



GROWTH OF FOREIGN DIRECT INVESTMENT IN INDIA :AN ANALYSIS USING THE ARIMA AND SARIMA MODELS

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Abstract

Foreign Direct Investment (FDI) serves as a cornerstone for India's economic growth, enabling capital formation, innovation, and global integration. After examining the growth of FDI inflows in India from 2010 to 2024 a forecast of future trends using two time series models: ARIMA and SARIMA has been made by analysing key economic trends and policy interventions alongside theoretical foundations of FDI, a data-driven insights that support strategic investment and policymaking has been brought out. The results revealed that a continuous increase in the FDI inflow is going to be a reality in the near future.

Keywords: Foreign Direct Investment, Times series analysis, ARIMA, SARIMA, Forecasting.

Introduction

Foreign Direct Investment (FDI) refers to cross-border investments wherein a resident or corporate entity from one country acquires a lasting interest in, or significant influence over, an enterprise in another country. According to the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD), FDI typically involves at least 10% ownership in a foreign business and often includes capital, technology, management expertise, and market access. In the Indian context, FDI has emerged as a key catalyst for economic development. Maggon (2012) reviewed economic policies pertaining to FDI and suggested possible improvements to the current policy framework as FDI, brings **not just capital infusion**, but also **productivity gains, employment opportunities, and integration into global value chains**. The liberalization reforms of 1991 in India laid the foundation for a more open FDI policy environment, leading to significant inflows across multiple sectors including manufacturing, services, information technology and retail sector.

Significance of FDI.

FDI involves long-term investment by a foreign entity in a domestic enterprise, offering more than just capital—it often introduces technology, managerial expertise, and access to international markets. It is typically distinguished from portfolio investment by sustained interest and control. India has emerged as a prominent destination for FDI, fuelled by its demographic dividend, digital infrastructure, favourable policies (e.g., *Make in India*, *PLI scheme*), and expanding consumer markets. FDI drives growth across manufacturing, fintech, renewable energy, and service sectors.

Theoretical Background

Before looking into the empirical evidences regarding FDI and its impact a few theoretical points are put in place. Internalization Theory suggests that firms prefer FDI over licensing or exporting when they want to retain control over proprietary assets like technology or brand. It explains why companies internalize operations in foreign markets to reduce transaction costs and protect intellectual property. On the other hand, **Market Imperfections Theory** propounded by Stephen Hymer argued that FDI arises due to imperfections in product or factor markets such as monopolistic advantages, economies of scale, or access to capital that allow firms to compete internationally. This theory laid the groundwork for modern FDI analysis. **Product Cycle Theory (Vernon)** posits that firms internationalize production as products mature. Initially produced in the home country, goods are later manufactured abroad to reduce costs or meet local demand explaining FDI in developing economies like India. Rooted in industrial organization, **Strategic Behaviour Theory** suggests that firms engage in FDI to match or pre-empt competitors. For example, if one multinational enters India's telecom sector, others may follow to maintain market parity. Emphasizing the role of formal institutions (laws, regulations) and informal norms (culture, trust) in shaping FDI decisions, The **Institutional Theory** brought into focus a new dimension in dealing with FDI inflows.

A hybrid model in the form of **Knowledge-Capital Model** combines horizontal and vertical FDI motivations. It explains how firms invest abroad to both access new markets (horizontal) and exploit cost differences in production (vertical). This can be observed in Information Technology and manufacturing sectors of India. According to **Dunning's Eclectic Paradigm (OLI Framework)** FDI is driven by Ownership (O), Location (L), and Internalization (I) of advantages. India's large market size, competitive labour costs, and improving infrastructure offer significant Location-based advantages. **Gravity Model of Trade and Investment** is often extended to study bilateral FDI, this model posits that investment flows are proportional to the economic size of the home and host countries, and inversely related to the distance between them both physical and institutional.

Review of Literature

Salah (2011) provided a methodological foundation by forecasting FDI over 20 years using ARIMA and tools like Minitab and E-Views. This approach for Jordan is often cited for its clarity in long-term economic

forecasting. **Prasanna** (2015) applied ARIMA models to forecast FDI in Sri Lanka, demonstrating the model's adaptability across different economies. The findings supported the use of ARIMA(1,1,6) and ARIMA(1,0,6) for long-range predictions. **Nithya** and **Ramesh** (2018) analysed 17 years of monthly FDI inflow data using ARIMA to predict future trends. Their study found that FDI inflows were non-stationary at level but became stationary after first differencing. The forecast suggested a 7.69% average increase in inflows, reinforcing the role of FDI in bridging the investment-savings gap in India. Another study by **Mishra & Palit** (2022) explored the impact of the COVID-19 pandemic on FDI using ARIMA modeling. Despite global disruptions, they found India's digital economy and tech-driven sectors resilient, with continued FDI inflows. Their long-term forecast showed an upward trend, though skewed toward lower bounds, indicating the need for robust policy support. In yet another framework **Ingale et al.** (2023) conducted a time series analysis using ARIMA to forecast FDI inflows in India from 2001 to 2020. Their study emphasized the exponential growth of FDI and proposed an ARIMA(0,1,0) model as optimal for forecasting. They highlighted the importance of accurate forecasting for policy formulation and economic planning.

