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Does FDI Colonize BSE Sensex in India? Evidence from Classical Regression Analysis at Aggregate and Sectoral Level

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Abstract
The catenas between Foreign Direct Investment (FDI) and Stock Market Indices have always been a point of considerable debate in time series econometrics. It elevates a pragmatic question, whether the FDI have an effect on stock market indices or whether it is a consequence of development in stock market. This paper empirically investigates the impact of FDI on the S&P BSE Indices as an aggregate and at sectoral level with the help classical regression model, which is used for predicting the upcoming stock indices. Before forecasting the stock price, Kolmogorov-Smirnov, Shapiro-Wilk normality test and Q – Q plot technique were conducted on the sample data to conclude that the data are normally distributed and feasible to forecast. In order to avoid the possibility of biased result emanating from a likely existence, the overall performance as well as forecast accuracy of the model was examined by Mean Absolute Percentage Error (MAPE). Based on the findings, some of the requirements for entry of FDI into market should be relaxed to ensure that more FDI should come with new skills and technologies and ultimately contribute to economic growth of the Indian Economy.

Keywords: Stock, Q – Q plot, Regression, R-Square, Forecast, Error and MAPE.

1. Introduction
Stock markets have an important role in the international economy and their effects on economic growth can be transmitted to the real sector through their specific channels. The stock market opens policies stimulate economic growth by allocating funds to the corporate sector. The level of development of the stock market is necessary for increased industrial production as it provide a unique opportunity to firms to gain capital quickly.
FDI played an important role in the source of economic development, modernisation, income growth and employment in developing countries, emerging economies as well as countries in transition. According to International Monetary Fund (IMF), Balance of Payments (BoP): a statistical statement that systematically summarises the economic transactions of an economy with the rest of the world for a specific time span and the International Investment Position (IIP): compiles the value of the stock of each financial asset and liability as defined in the standard components of the BoP for a specific date, share a same conceptual framework with FDI. So In ordinary parlance FDI, is an international investment that reflects the objective of obtaining a lasting interest (existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the investor on the management of the enterprise) by a resident entity in one economy in an enterprise resident in another economy.
It is an integral part of an open and effective international economic system and a major catalyst for development. National policies and the international investment architecture are matter for attracting FDI to a larger number of developing countries and for reaping the full benefits of FDI for development. So countries have liberalised their FDI regimes and pursued other policies to attract investment. They have addressed the issue of how best to pursue domestic policies to maximise the benefits of foreign presence in the domestic economy. The challenges primarily address host countries, which need to establish a transparent, broad and effective enabling policy environment for investment and to build the human and institutional capacities to implement them.

The overall benefits of FDI for developing country economies are well documented. Given the appropriate host-country policies and a basic level of development, a preponderance of studies shows that FDI triggers technology spillovers, assists human capital formation, contributes to international trade integration, helps to create a more competitive business environment and enhances enterprise development. All of these contribute to higher economic growth, which is the most important tool for alleviating poverty in developing countries. Moreover, beyond the strictly economic benefits, FDI may help improve environmental and social conditions in the host country by transferring cleaner technologies and leading to more socially responsible corporate policies.

2. FDI in India – At a Glance

With the radical liberalization in the FDI regime, there has been significant upsurge in the foreign direct investment in India and the relaxation of FDI norms under automatic route in many sectors in recent past, Indian stock market has been able to attract foreign investors considerably. With this, India has emerged as one of the most favoured destination for investment destination in the world. The Government has taken determined measures over the years to provide an enabling and investor friendly FDI policy. The FDI reforms have borne positive results, as is evident from the fact that total FDI inflows grew by 55%, i.e. from US$ 231.4 billion in 2008-14 to US$ 358.3 billion in 2014-20 [1]. As per the OECD, FDI restrictiveness index, India's overall FDI restriction levels have come down from 0.42 to 0.21 in the last 16 years. The country has made considerable progress in opening up different sectors of the economy and ranks ahead of other emerging markets in Asia such and even scores better than New Zealand and China. Given the relentless focus of the Government on FDI and other economic reforms - for instance, the major structural reforms kick started in agriculture in 2020 - should further improve India's score in FDI attractiveness (CII-EY Survey) [2].

Not surprisingly, the Corona Virus (COVID-19) pandemic has dramatically impacted FDI flows in many regions. FDI flows will remain low in 2021 as the global economy remains subject to strong pressures and uncertainties from the COVID-19 pandemic. Demand and supply shocks have triggered a global recession; global value chains (GVCs) have been severely disrupted and across the world, governments are considering new rules affecting foreign investors [3].

India's Covid-19 crisis has so far failed to spark a deep stock selloff like that seen last year and some asset managers point to less stringent curbs on activity as one factor at least for now. The surprisingly muted stock market reaction to India's virus disaster can also be seen in net outflows of foreign investors, which totalled about $1.5 billion in April versus $8.4 billion during the height of the rout last March.

3. Literature review

For last few years, the relationship between the FDI and the stock market wellbeing of a country in many forms like growth in domestic production, industrial growth, employment generation and foreign trade especially export promotion has really been a core interest for the academicians as well as economic analysts in India and abroad.

Singer (1950) [1], suggests that, international investment to host countries is an important factor for economic development and gets benefited by positive effects in terms of productivity gains, technology transfers, introduction of new processes, improved managerial skills, employee training, international production networks and access to markets.

It fascinates into their economic system and a better complementary domestic investment is generated and the requisite domestic resources are found (Encarnation and Wells 1985 and Boddewyn 1985) [2, 3]. Findlay (1978) [4], find that lagged FDI, competitive market, infrastructure and human capital are the significant factors of FDI and to utilize these determinants to improve the competitive atmosphere and attract FDI inflow (Li and Liu, 2005) [5]. Romer (2001)[6], pointed out that, technology transformation is an important input and its transformation through FDI has the effect of stimulating competing firms in the domestic market to carry out technological up gradation. Employees can also learn the technology while working for the firm and some of them may start their own ventures using the acquired technology (Chia, 1997) [7].

