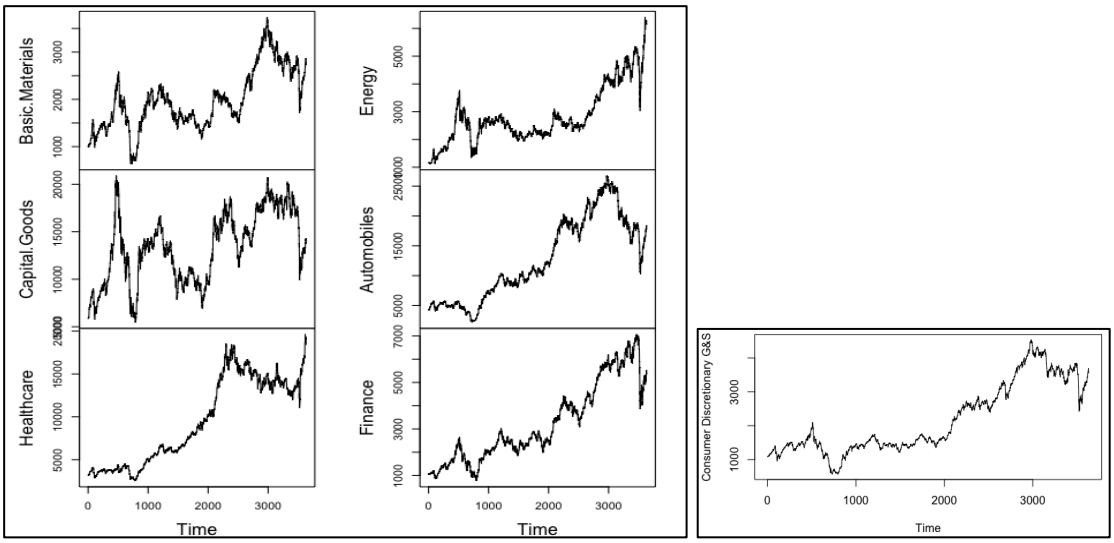


Source: bseindia.com

The above figures represent the movement of prices of sectoral indices such as S&P BSE Telecom, S&P BSE FMCG, S&P BSE IT, S&P BSE Bank, S&P BSE Metal, S&P BSE Teck, S&P BSE Power, S&P BSE Realty, S&P BSE Consumer durables, S&P BSE Industries, S&P BSE Utilities, and S&P BSE Oil & gas over the period of time. As it can be seen the fluctuations in telecom, industrials, utilities and oil & gas and metal sector

have been quite high. Whereas for other sectors there have been a continuous growth with fewer fluctuations. FMCG, IT, bank, Teck and consumer durables has seen a constant increase with less fluctuations. In case of realty and power, a hike in prices of the sector in the early 2000s is observed after which it returns back to its original value.