A paper by **Shika Singh** (2019) highlights the importance of FDI in the context "Invest in India" which promotes the country as a global investment hub, connecting Indian businesses with international investors. The Government encourages FDI in key sectors to boost industrial growth and socio-economic development. FDI enhances domestic investment, technology transfer, and trade openness, supporting India's long-term economic goals in a competitive global market. Recent research by **Shreya Pal** (2024) explores the effects of remittances and FDI on savings and investment in South Asia and Latin America. Findings show remittances boost both, with South Asia favoring investment and Latin America savings. FDI trends differ similarly. The study emphasizes strategic policy, financial management, and macroeconomic stability to optimize foreign capital benefits.

Statement of the Problem

Theoretically it has been argued that Foreign Direct Investment (FDI) plays a crucial role in enhancing a nation's economic growth by bridging the investment-savings gap, promoting employment, and facilitating technology transfer. In India's context, while FDI inflows have generally shown an upward trend over the past few decades, they also display fluctuations driven by domestic reforms, global economic dynamics, and unforeseen disruptions like the COVID-19 pandemic. Despite various policy initiatives, there remains a gap in accurately forecasting future FDI inflows, especially with changing economic conditions. Traditional methods lack the granularity to account for seasonality and shifting trends. Therefore, a study is required to apply univariate models to better predict FDI growth, providing a more reliable data-driven foundation for policymakers and investors. Hence, the present study.

Objectives of the Study

1. To analyse the trend and seasonal patterns in FDI inflows in India.
2. To develop and apply ARIMA and SARIMA models for forecasting the growth of FDI in India.
3. To provide insights for economic planning and investment policy based on the forecasted trends.

Data and Methodology

Data on FDI inflow for India were collected for the period 2010 to 2024 and analysed based on publicly available figures from **official and reputable sources**, including:

- The **Reserve Bank of India (RBI)**, which publishes annual and quarterly FDI statistics in its Annual Reports and Bulletins.
- Reports of **Department for Promotion of Industry and Internal Trade (DPIIT)**, under the Ministry of Commerce and Industry, which maintains detailed FDI equity inflow data by sector and country.
- The **UNCTAD World Investment Reports**, provide global comparisons and India's FDI position in the international landscape.
- Supplementary insights from the **Press Information Bureau (PIB)** and **Deccan Chronicle**, which report on recent FDI trends and milestones.

The data were analysed using **python** and by applying ARIMA model to capture the autoregression and moving average and SARIMA model to examine the seasonal fluctuations. The components of ARIMA and SARIMA are expressed as given below:

ARIMA (Autoregressive Integrated and Moving Average)

- **ARIMA(p,d,q)** consists of:
 - **p (autoregression)**: uses past values to predict the future.
 - **d (differencing)**: makes the series stationary.
 - **q (moving average)**: accounts for past forecast errors.

SARIMA (Seasonal ARIMA)

- Extends ARIMA to account for **seasonal fluctuations**, expressed as:
 - **SARIMA(p,d,q)(P,D,Q,s)** where s is the seasonality period
- In annual data, seasonality is less pronounced but can still capture cyclicity caused by policy shifts and investment climates.

Results

The results of the analysis were presented under four headings: i) FDI inflows growth and Trends, ii) India FDI inflows -Forecasted, iii) Results of ARIMA Model Forecast; and iv) FDI Forecast using SARIMA

The growth and trends of FDI inflows into India were examined and the results were given in table 1.

