FOREIGN DIRECT INVESTMENT (FDI) IN INDIA- ARIMA MODEL

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Abstract

Using the ARIMA (Auto Regressive Integrated Moving Average) model, this study investigates the dynamics of Foreign Direct Investment (FDI) in India, concentrating on its patterns and behavior across time. The study intends to examine past data in order to identify trends in Foreign Direct Investment inflows and predict future developments, offering important insights into how FDI affects India's economic growth. Future FDI inflows are predicted, important affecting factors are identified, and the stationarity of FDI series is examined using the ARIMA model. It is anticipated that the results will provide crucial information to help businesses, investors, and policymakers plan their foreign investment strategies in India. This study offers a more thorough comprehension of how domestic policies and changes in the global economy impact FDI trends.

Keywords:- Foreign Direct Investment (FDI), ARIMA Model, Economic Forecasting, Time Series Analysis, India's Economic Development.

For nations to thrive and flourish economically, especially rising economies like India, Foreign Direct Investment (FDI) is essential. In addition to offering financial resources, FDI improves technology transfer, creates jobs, and boosts economic activity across a range of industries. India's sizable customer base, highly qualified workforce, and economic changes have made it one of the most alluring locations for international investment throughout the years. Despite these benefits, a number of domestic and international factors, including market attractiveness, policy changes, political stability, and global economic conditions, have affected FDI inflow to India.

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Understanding current trends and projecting future Foreign Direct Investment inflows has been crucial for economic planning and policymaking in recent years. Accurately forecasting how FDI would behave in the upcoming years is crucial given the volatility of international markets and India's dynamic policy environment. Trends in FDI and other economic indicators have been analyzed and predicted using time series models such as ARIMA. In order to produce accurate projections and provide insightful information for future economic policies, this study attempts to model FDI inflows into India using the ARIMA approach.

Need and Significance

Given India's reliance on Foreign Direct Investment (FDI) for infrastructure development and economic growth, it is critical to understand current and emerging trends. Understanding how domestic and international factors affect Foreign Direct Investment (FDI) will help India better recruit and manage FDI as investors from around the world search for new possibilities. Through the application of the ARIMA model to historical data, this study seeks to give businesses, economic analysts, and policymakers the means to predict how Foreign Direct Investment (FDI) would behave in India, enabling them to make well-informed decisions. Additionally, by providing a quantitative analysis of FDI inflows in India—a crucial component of both economic planning and luring international investment—the study would add to the body of existing work.

Review of Related Literature

The literature has generally acknowledged the importance of foreign direct investment (FDI) in India's economic growth. FDI inflows significantly increased following India's economic liberalization in the early 1990s, particularly in industries like retail, automotive, and telecommunications (Sahoo, 2019). The main drivers of foreign direct investment (FDI) in India, such as labor costs, market size, infrastructure, and institutional quality, have been the subject of numerous studies (Kumar & Singh, 2020). India is now a popular location for international investment due to its economic changes and strategic positioning as one of the biggest emerging markets (Ranjan and Agrawal, 2022). Furthermore, FDI patterns have been greatly influenced by elements including trade liberalization, political stability, and foreign investment policy reforms (Jadhav, 2020). There is acknowledgement of the difficulties that still impact foreign investment flows, even if these economic and policy variables are primarily responsible for the growth of FDI in India. Barriers to optimizing FDI potential have frequently been recognized as regulatory concerns, administrative roadblocks, and infrastructure constraints (Sharma & Sood, 2018). Furthermore, FDI flows are thought to be influenced by the global economic climate, which includes changes in the foreign currency rate and world politics (Bansal & Gupta, 2022).