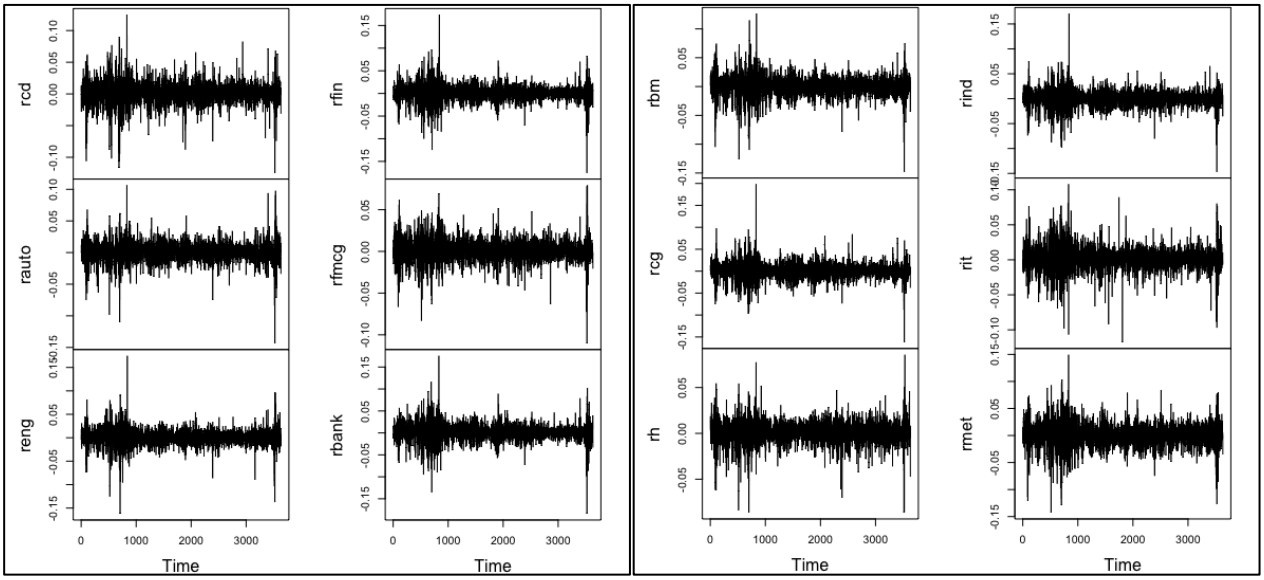
Figure 6.7: Sectoral indices (BSE) movements from 2006 to 2020 … (2)



Source: bseindia.com

The above graph represents the price of fluctuations of sectoral indices of S&P BSE Sensex that are S&P BSE basic materials, S&P BSE Energy, S&P BSE Capital goods, S&P BSE Automobiles, S&P BSE Healthcare, S&P BSE Consumer discretionary and S&P BSE Finance. The fluctuations in prices of basic materials and capital goods are quite higher. Whereas, the movement of prices of finance sector, automobiles and energy also follow similar patterns with continuous increase and lesser fluctuations; whereas, in case of healthcare and consumer discretionary the prices increased up to a point and then reduced following a wavy path.

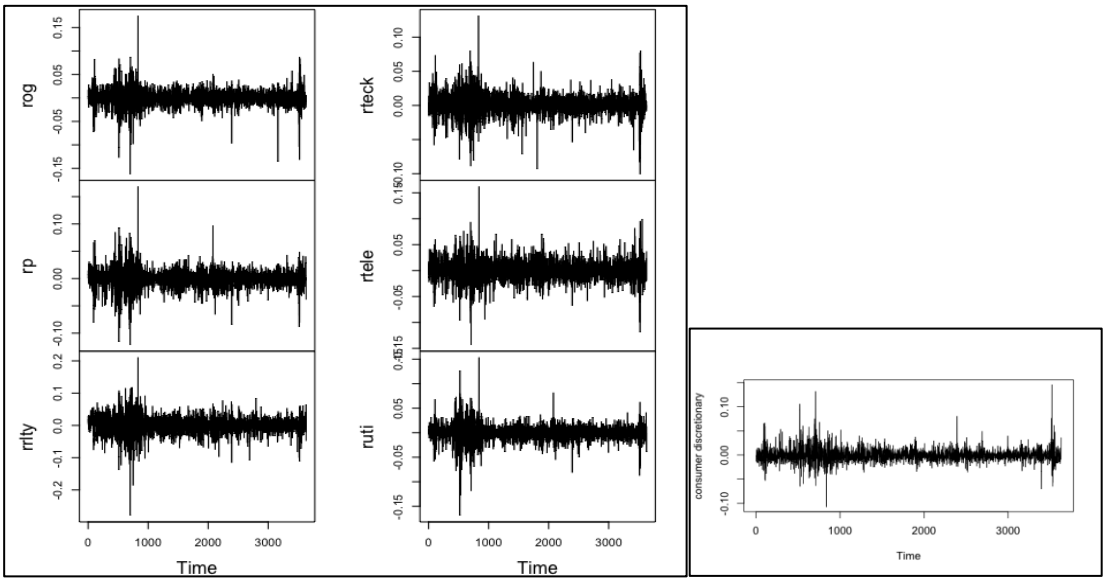
Figure 6.8: Sectoral indices (BSE) returns from 2006 to 2020 … (1)



Source: Authors estimation

The above graphs represent the daily returns of the sectoral indices of the Bombay stock exchange.