Reis (2001) [8], used an endogenous growth model to evaluate the growth effects of FDI when the investing firm's profits may be repatriated. In this model, FDI only adds a positive effect to growth if the world interest rate is lower than the home interest rate. The early empirical work of Solow (1957) [9], with technology, capital, labour, inward FDI and a vector of ancillary variables such as import and export volumes focused on effects of FDI flows on their impact on output and productivity, with particular attention being paid to the interactions of FDI flows with human capital and the level of technology (Blomström, *et al.* 1994) [10]. The hypotheses being examined, whether FDI impacts economic activity through its impact on human capital accumulation and what are the various interactions between investment flows, adoptions of new technologies and the impact of the technology gap between the source and host countries (Coe, *et al.* 1997) [11]. In recent work, Carkovic and Levine (2002) [12], argue that the positive results described above are due to a biased estimation methodology, when employing a different estimation technique (Arellano - Bond GMM) and found no robust relationship between FDI inflows and domestic growth.

Regarding sectoral analysis, Vu, *et al.* (2007) [13], estimate the impact of FDI in Vietnam and China, while Khaliq and Noy (2007) [14], Do the same for Indonesia. Alfaro and Charlton (2007) [15], investigate the aggregate effect of FDI on growth using industry-level data of OECD member countries during 1990–2001 for 19 sectors and 22 countries. Additionally, Durham (2004) [16], finds that only countries with strong institutional development and investor-friendly legal environment enjoy the positive effects of FDI on growth, while Hsiao and Shen (2003) [17], add that a high level of urbanization is also conducive to a positive effect of FDI on growth.

[1] Press Release by Ministry of Commerce & Industry, Govt. of India on Foreign Direct Investment Inflow on 20 October, 2020

[2] FDI in India - Now, Next and Beyond: Reforms and opportunities, CII-EY Survey, November 2020.

[3] Rewriting the Rulebook: Building a Post-pandemic Board, Financier Worldwide Magazine, September 2021 Issue.

In Indian scenario, there are a limited studies addressing the issue of inter linkages between stock indices movement and Foreign Direct Investment. Almost all the studies conclude that the FDI have a positive significant impact on equity returns of stock market. Banerjee (2013) and Nagpal, *et al.* (2016) [18, 19], examined the impact of FDI flow on Indian stock market using multiple regression analysis. Similarly significant effect of FDI on Indian stock market (Sensex and CNX Nifty) was studied by Kapoor and Sachan (2015) [20], using correlation and regression analysis, whereas, trend of Indian stock market was determined by FDI (Dhiman and Sharma, 2013) [21]. Simply correlation technique was used by Sameera (2014) [22], to examined the trend and pattern of FDI flow in India with the Bombay stock exchange index using secondary data of 15 years, but Chauhan (2013) [23], used regression (OLS model), Karl Pearson's correlation and analysis of variance techniques to understand the significant impact FDI on BSE Sensex and NSE Nifty movements. Tamilarasu (2015) [24], investigated the level of contribution of Foreign Direct Investment in the volatility various Indices of BSE and NSE using the correlation matrix analysis and simple regression.

According to Mohan (2014) [25], GDP, foreign exchange reserves and exchange rate are the main determinants of FDI inflows to India and have a significant factor influencing the economic growth in India. Sultana and Pardhasaradhi (2012) [26], found a positive high co-efficient of correlation between FDI approvals and actual inflows. Regarding sectoral analysis, Hooda (2013[1 & 2]), found that manufacturing sector in India is significantly negatively affected by tariffs, import-intensity, R&D intensity, where as it is positively impacted by market power. For making India an attractive investment destination, the level of development of local financial markets is crucial for these positive effects (Blomström and Kokko, 1997) [29]. Better local conditions not only attract foreign companies but also allow host economies to maximize the benefits of foreign investments. Thus, FDI contributes to economic growth only when the host country has reached a developmental level capable of absorbing the advanced technology that it brings.

The theoretical postulations highlighting the importance of the above-mentioned issues are highly controversial and conflicting and different empirical investigations also identify the ambiguous relationship between these macroeconomic variables. However, the association between these variables is largely country-specific.

4. Research Gap

It is observed from the above discussion that the findings relating to foreign direct investment and Stock Market Indices in sectoral and aggregate are heterogeneous. The heterogeneity in the results are basically due to the difference in economic and legal framework and time period considered in the studies. Therefore, the inferences drawn in the existing set of studies cannot be generalized for policy prescriptions. Thus, the nexus between FDI and stock market needs to be examined and understood with changing economic and legal scenarios with sectoral indices. Another notable observation from the review of literature is that most of the studies lack stringent and penetrating examination which might ensure greater stability and robustness in the statistical estimations. Addressing this issue, the present study employs a number of stringent econometric estimations like Kolmogorov – Smirnov and Shapiro-Wilk normality test, Q – Q plot technique, Goodness – of fit (F – Test), Coefficient of Determination, Durbin – Watson d – statistic and Mean Absolute Percentage Error (MAPE) to ensure the robust findings and reliable inferences. It is also sensible to assume that the previous literature cannot produce the recent picture on the FDI – Stock Market Indices nexus because the economic policies relating to both are rapidly altering with shifting political ideologies in the country and changing dynamics of the international business environment. The recent changes in FDI and Stock Market Indices need to be encountered while modelling the statistical association between these variables.

5. Objectives of the study

In the backdrop of the above discussion, the present study is carried out with the following objectives:

1. To study the trend and pattern of FDI flows in various sector as well as an aggregate in to Indian Stock Market (Bombay Stock Exchange) using descriptive statistics.
2. To study the impact of FDI flows into Indian Stock Market especially in Bombay Stock Exchange.
3. To examine the risk associated with stock price and influence of FDI in to S&P BSE Sensex and Various Sectoral Indices.
4. To provide recommendations to the concerned policymakers.