Time series forecasting in a variety of domains, such as business, finance, and economics, has made extensive use of

ARIMA models. ARIMA's capacity to effectively predict short- to medium-term trends was demonstrated by Kapoor and Sahu's (2017) use of the model to forecast FDI inflows into India. They discovered that the underlying patterns of FDI inflows, which were impacted by both domestic and international economic forces, were effectively captured by the ARIMA model. This study was expanded upon by Mishra and Patra (2019), who used ARIMA to anticipate FDI flows over a 10-year horizon and monitor the cyclical nature of FDI and its relationship to global economic conditions. According to their findings, the ARIMA model performed well in forecasting the time and size of FDI changes. Although the ARIMA model has demonstrated potential, it is not always able to capture complex macroeconomic shocks or abrupt policy changes that have the potential to significantly alter trends in foreign direct investment. According to Sharma and Srivastava (2021), ARIMA's dependence on historical data might not take into consideration unanticipated circumstances like shifts in governmental regulations or international financial crises. This implies that although ARIMA is helpful for short-term forecasts, longer-term projections can call for other models that take into account outside factors like shifting economic policies and geopolitical dangers.

Scope of the Study

The scope of this study is to forecast the trends of Foreign Direct Investment (FDI) inflows into India up to the year 2028, employing the ARIMA (Auto-Regressive Integrated Moving Average) model. By analyzing historical FDI data from 2012 to the most recent available data, this study aims to predict the trends of FDI from 2025 to 2028, a period influenced by both domestic and global factors such as economic policies, international trade relations, and geopolitical events. This research will focus on aggregate FDI inflows while also considering the sectoral distribution of FDI across key sectors like telecommunications, retail, manufacturing, and services. The ARIMA model will be utilized to capture the time-dependent relationships and patterns in the data, providing valuable insights for policymakers and business leaders to make informed decisions regarding future foreign investment strategies in India.

Research Objectives

1. To analyze the historical trends and patterns of Foreign Direct Investment (FDI) in India.
2. To apply the ARIMA time series model to forecast future FDI inflows into India.

Hypothesis

There is no significant trend or pattern in FDI inflows in India based on historical data.

Methodology of the Study

Quantitative data analysis is used in this investigation. Secondary data were gathered from credible sources including UNCTAD, the Ministry of Finance, and the Reserve Bank of India (RBI). The study examined foreign direct investment inflows into India from 2012 to 2024. The stationarity of the data is assessed using statistical procedures like the Augmented Dickey-Fuller (ADF) test. The best-fit parameters (p, d, and q) for the time series are determined by applying the ARIMA model to the FDI data. Model selection is done using the Akaike Information Criterion (AIC). Future FDI inflows are predicted for a four-year period starting in 2025 using the best ARIMA model.

Result and Interpretation

The variable D (FDI) has a unit root, according to the results of the Augmented Dickey-Fuller (ADF) test, which is statistically significant at the 5% level. We reject the null hypothesis since the ADF test statistic is -2.595742 and the corresponding p-value is 0.0148, both of which are below the 5% significance level. This implies that the Foreign Direct Investment (FDI) series' initial difference, D (FDI), is stable. Stated otherwise, the initial FDI series may show a unit root (non-stationary), but after differencing, its first difference has become stationary, making the series appropriate for additional time series modeling, such as the ARIMA model.

The significance of the lag factor in explaining the variance in the differenced FDI series is further supported by the ADF test equation for D (FDI, 2), which indicates that the coefficient of the lagged difference of FDI (D (FDI (-1))) is -0.691402 with a t-statistic of -2.595742. A decent fit is shown by the model's R-squared value of 0.394, which shows that it accounts for around 39.4% of the variance in the differenced series. Mild autocorrelation, which is common in economic time series data, is indicated by the Durbin-Watson statistic of 1.487.

The constant term's (C) coefficient, according to the FDI1 variable's ARMA (Auto Regressive Moving Average) model estimation, is 3.184506 with a t-statistic of 2.745858, suggesting statistical significance at the 5% level (p-value = 0.0226). With a coefficient of -0.780450, the AR (3) term is likewise highly significant (p-value = 0.0071), indicating that the FDI series' third-order autoregressive component is crucial in understanding its behavior. Potential mean-reverting tendency in FDI inflows over time is reflected in the negative sign of the AR (3) coefficient, which shows that FDI in one period is negatively connected to its value three periods ago. FDI1=3.184506+ AR (3) (-0.780450) as a result

With an R-squared value of 0.5059, the model is thought to provide a decent fit, accounting for about 50.6% of the variation in the differenced FDI series. When taking into consideration the amount of parameters, the model's explanatory ability is considerably diminished, as indicated by the Adjusted R-squared value of 0.3961. At the 5% level, the model's overall significance is confirmed by the F-statistic value of 4.607680 (p-value = 0.0419). Financial time series data typically exhibit minor positive autocorrelation, as indicated by the Durbin-Watson statistic of 1.334830.