Figure 6.9: Sectoral indices (BSE) returns from 2006 to 2020 … (2)



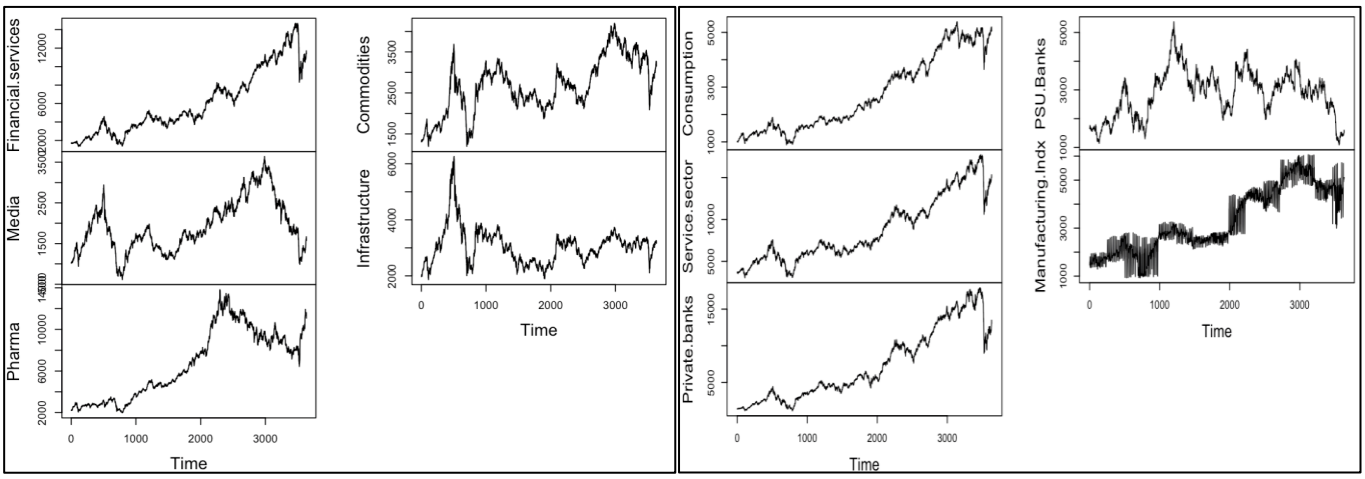
Source: Authors estimation

The above graphs represent the daily returns of the sectoral indices of the Bombay stock exchange.

6.3.3 Trend of prices & returns of sectoral & thematic indices of National stock exchange

The following figures represent the price movements of each sectoral and thematic indices of NSE.