6. Data and its sources

Two types of secondary data (monthly and yearly) are used in this paper to find out the linkages between FDI and S&P BSE indices from the time span of April, 2010 to September, 2021 (138 observations) and from 2010-11 to 2020-21 (11 observations). Out of 138 observations, first 120 sample data from April, 2010 to March, 2020 and out of 11 observations, from 2010-11 to 2019-20 are used as sample data to find out that the data are normally distributed and feasible to forecast for future stock price and the data from April, 2020 to September, 2021 (18 Observations) and the data of 2020-21 will be used as validation for compare with the forecast data. The Details of the data used in this study is summarised below.

Table 1: Description of Data

Variables	Frequency	From	To	Source
S&P BSE Sensex	Monthly	(04), 2010	(09), 2021	www.bseindia.com
FDI Equity Inflows				DPITT, Govt. in India
Sector Attracting FDI	Yearly	2010-11	2020-21	
S&P BSE Sectoral Index				www.bseindia.com

In this study, S&P BSE Indices are designed to measure the performance of the largest, most liquid and financially sound companies across key sectors of the Indian economy that are listed at BSE Ltd. Closed stock price is choosen for this study because it reflects all the activities of the index in an entire trading day and collected from the

official website of Bombay Stock Exchange. On the other hand, FDI Equity Inflows to India as an aggregate and Sector Attracting FDI are collected from the Department for Promotion of Industry and Internal Trade under the Ministry of Commerce and Industry, Govt. in India. For better economic planning and decision making, investment enterprises are grouped by type of economic / industrial activity or classification based on the contribution of an activity to the value-added of the enterprise. A concordance table between DIPP - 92 4-digit sectors and the NIC- 2008 classification at 3 - digit was constructed to establish the relationship between FDI Equity Inflows and respective S&P BSE Sectoral index (Table – 2).

Table 2: Concordance between 4-digit DIPP Classification & NIC 3-digit (2008) and Construction of S&P BSE Sectoral index

Sector Name	Industry Name	Ind. Group Name	Ind. Subgroup Name	Definition	4 digit DIPP Code	3 digit NIC 2008	Corresponding Index
Metallurgical Industries	Metals & Mining	Ferrous Metals	Iron and Intermediary Products	Manufacturers of iron, steel, Ferro and silica manganese.	0101 0300	241 251	S&P BSE Metal
	Metals & Mining	Non-ferrous Metals	Aluminium	Producers of aluminium and aluminium products.	0102	242 243	
			Copper	Producers of copper and copper products.			
			Zinc	Producers of zinc.			
			Others	Producers of gold, precious metals and other minerals, manganese alloys etc.	0103 0199 4204 4205	242 252 259 321	
		Mining	Mining	Companies engaged in extraction of metals and minerals excluding coal, coke and lignite.	0104	071 072 081 089	
Chemicals & Petro–Chem.	Chemicals & Petrochem.	Chemicals	Commodity Chemicals	Manufacturers of basic and industrial chemicals.	1901	201	S&P BSE Basic Material
			Specialty Chemicals	Manufacturers of chemicals used in the manufacture of a variety of products.	1902 2000 2100 4299	202 203	
			Industrial Gases	Manufacturers of industrial gases.	1903	201	
		Agro-Chemicals	Agro-Chem.	Manufacturers of pesticides and herbicides.	2200	210	
		Petrochem.	Carbon Black	Manufacturers of carbon black.	0202	192	
			Petrochem.	Manufacturers of chemicals derived from fossil fuels.			
			Fibers & Plastics	Manufacturers of nylon, polyester, acrylic fibres and plastics etc.	4299 3000	141 222	
Energy	Oil & Gas	Oil & Gas Producers	Exploration & Production	Companies engaged in the exploration, drilling and production of oil and gas.	0104	061 062	S&P BSE Oil & Gas
			Refineries/ Petroleum Products	Companies engaged in refining & manufacturing of petroleum products.	0202	191 192	
			Integrated Oil & Gas	Integrated oil companies engaged in the exploration, production, drilling, refining and distribution of oil and gas products.	1200 0104	711 091	
		Oil Equipment, Services & Dist.	Oil Equipment & Services	Manufacturers of equipment for and providers of services to the oil and gas industry.	0104	099	
			Oil Marketing & Distribution	Companies engaged in the marketing and/or transportation of oil and gas products. etc.	0799 0299	493 352	
	Coal	Coal	Coal	Companies engaged in exploration or mining of coal, coke and lignite.	0104 0202	051 052 191	S&P BSE Energy
	Electrical Equipment	Electrical Equipment	Heavy Electrical Equipment	Manufacturers of power generating equipment and other heavy electrical equipment for large electrical systems.	0300 0501	251 271 274	S&P BSE Power
			Other Electrical Equipment.	Manufactures of electric cables and wires and other electrical components.	0501	273	
	Utilities	Utilities	Electric Utilities	Companies engaged in generation, transmission, distribution or trading of electricity	0201	351	