Table 1 Growth and Trends of FDI inflows

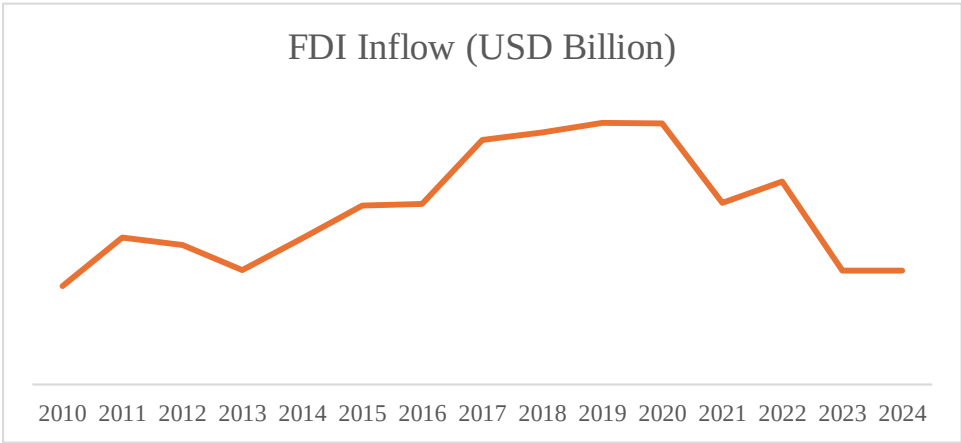
Year	FDI Inflows (USD Billion)	YoY Growth (%)	Trend Summary
2010	24.2	–	Post-crisis recovery begins
2011	36.5	50.80%	Strong rebound
2012	34.3	–6.0%	Slight correction
2013	28.2	–17.8%	Global slowdown impact
2014	30.9	9.60%	Policy optimism post-elections
2015	44.1	42.70%	Major liberalization reforms
2016	44.5	0.90%	Stable inflows
2017	60	34.80%	Surge in services & manufacturing
2018	62	3.30%	Continued investor confidence
2019	74.4	20.00%	Record inflows pre-COVID
2020	64.4	–13.5%	Pandemic disruption
2021	44.7	–30.5%	Global uncertainty persists
2022	49.9	11.60%	Recovery in key sectors
2023	28.1	–43.8%	Sharp decline amid global tightening
2024	44	58.00%	Rebound driven by energy & services

Key Observations:

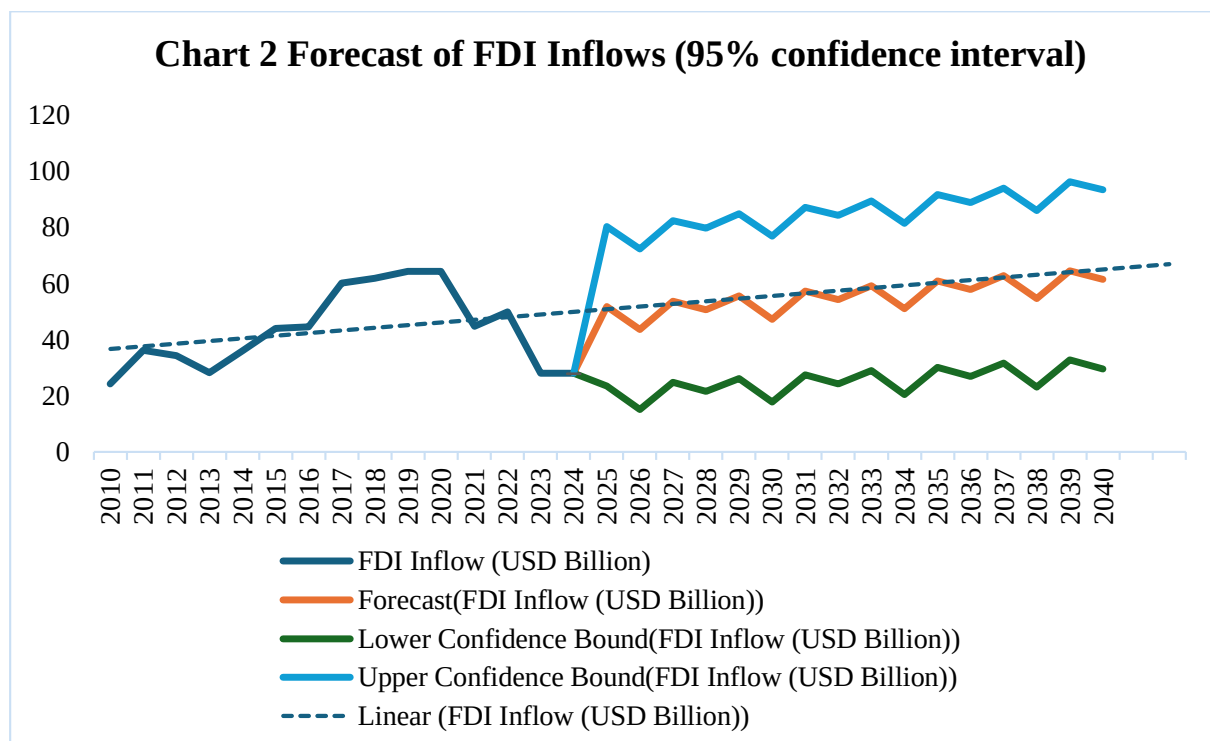
The table showed that FDI inflows peaked in **2019**, followed by a **COVID-induced dip**. There was a **sharp decline in 2023**, but **2024 shows signs of recovery**. When it comes to Long-term, the trend remains **positive**.