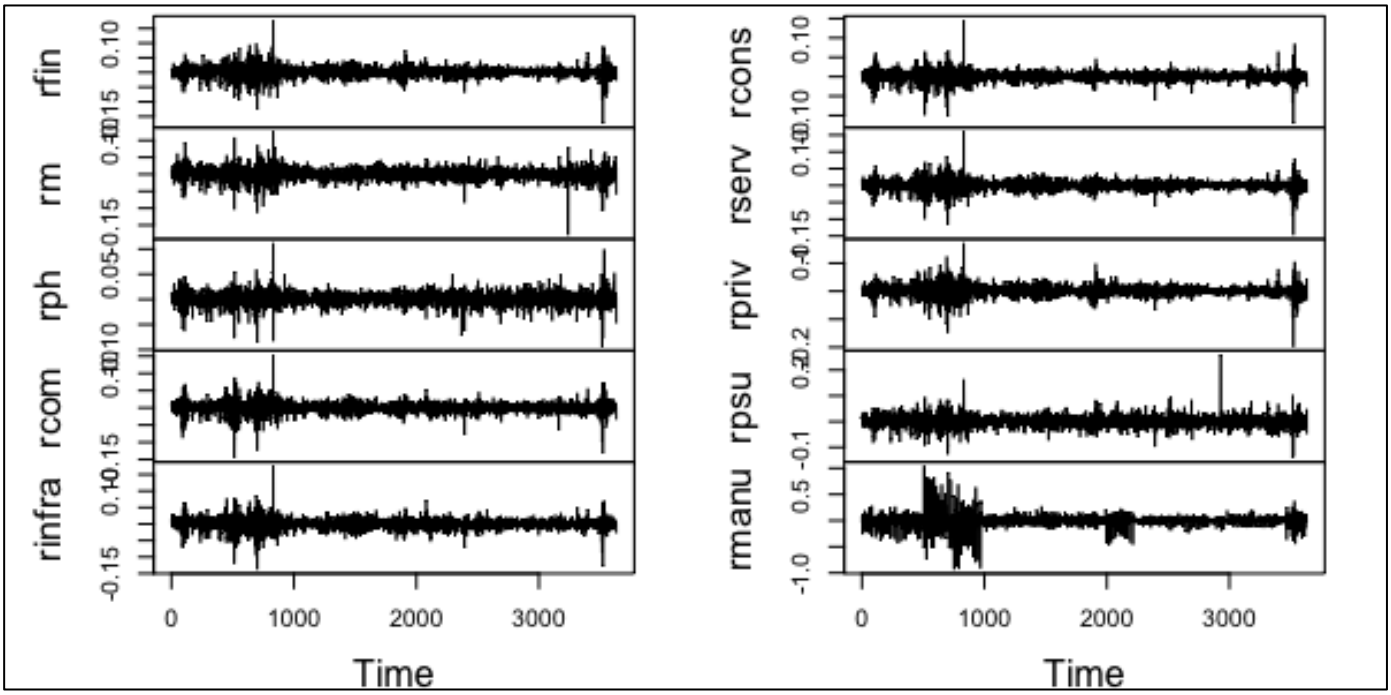
Figure 6.10: Sectoral and Thematic indices (NSE) movements from 2006 to 2020



Source: nseindia.com

The graph above represents the sectoral and thematic indices of national stock exchange that are financial services index, pharmaceuticals index, media index, commodities index, infrastructure index, India consumptions index, service sector index, private sector index, India manufacturing index and PSU banks index. Financial services sector, consumption, services sector, private banks, manufacturing sector seem to follow similar pattern of increase in prices over a period of time with minor fluctuations. Media, commodities, infrastructure and PSU banks follow a different path of rise in prices with higher fluctuations. The price of pharmaceuticals increases and then falls with small fluctuations.

Figure 6.11: Sectoral and Thematic indices (NSE) returns from 2006 to 2020



Source: Authors estimation

Figure represent the daily returns of the sectoral as well as thematic indices of the national stock exchange.

6.3.4 Descriptive analysis of sectoral/thematic indices of BSE and NSE

Table 6.2: Descriptive statistics of Sectoral Indices (BSE)

Descriptive Statistics	Number of observation	Minimum	Maximum	Mean	Median	Std deviation	Skewness	Kurtosis
Automobiles	3633	2155	26751	12689	10802	6847	0.3	-1.208
Bank	3633	3633	36962	16440	13276	8755	0.578	-0.801
Basic materials	3633	634	3739	1984	1906	628	0.477	-0.294
Capital goods	3633	5453	20906	13378	13515	3689	-0.115	-1.001
Consumer discretionary	3633	566	4537	2078	1590	1003	0.835	-0.538
Consumer durables	3633	1452	27706	9896	6690	6987	0.931	-0.43
Energy	3633	1119	6406	2838	2575	1014	0.959	0.483
Finance	3633	763	7076	3253	2618	1687	0.574	-0.867
FMCG	3633	1594	12772	6109	6132	3450	0.251	-1.34
Healthcare	3633	2519	19642	9469	8464	4947	0.155	-1.539
Industrials	3633	828	4071	2419	2369	698	0.008	-0.862
IT	3633	2011	18457	8252	6642	3995	0.506	-0.867
Metal	3633	4250	20298	11116	10612	3147	0.378	-0.412
Oil & Gas	3633	4309	16606	10209	9769	2803	0.268	-0.531
Power	3633	1291	4863	2210	2049	566	1.566	3.131
Realty	3633	1033	13647	2843	2031	2151	2.247	5.037
TECK	3633	1634	8888	4713	3930	1725	0.381	-1.024
Telecom	3633	839	2785	1342	1269	335	1.621	2.985
Utilities	3633	893	3456	1729	1707	374	0.518	0.644