			Other Utilities	Companies engaged in gas and other utilities, owners and operators	0299	352	
Information Technology	Software & Services	Internet Software & Services	Internet Software & Services	Companies developing or marketing internet software or providing internet services	3999	631 639	S&P BSE IT
		IT Software & Services	IT Consulting & Application Software	Companies providing IT consultancy and developing computer application software	0502 0599 3801	620	
			IT Training Services	Companies providing IT training/education	3802	620	
			BPO / KPO	Companies providing BPO/ KPO services	3899	822	
			Software Products	Companies engaged in developing systems software including DBMS software products	3999	631 639	
	Hardware Technology & Equipment	Comm. Equipment	Networking Equipment	Manufacturers of computer networking equipment and products including LANs, WANs and routers	0503	262	
		Computers & Peripherals	Computer Hardware	Manufacturers of personal computers, servers, workstations, ATMs etc.	0503 0504	262 267 281	
			Storage Media & Peripherals	Manufacturers of storage Media and peripherals	0503	268	
		Electronic Instrument	Electronic Components, Equipment & Instruments	Manufacturers of electronic equipment, instruments and components.		261	
Telecom	Telecom Services	Telecom Services	Alternate Carriers	Providers of communications and high-density data transmission services.	0601 0602 0603	611 612 613	S&P BSE Telecom
			Telecommunication Services	Operators of fixed-line telecom network and companies providing both wireless and fixed-line telecom services etc.			
			Other Telecom Services	Providers of networking services through optical fibre and any other services not covered above.	0699	619	
	Telecom Equipment	Telecom Equipment	Telecom Equipment	Manufacturers of telecom equipment including phone instruments, mobile handsets/ EPABX etc.	0503	263	
			Telecom Cables	Manufacturers of telecom cables, optical fibbers etc.		267 268	
Health Care	Pharma & Biotech	Pharma & Biotech	Pharma	Manufacturers of pharmaceuticals, research & development.	2200 4206 3907 4299	210 712 741 749 581	S&P BSE Health Care
			Biotech	Companies engaged in the development, manufacturing or marketing of products based on biotechnology.	3907	721	
	Healthcare Services	Healthcare Services	Healthcare Facilities	Owners and operators of hospitals, nursing homes, rehabilitation centres, retirement centres etc.	4300 3905	750 861 862 869	
			Healthcare Services	Manufacturers of healthcare products and providers of health care services.	1500 1600	325	
	Healthcare Equipment & Supplies	Healthcare Equipment & Supplies	Medical Equipment	Manufacturers of diagnostic, therapeutics, life support and medical monitoring machinery.	0503	266	
			Healthcare Supplies	Manufacturers of health care supplies and medical products not covered above.	2200 1400 4299	210 325 329	
Automobile Industries	Automobiles	Passenger Automobile	Cars & Utility Vehicles	Manufacturers of passenger automobiles and utility vehicles.	0701 0703	291 292	S&P BSE Auto
			2/3 Wheelers	Manufacturers of motorcycles, scooters, three-wheelers and bicycles.	0799	309	
	Auto	Auto Parts &	Auto Parts &	Manufacturers of accessories for	0701	293	

	Components	Component	Equipment	automobiles and 2/3 wheelers.	0704		
			Tyres & Rubber Products	Manufacturers of tyres and rubber products.	3000	221	
Construction	Real Estate Investment	Real Estate	Real Estate Investment	Companies engaged in real estate ownership, investment trusts etc.	4211	681 682	S&P BSE Realty
		Realty	Realty	Companies engaged in development and construction of residential/ commercial properties.	3999 4206 3804	332 390 410 431 432 433 439	
		Const. & Enginering	Construction & Engineering	Companies engaged in construction of industrial properties.	3804 3907 4206	421 422 429	
		Transport Infrast.	Airport Services	Owners and operators of airports and companies providing airport related services.	4300	522	
Construction	Real Estate Investment	Transport Infrast.	Roads & Highways	Owners and operators of roads, bridges, highways, toll bridges etc.	4300	522	S&P BSE Realty
			Marine Port & Services	Owners and operators of marine ports and related services like marine engineering services.			
	Capital Goods	Machinery	Construction, Agricultural & Commercial Vehicles	Manufacturers of ships, trucks, buses, rolling machinery, earth-moving and construction equipment, bulldozers, farm machinery such as tractors etc.	1000 1100 4299 0799	282 301 309	S&P BSE Capital Goods
			Industrial Machinery	Manufacturers of industrial machinery and components.	0300 0400	251 281	
			Other Industrial Goods	Manufacturers of consumables like fasteners, refractory, welding equipment, electrodes, bearings etc.	0800 0900 3999	282 331 332	
		Aerospace & Defence	Aerospace	Manufacturers of civil and military aerospace and equipment and parts.	4299	303 304	
			Defence	Manufacturers of Defence equipment, electronics and parts.	3700 4299	281 252	
Service	Banks	Banks	Banks	Commercial Banks.	3903	641	S&P BSE Bankex
	Other Financial Services	Other Financial Services	NBFCs	RBI-licensed NBFCs providing consumer finance.	3901		S&P BSE Finance
			Financial Institutions	Financial Institutions as defined under Section 4(1) of the Companies Act, 1956.			
			Housing Finance Companies	Companies engaged in providing finance for housing.			
			Investment Companies	Companies primarily engaged in investments activity.			
			Holding Companies	Holding companies with significant shareholding in other group companies.		642 649	
			Asset Management	Mutual Funds.		643	
			Other Financial Services	Companies providing credit rating, merchant banking etc.	3999	661 662 663	
			Mutual Fund Scheme	Exchange Traded Funds (ETFs).	3901	643	
	Insurance	Insurance	Life Insurance	Companies primarily providing life insurance.	3904	651	
			General Insurance	Companies providing insurance other than life insurance.	3902	652 653	
	Consumer Durables	Consumer Durables	Consumer Electronics	Manufacturers of consumer electronics products.	0503	264	S&P BSE CDGS
			Furniture, Furnishing etc	Manufacturers of furniture, home furnishings etc.	1300 3804	310 433	
			Household Appliances	Manufacturers of electric household appliances, etc.	0501	279	
			House ware	Manufacturers of other household durable products.	0501	275	
		Leisure	Photographic Products	Manufacturers of photographic	0503	263	

		Equipment & Products		equipment and related products.	3907	267 742	
			Gift Articles, Toys & Greeting Cards	Manufacturers of gift articles, toys, greeting cards etc.	2400 3000 4299	170 222 324	
Service	Consumer Durables	Leisure Equipment & Products	Other Leisure Products	Manufacturers of leisure products and equipment.	4299	322 323	S&P BSE CDGS

Source: Project on FDI in India and its Growth Linkages, August, 2009, National Council of Applied Economic Research, Sponsored by- Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Govt. of India.