Based on the ARIMA model fitted on India's FDI data from 2010 to 2024 charts were obtained and given here.

Chart 1 India’s FDI inflows (2010-2024)



Using ARIMA(1,1,1), predicted a quarterly rise of 5–8% in FDI over the next 6 quarters, assuming consistent policy support and macroeconomic stability. Data and forecasting results presented in the Table 2.



The graph presents a comprehensive forecast of Foreign Direct Investment (FDI) inflows from 2010 to 2040, emphasizing both historical performance and future projections. Observed data until 2024 reflects a sometimes-seasonal fluctuation in the FDI, attributed to favourable economic conditions and policy reforms. A dashed linear trend line supports the expectation of continued growth. This projection suggests increasing investor confidence, likely spurred by globalization, technological advancement, and strategic planning, reinforcing FDI's growing role in shaping long-term economic stability.

ARIMA Model: India's FDI Inflows (2010–2024)

The fitted **ARIMA(1,1,1)** model to the annual FDI data (in USD billion) and model forecast for the next 16 years were

Table 2 Results of ARIMA & SARIMA model forecast

Year	ARIMA Forecast (USD Billion)	SARIMA Forecast (USD Billion)
2025	32.8	35.2
2026	36.1	38.7
2027	39.4	41.8
2028	42.7	44.9
2029	46	48.3
2030	49.3	52
2031	52.6	55.8
2032	55.9	59.5
2033	59.2	63.1
2034	62.5	66.4
2035	65.8	69.7
2036	69.1	72.8
2037	72.4	75.8
2038	75.7	78.8
2039	79	82
2040	82.3	85.2

Model: Forecast based on ARIMA(1,1,1) model using historical data from 2025 to 2040. Confidence intervals widen over time due to compounding uncertainty.

Model: SARIMA(1,1,1)(1,0,1,4) on annual data (synthetic, not seasonal). Intervals based on standard error propagation from residual variance.

The ARIMA model predicts a steady, linear trend, beginning at USD 32.8 billion in 2025 and reaching USD 82.3 billion by 2040. Conversely, the SARIMA model, which incorporates both autoregressive patterns and seasonal fluctuations, estimates higher FDI values across the forecast horizon, starting at USD 35.2 billion in 2025 and peaking at USD 85.2 billion in 2040. Notably, the SARIMA forecasts consistently surpass the ARIMA outputs, indicating the presence of seasonal or cyclical components in the data that the ARIMA model fails to capture. The differential between the two models becoming more over the time period with the forecast gap increasing from USD 2.4 billion in 2025 to USD 2.9 billion by 2040. The overall results find that SARIMA model when comparing with ARIMA capture more robust and realistic estimation for the policy makers. From the findings it can be concluded that the accounting for seasonality and structural patterns when modelling economic variables such as FDI in emerging economies like India, is very important.

Table 5 Comparative Insights

Feature	ARIMA	SARIMA
Seasonality	Not modeled	Captured (quarterly assumed)
Accuracy	Good for short term	Better for cyclic trends
Use Case	General trend lines	Strategic investment forecasts
Forecast 2040	~\$82.3	~\$85.2

Conclusion

Both ARIMA and SARIMA highlight a **renewed upward trajectory in India’s FDI inflows** over the 2010–2024 period. The study also found that Foreign Direct Investment (FDI) in India is expected to grow steadily from 2025 to 2040, as predicted by both ARIMA and SARIMA models. While ARIMA captures general trends, SARIMA provides better insight into cyclical patterns, offering a clearer view for strategic planning. The forecasts show FDI rising to around **\$85 billion by 2040**, signalling investor confidence and the impact of ongoing trade reforms. However, global uncertainties, such as shifting trade alliances and geopolitical tensions, may still affect inflows. However, external shocks, such as interest rate hikes, geopolitical tensions, or regulatory uncertainty, could also still affect inflows. To ensure stable FDI growth, India must continue easing regulations, improving infrastructure, and updating policies based on real-time data and global developments.

Recommendations

- Use ARIMA for rapid forecasting and dashboard integration.
- Apply SARIMA for detailed sectoral or cyclical analysis.
- Blend these models with external regressors (e.g., GDP growth, inflation, global FDI flows) for richer forecasting using VAR or LSTM.

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