Source – Author's estimation

The table displays descriptive statistics for daily closing prices of BSE Sensex sectoral indexes. The tables show the indices' minimum and highest values, as well as the mean, median, and standard deviation. The skewness scores for all of the indexes are positive, indicating a favourably skewed returns distribution. Kurtosis values, on the other hand, are negative in all sectors except energy, electricity, real estate, telecom, and utilities. This validates the presence of large tails in the stylised facts of returns distribution, which is one of the distribution features.

Table 6.3: Descriptive statistics of returns of Sectoral Indices (BSE)

Descriptive Statistics	Minimum	Maximum	Mean	Median	Std deviation	Skewness	Kurtosis
Automobiles	-0.1433	0.1063	0.0004	0.0008	0.0153	-0.405	6.75
Bank	-0.1831	0.1724	0.0005	0.0007	0.0191	-0.1975	7.6
Basic materials	-0.1477	0.1262	0.0003	0.001	0.0174	-0.5449	6.44
Capital goods	-0.1618	0.198	0.0002	0.0004	0.0182	0.0871	8.31
Consumer discretionary	-0.108	0.1319	-0.0003	-0.0011	0.01371	0.84190	8.25
Consumer durables	-0.1244	0.1248	0.0005	0.0011	0.0173	-0.4585	6.42
Energy	-0.1621	0.1747	0.0005	0.0005	0.0176	-0.3139	10.05
Finance	-0.175	0.1735	0.0005	0.0008	0.018	-0.2975	8.71
FMCG	-0.1101	0.0792	0.0005	0.0007	0.0128	-0.2665	5.66
Healthcare	-0.0865	0.0857	0.0005	0.0008	0.0121	-0.585	6.18
Industrials	-0.1465	0.1704	0.0002	0.0009	0.0167	-0.2964	7.67
IT	-0.1176	0.1078	0.0004	0.0003	0.0164	-0.1893	5.68
Metal	-0.1427	0.1493	0.0001	0.0006	0.0216	-0.3599	4.4
Oil & Gas	-0.1621	0.1748	0.0003	0.0005	0.0173	-0.4984	10.76
Power	-0.1213	0.1683	0	0.0008	0.0166	-0.1619	8.22
Realty	-0.2796	0.2106	0.0001	0.0011	0.0262	-0.4984	7.49
TECK	-0.1005	0.1312	0.0004	0.0007	0.0148	-0.1871	6.48
Telecom	-0.1432	0.1618	0.0001	0	0.0196	0.0153	4.57
Utilities	-0.169	0.1535	0.0001	0.0006	0.0163	-0.4797	11.26

Source – Author's estimation

The table shows the descriptive data for the daily returns distribution of the BSE Sensex indexes. The table shows the minimum and maximum values of the return's distribution. The mean value of all the sectors range from 0-0.05%; whereas, median range from 0.03% to 11%. All the sectors are negatively skewed reflecting more negative outliers than positive. In addition, the values of kurtosis of all the sectors are extremely high denoting the presence of heavy tails. This validates the presence of large tails in the stylised facts of returns distribution, which is one of the distribution features.