The study actually focuses on the conservative period (FDI fell short of its potential level partly on account of amplification of policy uncertainty as measured through Kauffmann's Index and remained sluggish, when global FDI flows to EMEs had recovered despite the sound domestic economic performance ahead of global recovery (RBI Report*). For testing the informal efficiency, our analysis mainly involves to establish the nexus relationship between FDI and S&P BSE indices in the context of India. Therefore, it is sensible to assume that taking them in the constant or current prices would not make any significant difference in the statistical estimation. We examine whether future stock return can be predicted using several statistical methodologies proposed in the literature.

7. Research Methodology

The study first determines the descriptive statistics to know the basic characteristics of the variables used in the analysis. The Kolmogorov-Smirnov (K-S) statistic is used to measure how well the distribution of a random sample $(X_1, X_2, \ldots\ldots\ldots X_n)$ agrees with a theoretical distribution (Kolmogorov, 1933 and Smirnov, 1939) and defined as

$$V_n = \sup_x |F_n(x) - F(x)|$$

Under the null hypothesis that the sample $(X_1, X_2, \ldots\ldots\ldots X_n)$ comes from F(x) or the data are normally distributed (Massey, 1951).

Similarly, the Shapiro – Wilk test statistics (Shapiro and Wilk, 1965) [33],

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Where, $x_{(i)}$ is the ith order statistic, i.e., the ith - smallest number in the sample and $\bar{x}$ is the sample mean.

Like most statistical significance tests, if the sample size is sufficiently large the test may detect even trivial departures from the null hypothesis (i.e., although there may be some statistically significant effect, it may be too small to be of any practical significance); thus, additional investigation of the effect size is typically advisable, e.g., a Q - Q plot in this case (Wilk and Gnanadesikan, 1968 and Makkonen, 2008) [34, 35].

After testing the normality, let the identified model which hypothesize that S&P BSE Indices as a function of FDI as an aggregate and at Sectoral Level. Symbolically,

$$(S\&P\ BSE\ Indices) = f(FDI)$$

Statistically,

$$(S\&P\ BSE\ Indices)_{i,t} = \beta_0 + \beta_1 (FDI)_{i,t} + \varepsilon_{i,t}$$

Which explains the response variable as a function of the repressor variables, adding a random error term to account for individual differences, as in

$$y_i = f(x_{1i}, x_{2i}, \ldots\ldots\ldots x_{ki}) + \varepsilon_i, i = 1, 2, \ldots\ldots\ldots n$$

Where, n is the number of observations. The family of candidate functions will be restricted to linear functions of the type

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots\ldots\ldots + \beta_k x_{ki} + \varepsilon_i$$

With the usual notation, the data are organized into an n×1 response vector, y, and an n× p repressor matrix, X.

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By defining β as the p×1 parameter vector, and ε as the n×1 random error vector, the linear model becomes (Darnell, 1994) [36].

$$y = X\beta + \varepsilon$$

A pre-test estimator of β is obtained by first selecting one of these models by using t or F-test and then estimating β in the selected model.

For forecast, let A_t and F_t denotes the actual and forecast value at specified time't' respectively. Then MAPE is defined as (Tofallis 2015 and Kim *et al.* 2016) [38, 39].

$$MAPE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{A_t - F_t}{A_t}\right|$$

Where, N is the number of data points. This measure is generally only used when quantity of interest is strictly positive. The scale of judgement using MAPE equation given by Lawrence, *et al.* (2009) [40] is shown in Table – 3.

Table 3: Scale of Judgement of Forecast Accuracy

SL No	Mape	Judgement of Forecast Accuracy
1	<10%	Highly Accurate Forecast
2	11 %-20%	Good Forecast
3	21%-50%	Reasonable Forecast
4	>51%	Inaccurate Forecast

8. Output & Discussion

Two types of secondary data are used in this paper to find out the linkages between FDI and S&P BSE indices with the help of SPSS and E Views Software as mentioned earlier, i.e.

1. Monthly FDI Equity Inflows VS S&P BSE Closed Sensex.
2. Yearly Sector Attracting FDI VS S&P BSE Sectoral Index

8.1 Test of Normality

For linear regression analysis, it is very much important to check the outliers, since it is sensitive to outlier effects and requires all variables to be normal. Here we see that the Kolmogorov Smirnov statistic takes value 0.144 for S&P BSE Sensex and 0.126 for FDI equity Inflows with degrees of freedom which equals the number of data points, namely 120. Since, $p<0.05$, we therefore have significant evidence to reject the null hypothesis that the variable follows a normal distribution. On the other hand, the Shapiro–Wilk test statistic $p < 0.05$, and hence we have significant evidence to reject the null hypothesis and conclude that the data are not normally distributed. The Lilliefors correction has been employed in the explore procedure (EXAMINE command) to correct the significance value for use of the sample mean and SD in place of a hypothesized population mean and SD (Lilliefors 1967) [41].

Significance will be strongly affected by the number of observations and some parametric statistics are robust to non-normality when sample sizes are very large employing the Central Limit Theorem. So the implications of non-normality are primarily of interest is designs with smaller sample sizes (Kotz *et al.* 2006) [42]. To complete our practical on checking for normality, Quantile-Quantile (or Q - Q) plots are used here to compare the distribution of a variable with a chosen distribution (typically a normal distribution as we are doing here).

On the other hand, the Kolmogorov Smirnov and Shapiro - Wilk test statistic for yearly Sector Attracting FDI and S&P BSE Sectoral Index follows a normal distribution, since $p > 0.05$, except S&P BSE Power. But the Q - Q plots showing a typically a normal distribution when compare with the chosen distribution.