Over the next four years, India is expected to have a favorable increase in foreign direct investment (FDI) inflows. The estimated FDI for 2025 is roughly 68.4 billion USD, and it is anticipated to rise to 71.1 billion USD in 2026. With estimates of 76.4 billion USD in 2027 and 84.1 billion USD in 2028, the rise is

Table 1.1

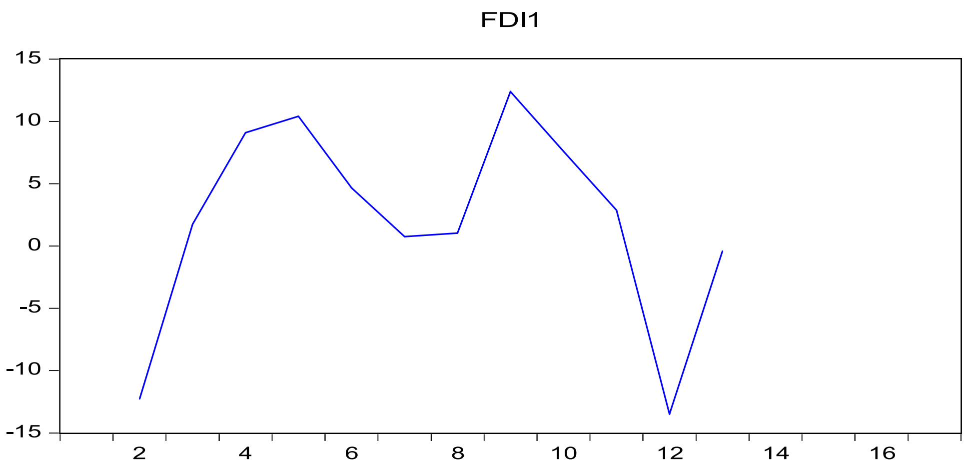
Augmented Dickey-Fuller Tests- D (FDI)

Null Hypothesis: D(FDI) has a unit root				
Exogenous: None				
Lag Length: 0 (Automatic - based on SIC, maxlag=2)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2.595742	0.0148
Test critical values:	1% level		-2.792154	
	5% level		-1.977738	
	10% level		-1.602074	
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(FDI,2)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI(-1))	-0.691402	0.266360	-2.595742	0.0267
R-squared	0.394080	Mean dependent var		1.077273
Adjusted R-squared	0.394080	S.D. dependent var		9.487883
S.E. of regression	7.385448	Akaike info criterion		6.923408
Sum squared resid	545.4485	Schwarz criterion		6.959581
Log likelihood	-37.07875	Hannan-Quinn criter.		6.900607
Durbin-Watson stat	1.487680	Significant		

Source: Secondary data

Figure 1.1

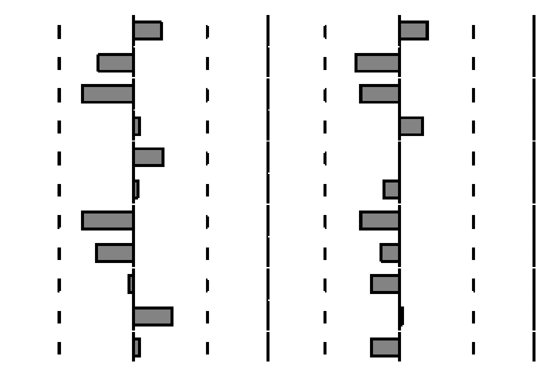
Stationarity of the Data- D (FDI)



expected to continue. According to these forecasts, India is probably going to see steady rise in FDI inflows, which would be indicative of the country's ongoing appeal as a place to invest because of its advantageous economic climate, recent policy changes, and worldwide market trends. These projections, however, make the assumption that the economic climate won't be significantly changed during this