Table 6.4: Descriptive statistics of Sectoral & Thematic indices (NSE)

Descriptive Analysis	Number of observation	Minimum	Maximum	Mean	Median	Standard deviation	Skewness	Kurtosis
Commodities index	3633	1193	4200	2679	2675.7	656	-0.062	-0.555
Financial services index	3633	1345	14698	6055	4738.9	3423	0.708	-0.553
India Consumption index	3633	890	5391	2754	2334.55	1355	0.442	-1.27
India Manufacturing index	3633	926	6058	3311	2809	1321	0.24	-1.2
Infrastructure index	3633	1863	6261	3059	3068.65	640	1.465	4.429
Media index	3633	610	3643	1930	1800.05	641	0.478	-0.46
Pharmaceuticals index	3633	1969	13831	6669	6432.3	3299	0.208	-1.314
Private bank index	3633	1130	17914	7373	5507.76	4815	0.593	-0.939
PSU Bank index	3633	1087	5376	2872	2991.5	811	-0.037	-0.376
Service sector index	3633	3024	17722	8788	7242.9	3834	0.608	-0.784

Source – Author's estimation

The table shows descriptive analysis of closing prices of selected sectoral and thematic indices of national stock exchange. It includes the minimum and maximum values of the indices, mean, median as well as standard deviation. The skewness values of indices are all positive except for commodities and PSU banks. Kurtosis value are all below 3 and negative except for infrastructure which signifies presence of outliers in the data. This validates the presence of large tails in the stylised facts of returns distribution, which is one of the distribution features.

Table 6.5: Descriptive statistics of returns of Sectoral & Thematic indices (NSE)

Descriptive Analysis	Minimum	Maximum	Mean	Median	Std deviation	Skewness	Kurtosis
Commodities Index	-0.1455	0.1543	0.0002	0.0008	0.0162	-0.5127	9.18
Financial services index	-0.1736	0.1781	0.0005	0.0009	0.0185	-0.2124	8.13
India Consumption index	-0.1205	0.1457	0.0004	0.0008	0.0128	-0.3235	12.56
India Manufacturing index	-0.932	1.038	0.0003	0.0017	0.0978	-0.361	30
Infrastructure index	-0.1377	0.1753	0.0001	0.0006	0.0168	-0.2136	8.79
Media index	-0.1788	0.1256	0.0001	0.0005	0.0179	-0.5339	7.03
Pharmaceuticals index	-0.0935	0.1116	0.0004	0.0007	0.0131	-0.3112	6.33
Private banks index	-0.197	0.1712	0.0006	0.0008	0.0196	-0.3229	8.89
PSU Banks index	-0.1411	0.2595	0	0.0003	0.0224	0.3902	7.88
Service sector index	-0.1468	0.1599	0.0004	0.0007	0.0151	-0.331	10.54

Source – Author's estimation

The accompanying table shows the daily returns of NSE's sectoral and thematic indices. It displays the results' minimum and maximum values. The median values vary from 0.03-0.09 percent, whereas the mean values range from 0-0.06 percent. The skewness values of all indexes' returns are negative, with the exception of PSU banks, confirming the presence of negative returns. Similarly, all of the indices' kurtosis values are excessive, indicating the presence of heavy tails. This validates the presence of large tails in the stylised facts of returns distribution, which is one of the distribution features. Because skewness and kurtosis only determine the shape properties of the return distribution, more research is required to fully comprehend the characteristics of the distribution.

6.4 NORMALITY TEST OF BSE AND NSE

The Jarque bera test for normalcy is used to determine the dataset's normality. Given below is the result of the test of S&P BSE Sensex and Nifty50.

Table 6.6: Normality test of BSE

Index	Statistic	Index	Statistic
SENSEX	238*	Healthcare	372.8*
Automobiles	275.2*	Industrials	112.1*
Bank	299.2*	IT	86.1*
Basic materials	151.1*	Metal	297.2*
Capital goods	159.4*	Oil & Gas	690.7*
Consumer discretionary	362.9*	Power	246*
Consumer durables	553*	Realty	690.7*
Energy	592.4*	Teck	246.1*
FMCG	309.6*	Telecom	294.3*
Finance	313*	Utilities	225.6*