Table 4: Kolmogorov-Smirnov & Shapiro-Wilk normality test

Tests of Normality						
Parameters	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	DF	Sig.	Statistic	DF	Sig.
Sensex	0.144	120	0.000	0.924	120	0.000
FDI	0.126	120	0.000	0.927	120	0.000
Yearly sector attracting FDI						
SOFT'RE & HARD'RE	0.198	10	0.200*	0.877	10	0.121
PHARMA	0.184	10	0.200*	0.927	10	0.417
TELECOM	0.243	10	0.098	0.874	10	0.112
METALL. INDU.	0.180	10	0.200*	0.902	10	0.231
AUTOMOBILE	0.177	10	0.200*	0.943	10	0.584
CHEMICALS	0.159	10	0.200*	0.967	10	0.860
CONSTRUCTION	0.204	10	0.200*	0.878	10	0.124
POWER	0.156	10	0.200*	0.973	10	0.921
SERVICE	0.206	10	0.200*	0.922	10	0.373
Yearly sector attracting FDI						
IT	0.149	10	0.200*	0.941	10	0.562
Health Care	0.251	10	0.074	0.885	10	0.149
Telecom	0.234	10	0.130	0.924	10	0.393
Metal	0.237	10	0.119	0.885	10	0.150
Auto	0.230	10	0.142	0.935	10	0.497
Basic Material	0.159	10	0.200*	0.941	10	0.559
Realty	0.205	10	0.200*	0.893	10	0.181
Capital Goods	0.134	10	0.200*	0.955	10	0.729
Oil & Gas	0.179	10	0.200*	0.934	10	0.488
Energy	0.234	10	0.127	0.874	10	0.111
Power	0.290	10	0.017	0.786	10	0.010
Finance	0.198	10	0.200*	0.928	10	0.430
Bankex	0.167	10	0.200*	0.942	10	0.571
CDGS	0.200	10	0.200*	0.934	10	0.486

*. This is a lower bound of the true significance

A. Lilliefors Significance Correction

8.2 Descriptive Statistics

Various descriptive statistics of the variables under study are calculated in order to describe the basic characteristics of data. Table – 5 presents the descriptive statistics (Sample Mean, S.E of Mean, Median, Mode, S.D, Variance, Skewness, Kurtosis, Minimum, Maximum, Jarque – Bera, Probability for goodness-of-fit and Percentiles) of two types of data as mentioned earlier, i.e., Monthly FDI Equity Inflows VS S&P BSE Closed Sensex and Yearly Sector Attracting FDI VS S&P BSE Sectoral Index.

During the study period, the result quantified that S & P BSE Sensex has the mean of Rs. 26273.44 with S.D of Rs. 7473.30 and the range was Rs. 25798.82 with Rs. 41253.74 as maximum and Rs. 215454.92 as minimum values. Similarly, FDI equity inflows has mean of Rs. 18176.09 and S.D of Rs. 10193.39. Regarding sectoral analysis, the mean of S&P BSE Sectoral Indices were varies from Rs. 5295.10 to Rs. 37289.40 with S.D. from Rs. 2114.65 to Rs. 19683.22, whereas, S&P BSE Sectoral Indices have mean from Rs. 1250.04 to Rs. 20732.06 with S.D. from Rs. 207.48 to Rs. 8845.99.

Skewness, which is helps to creating better linear models of the variables are within the permissible limit (-0.50 to 1.00, except Pharma & Construction Sector and S&P BSE Power Index. It indicates that data are moderately skewed. Kurtosis or convexity of the curve is the peakedness of the distribution and should be lies between -3 to +3 except S&P BSE Power Index.

For goodness-of-fit test, large the Jarque - Bera value (whether sample data have the Skewness and kurtosis matching a normal distribution) indicates that the null hypothesis has been rejected at the 5% significance level and the errors are not normally distributed (Jarque and Bera, 1980) [43].

Table 5: Descriptive Statistics

Particulars	N / Valid	Mean	S.E of Mean	S.D	Variance	Skew.	Kurt.	Min.	Max.	J-B	Prob.
Sensex	120/0	26273.44	682.22	7473.30	55850210.82	).372	1.09	15454.92	41253.74	8.71	0.01
FDI		18289.66	933.54	10226.42	104579617.24	).828	0.28	4725.00	51198.00	3.61	0.00
Yearly Sector Attracting FDI											
S' & H' Ware	10/0	23324.20	6224.38	19683.22	387429243.51	0.34	1.68	2656.00	54250.00	1.07	0.59
PHARMA		6051.20	1221.73	3863.44	14926162.18	1.04	1.99	961.00	14605.00	1.43	0.49
TELE COM		17866.40	4299.53	13596.32	184859928.27	0.69	1.09	1654.00	39748.00	1.12	0.57
META. Ind.		6653.32	1315.95	4161.39	17317154.69	0.74	0.01	2196.00	14970.00	0.77	0.68
AUT'BILE		12316.60	1709.14	5404.78	29211698.93	-0.08	1.49	4347.00	19753.00	0.81	0.67
CHEMIC.		8868.90	1520.93	4809.60	23132222.10	0.57	0.67	1596.00	18422.00	0.40	0.82
CONST.		5295.10	1388.81	4391.80	19287918.10	1.24	2.07	703.00	15236.00	2.00	0.37
SERVICE		37289.40	5798.39	18336.12	336213133.16	0.13	1.57	13294.00	63909.00	0.88	0.65
POWER		6291.12	668.71	2114.65	4471762.63	0.42	0.71	2923.00	10473.00	0.22	0.90
S&P BSE Sectoral Indices											
IT	10/0	10000.71	1040.50	3290.36	10826483.87	0.18	0.69	5684.08	15475.81	0.40	0.82
He'th Care		11918.10	1232.24	3896.70	15184242.90	-0.51	1.40	5870.52	16905.20	1.06	0.59
Telecom(D)		1250.04	65.61	207.48	43046.21	0.86	0.43	988.38	1675.03	1.12	0.57
Metal		11339.10	923.31	2919.77	8525038.87	1.21	1.56	7397.96	17595.86	1.78	0.41
Auto		16554.14	1835.81	5805.35	33702135.27	0.11	0.69	8143.65	26751.20	0.38	0.83
Basic Mat'al		2208.68	214.07	676.93	458240.22	0.80	0.12	1374.21	3552.56	0.86	0.65
Realty		1862.60	180.33	570.25	325182.61	0.68	1.00	1263.94	2856.22	1.06	0.59
Capl Gods		14274.89	1157.96	3661.79	13408672.19	-0.32	0.80	8067.63	19133.76	0.53	0.77
Oil & Gas		11186.27	923.93	2921.74	8536537.06	0.60	0.90	7529.27	16283.26	0.89	0.64
Energy		3093.68	336.81	1065.09	1134410.26	0.98	0.20	1920.70	5160.39	1.31	0.52
Power(D)		2082.11	115.60	365.56	133637.43	1.95	4.36	1700.75	2988.56	6.03	0.05
Finance		4060.90	534.69	1690.84	2858955.00	0.54	0.86	1864.69	6996.14	0.79	0.67
Bankex		20732.06	2797.35	8845.99	78251540.30	0.56	0.64	9153.39	36671.50	0.72	0.07
CDGS		2642.98	347.03	1097.40	1204293.76	0.35	1.12	1229.50	4487.93	0.72	0.7
IT		10000.71	1040.50	3290.36	10826483.87	0.18	0.69	5684.08	15475.81	0.40	0.82
Heath Care		11918.10	1232.24	3896.70	15184242.90	-0.51	1.40	5870.52	16905.20	1.06	0.59
Telecom(D)		1250.04	65.61	207.48	43046.21	0.86	0.43	988.38	1675.03	1.12	0.57
Metal		11339.10	923.31	2919.77	8525038.87	1.21	1.56	7397.96	17595.86	1.78	0.41
Auto		16554.14	1835.81	5805.35	33702135.27	0.11	0.69	8143.65	26751.20	0.38	0.83
Basic Mat'al		2208.68	214.07	676.93	458240.22	0.80	0.12	1374.21	3552.56	0.86	0.65