Source – Author's estimation

Asterisk (*) denotes significance at 5%

Table 6.7: Normality test of NSE

Index	Statistic
Nifty50	249.5*
Commodities Index	48.7*
Financial services index	350.1*
India consumption index	361.9*
India manufacturing index	252.8*
Infrastructure index	247.5*
Media index	170.1*
Pharmaceutical index	287.1*
Private bank index	346.4*
PSU index	22.1*
Services sector index	316.8*

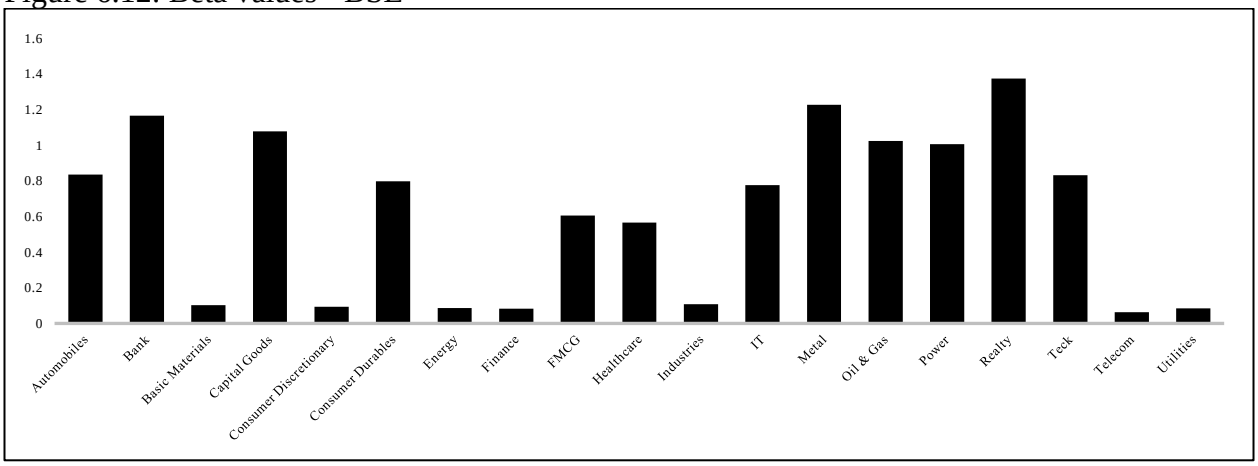
Source – Author's estimation

Asterisk (*) denotes significance at 5%

The test's null hypothesis is that the given series is normally distributed; the alternative hypothesis is that the distribution is non-normal. Looking at the table it is clear that the probability value of Sensex and Nifty50 is below the 0.05 thereby rejecting the null hypothesis and confirming the data being of a non-normal nature. As a result, the analysis is carried out using the student t distribution, which has a larger tail. Extreme values are more likely in this distribution than in a normal distribution, resulting in thicker tails. It can be used to simulate financial returns with increased kurtosis (as shown in descriptive analysis of the indexes) since it has fatter tails than a normal distribution, allowing for a more realistic calculation.