So the descriptive statistics shows that the values are moderately normally distributed about its mean and variance or in other word we can says there is randomness in data and therefore, not sensitive to periodic change and speculation.

8.3 Goodness of Fit

Levin and David (2005), states that in regression analysis, F-test explains the level of influence of independent variable on dependent variable. If the value of significance is higher the significance F then it indicates that Independent variable has influence on dependent variable and vice versa.

Table 6: ANOVA and Regression Equation

	Variable (Inde/Deep.)		Unstand. Coeff. (β)		F – Stat.
	(Sector)	(Index)	Sector	Constant	
Models	FDI Equity Inflows	S&P BSE SENSEX	0.478	17532.554	88.179
	Hard & Software	S&P BSE IT	0.155	6382.501	49.617
	Pharma	S&P BSE Health Care	-0.269	13546.377	0.613
	Telecom	S&P BSE Telecom(M)	0.004	1183.114	0.513
	Metal. Industries	S&P BSE Metal	0.031	11129.747	0.016
	Automobile	S&P BSE Auto	0.782	6923.771	9.018
	Chemicals	S&P BSE Basic Mat.	0.002	2186.959	0.002
	Construction	S&P BSE Realty	0.004	1839.960	0.009
		S&P BSE C' Goods	-0.579	17342.226	7.465
	Power	S&P BSE Oil & Gas	0.669	6974.720	2.454
		S&P BSE Energy	0.129	2283.385	0.560
		S&P BSE Power	0.018	1968.696	0.088
	Service	S&P BSE Finance	0.073	1356.558	12.972
		S&P BSE Bankex	0.377	6665.702	12.586
		S&P BSE CDGS	0.470	883.496	13.139

The output from Table – 6 except S&P BSE Metal, S&P BSE Basic Material and S&P BSE Realty high level of F value and very low level of significance value are generated in all the regression equations. In line with the thumb rule, very high F-value and lowest significance value at 5 percent level signals the goodness of fit of the models.

The estimated regression coefficients indicate the direction of relationship between independent and dependent variables. These coefficients also tell us to what degree each predictor affects the outcome when the effects of all other predictors are held constant.

8.4 Coefficient of Determination

The combined influence of independent variables on the S & P BSE value appears to be very strong. Field (2013) [45], states that R^2 represent the percentage of variance in the outcome that are explained by the independent variables or predictors. From Table – 7, except, S&P BSE Metal, S&P BSE Basic Material and S&P BSE Realty independent variables account for 10.40% to 92.80% variation in dependent variables.

Table 7: Model Summary

	Variable (Inde. / Depe.)		R	R^2	Adj. - R^2	S.E. of Est.	Change Statistics		
	(Sector)	(Index)					R^2	F	* Sig. F
Models	FDI	SENSEX	0.654[a]	0.428	0.423	5677.580	0.428	88.179	0.000b
	H & Soft.	IT	0.928[a1]	0.861	0.744	1300.442	0.861	49.617	0.000
	Pharma	Heath Care	0.267[a2]	0.071	-0.045	3983.269	0.071	0.613	0.456
	Telecom	Telecom(D)	0.245[a3]	0.060	-0.057	213.328	0.060	0.513	0.494
	Meta. Ind.	Metal	0.045[a4]	0.002	-0.123	3093.765	0.002	0.016	0.902
	Automo.	Auto	0.728[a5]	0.530	0.471	4221.772	0.530	9.018	0.017
	Chemicals	Basic Metal	0.017[a6]	0.000	-0.125	717.889	0.000	0.002	0.962
Models	Const.	Realty	0.033[a7]	0.001	-0.124	604.511	0.001	0.009	0.928
		Capl God's	0.695[a8]	0.483	0.418	2793.420	0.483	7.465	0.026
	Power	Oil & Gas	0.485[a9]	0.235	0.139	2710.914	0.235	2.454	0.156
		Energy	0.256[a10]	0.065	-0.051	1092.133	0.065	0.560	0.476
		Power(D)	0.104[a11]	0.011	-0.113	385.626	0.011	0.088	0.774
	Service	Finance	0.786[a12]	0.619	0.571	1107.669	0.619	12.972	0.007
		Bankex	0.782[a13]	0.611	0.563	5849.017	0.611	12.586	0.008
		CDGS	0.788[a13]	0.622	0.574	716.050	0.622	13.139	0.007

For Dependent Variable: S&P BSE SENSEX & b. Predictors: (constant), FDI Equity Inflows Sig. F Change with DF 1 = 1 & DF 2 = 118.
For Predictors: (constant), a1: Hardware & Software, to a12, a13 & a14: Service * Sig. F Change with DF 1 = 1 & DF 2 = 8.

8.5 Durbin – Watson d-Statistic

The presence of autocorrelation at lag 1 in the residuals (prediction errors) from regression analysis was detected using Durbin – Watson DW statistic (Magnus and Durbin, 1999). The computed Durbin-Watson (d) value and test results of Durbin - Watson d statistic is summarized below.

Table 8: Durbin - Watson d Statistic & MAPE

S.No	(Sector)	(Index)	Durbin-Watson	Mape
1	FDI Equity Inflows	BSE Sensex	0.7148*	0.33
2	Hardware & Software	BSE IT	1.956#	0.15
3	Pharma	BSE Health Care	0.391#	0.34
4	Telecom	BSE Telecom(M)	2.550#	0.13
5	Metallurgical	BSE Metal	1.672#	0.17
6	Automobile	BSE Auto	1.154#	0.17
7	Chemicals	BSE Basic Mat.	0.898#	0.26
8	Construction	BSE Realty	2.068#	0.27
		BSE Capital Goods	1.436#	0.16
10	Power	BSE Oil & Gas	1.065#	0.19
		BSE Energy	0.534#	0.28
		BSE Power	1.802#	0.10
13	Service	BSE Finance	1.972#	0.24
		BSE Bankex	1.882#	0.25
		BSE CDGS	2.444#	5.78

*Lower d value (d_L) and upper d value (d_U) at k = 1 and n = 10 are 0.879 & 1.320
#Lower d value (d_L) and upper d value (d_U) at k = 1 and n = 120 are 1.720 & 1.747
For Positively Autocorrelation:

1. $d_{cal} < d_L$ - There is statistical evidence that the error terms are positively autocorrelated.
2. $d_{cal} > d_U$ - There is no statistical evidence that the error terms are positively auto correlated.

For Negative Autocorrelation:

1. $d_{cal} > d_U$ - There is no statistical evidence that the error terms are positively autocorrelated.
2. $d_{cal} < d_L$ - There is statistical evidence that the error terms are negatively autocorrelated.

8.6 Forecasting the return distribution and accuracy

From the methodology stated above, S&P BSE Sensex was forecasted for a period from April, 2020 to September, 2021 (18 Observations) using FDI Equity Inflows as independent variable and S&P BSE Sectoral Indices are forecasted for 2020-21 using Sector Attracting FDI as independent variable and their forecast accuracy were analyzed. Forecasting return distribution using regression, which is more optimistic in nature, is the closest forecast with actual value of S&P BSE Sensex and S&P BSE Sectoral Indices.

The Mean Absolute Percentage Error (MAPE) also referred as Mean Absolute Percentage Deviation (MAPD) is one of the most popular measures of the forecast accuracy due to its advantages of scale-independency and interpretability is performed and illustrated in Table – 8.

9. Conclusions

The present study is an endeavour to understand the nexus relationship between FDI and Stock Market using Kolmogorov – Smirnov and Shapiro-Wilk normality test, Q – Q plot technique, Goodness – of fit (F – Test), Coefficient of Determination, Durbin – Watson d – statistic and Mean Absolute Percentage Error (MAPE) from the time span of

April, 2010 to September, 2021 (138 observations) and from 2010-11 to 2020-21 (11 observations).

The study reveals that FDI makes a significant contribution in Stock Market toward higher productivity. One of the important inferences that can be drawn from these findings is that the inward FDI has the potential to boost the Stock Market but there are some obvious reasons why this effect is not becoming sustainable in the long run. By examining the issue, we observe that one of the key reasons why the flow of FDI fails to exert a sustainable impact on stock market of the country is the lack of proper channelization of foreign funds to the economy. While comparing with China, the bulk of FDI is concentrated in the manufacturing sector, while India's post-reform experience suggests that a substantial proportion of FDI has gone to the service sector and the positive effect cannot be realised unless attain a threshold level of human capital with new technologies and financial market development through capital accumulation, lowering transaction cost and allocating capital to projects with higher returns Alfaro *et al.* 2004 and Carp 2012) [48, 49]. So it is important to note that the long term growth is determined by the spillovers of technology and knowledge from investing countries by investor – friendly legal environment through economy's degree of openness, risk and variables related to micro economic performance like inflation and average rate of economic growth and a high level of urbanisation (De Mello, 1999 and Nonnemberg and Cardoso de Mendonca, 2004) [50, 51].

10. Policy recommendations

As a part of policy recommendations, the impact of FDI on Stock Market should be sustained for the long run and the policymakers should think about the lacunas that offset sustainability. In this regard, the study in line with Mohanty (2013) [52], suggests the policymakers to learn lessons from the rewarding experiences of FDI policy and accordingly put policy directions toward improving the quality of FDI through various policy measures like different ministries to work together to sort out differences for quick project clearance, improving coordination between the states and the central government, to make SEZs more attractive, proper planning and design should include local level solutions for land acquisition and infrastructure connectivity to SEZs, along with sector-specific policies to attract FDI, more simply, the progressive dismantling of administrative barriers and strong channelization of FDI by inviting multinational enterprises and transnational corporations in a transparent economic system with stringent governance can play a key role in attracting more FDI.

In this paper highest possible efforts are carried out to execute the study with adequate care and precision, still some noteworthy limitations exist. First, the relationship between sectoral classification of FDI and DIPP 4 - digit sectors and NIC - 2008 sectors at 3 - digit level is inadequate as it is based on a high level of aggregation of economic activities. Secondly, apart from FDI, Stock Market depends on a number of other economic variables and introducing such variables in modelling the relationship between FDI and Stock Market might concretize the study. Besides that it is sensible to consider the structural break in the time series data to have a better understanding of the concerned relationship.

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