6.5 BETA ANALYSIS

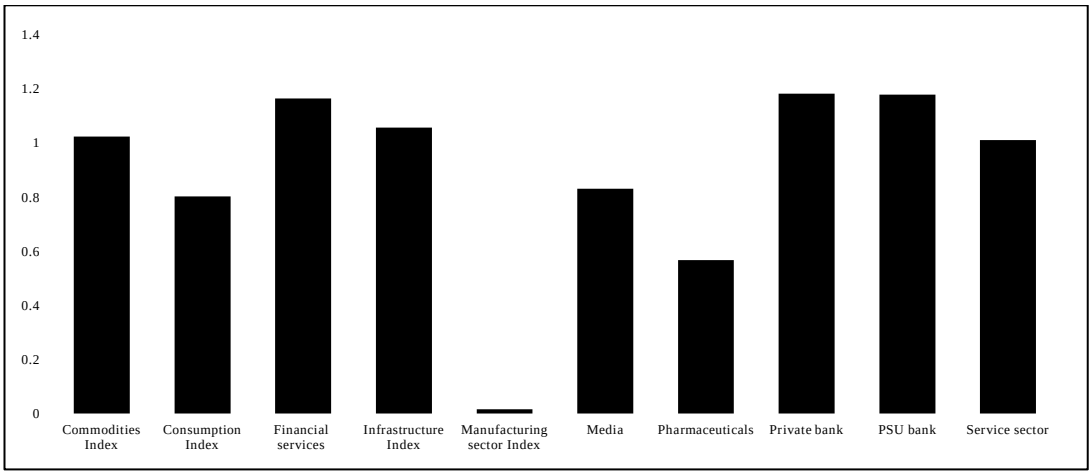
Figure 6.12: Beta values - BSE



Source – Author's estimation

According to the above figure, sectors that are Banks, Capital goods, Metal, Oil & Gas, Power and Realty are highly volatile with respect to the benchmark index S&P BSE Sensex. Other sectors are comparatively less volatile than the market index such as Energy, Finance, FMCG, Automobiles, Basic materials, Healthcare, Industrials, Information technology, Teck, Telecom and Utilities.

Figure 6.13: Beta values - NSE



Source – Author's estimation

As reflected in the figure above, the beta values of sectors such as financial services, commodities, services sector, private banks, PSU banks, and infrastructure are the most volatile sectors of the National stock exchange with respect to the benchmark index Nifty50. Other sectors such as metals, pharmaceuticals, manufacturing index and consumption are relatively less risky than the market index. The volatility of these sectors is at par with that of the benchmark index while the rest of the sectors are less volatile than the market index. The kurtosis of the prices of the indices have heavy tails according to the data with more negative outcomes than positive. Although the beta values are used to determine risk in short period of time, for longer duration there are other techniques to evaluate the risk associated with the markets.

6.6 CORRELATION ANALYSIS

Table 6.8: Correlation analysis between Sectoral indices – BSE Sensex

Sectors	S&P BSE Sensex
Automobiles	0.8812712
Bank	0.98792216
Basic materials	0.85166256
Capital goods	0.78614768
Consumer discretionary	0.94804603
Consumer durables	0.9627346
Energy	0.89287653
Finance	0.98680902
FMCG	0.9611502
Healthcare	0.8610344
Industries	0.80472479
IT	0.96336709
Metal	0.04998389
Oil & gas	0.86656299
Power	-0.2114486
Realty	-0.361459
Teck	0.96774167
Telecom	-0.240415
Utilities	0.2789374

Source – Author's estimation

The above table represents the correlation of various sectoral indices with the benchmark index S&P BSE Sensex. A strong positive correlation is found between automobile sector, basic materials, banks, capital goods sector, consumer durables, energy, finance, FMCG, healthcare, industries, IT, Oil and Gas and TECK sector with Sensex respectively, Metal utilities have a low positive correlation. While, power, realty and telecom have negative but weak correlation with Sensex.

Table 6.9: Correlation analysis between Sectoral & Thematic indices – NSE Nifty50

Sectors	Nifty50
Commodities index	0.799
Financial services index	0.989
Index Manufacturing index	0.928
India Consumption index	0.984
Infrastructure index	0.132
Media index	0.663
Pharmaceuticals index	0.796
Private bank index	0.989
PSU bank index	0.253
Service sector index	0.996

Source – Author's estimation

The table exhibits correlation between the selected sectoral and thematic indices with the broad index of NSE i.e., Nifty50. It can be noted that sectoral/thematic indices financial services, India manufacturing, India consumption index, service sector and private banks have a positive strong relationship with Nifty50. While the others have a positive but very low correlation with Nifty50 index.

Conclusion –

The chapter highlights the trend of prices and returns of all the indices (benchmark, sectoral and thematic) considered in the study along with the descriptive statistical analysis of each indices. The normality test conducted confirms that the data does not follow a normal distribution and points out various sectors that are highly correlated with the benchmark indices in case of Bombay stock exchange as well as National stock exchange. Beta analysis also lists out sectors that are highly volatile with respect to their benchmark indices. Finally, it is also important to know sectors that aren't highly correlated with the benchmark indices which will help portfolio managers to incorporate in portfolio diversification.