Figure 1.2

Correlogram of the Data- D (FDI)



	AC	PAC	Q-Stat	Prob
1	0.219	0.219	0.7348	0.391
2	-0.27...	-0.33...	1.9877	0.370
3	-0.40...	-0.30...	5.0820	0.166
4	0.064	0.183	5.1688	0.270
5	0.226	-0.00...	6.3984	0.269
6	0.028	-0.13...	6.4200	0.378
7	-0.38...	-0.31...	11.512	0.118
8	-0.29...	-0.14...	15.078	0.058
9	-0.03...	-0.20...	15.145	0.087
1...	0.309	0.024	23.173	0.010
1...	0.049	-0.22...	23.569	0.015

Table 1.2

ARMA Maximum Likelihood (OPG - BHHH) - D (FDI)

Dependent Variable: FDI1				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Date: 12/01/24 Time: 19:28				
Sample: 2 13				
Included observations: 12				
Convergence achieved after 10 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.184506	1.159749	2.745858	0.0226
AR(3)	-0.780450	0.225168	-3.466077	0.0071
SIGMASQ	29.62054	16.75659	1.767695	0.1109
R-squared	0.505912	Mean dependent var		2.032500
Adjusted R-squared	0.396114	S.D. dependent var		8.087018
S.E. of regression	6.284429	Akaike info criterion		6.961172
Sum squared resid	355.4465	Schwarz criterion		7.082399
Log likelihood	-38.76703	Hannan-Quinn criter.		6.916290
F-statistic	4.607680	Durbin-Watson stat		1.334830
Prob(F-statistic)	0.041891			
Inverted AR Roots	.46+.80i	.46-.80i	-.92	

Source: Secondary data

time by any major external shocks or policy changes.

Finding

The Augmented Dickey-Fuller (ADF) test on the differenced FDI series (D (FDI)) revealed that the series became stationary after differencing, indicating that the FDI data exhibited a unit root prior to differencing but became stable post-transformation. The ADF test statistic of -2.595742 and a p-value of 0.0148

Table 1.3

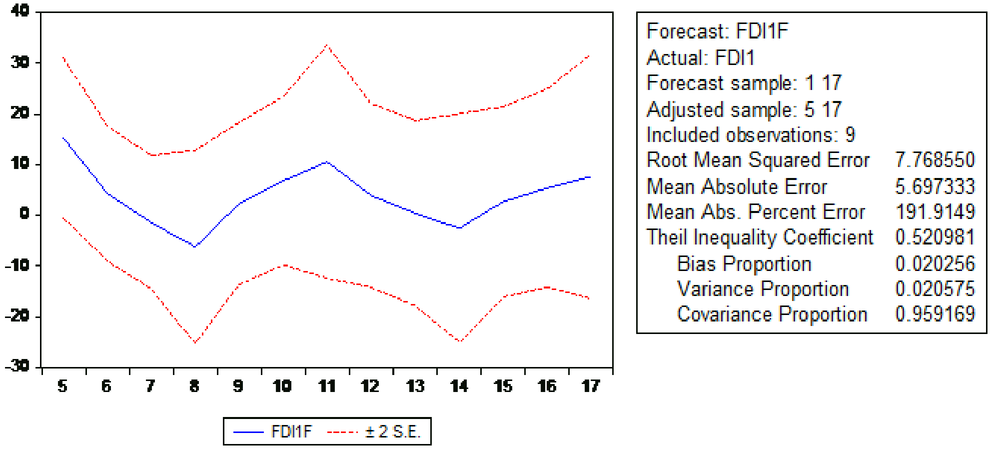
Foreign Direct Investment Inflows in India 2012-2024(Billion U.S. Dollars)

Year	FDI Inflows in India
Actual(Billion U.S. Dollars)	
2012	46.56
2013	34.3
2014	36.05
2015	45.15
2016	55.56
2017	60.22
2018	60.97
2019	62
2020	74.39
2021	81.97
2022	84.84
2023	71.36
2024	70.95
Predicted (Billion U.S. Dollars)	
2025	68.40452
2026	71.05682
2027	76.436
2028	84.09247

Source: Secondary data

Figure 1.3

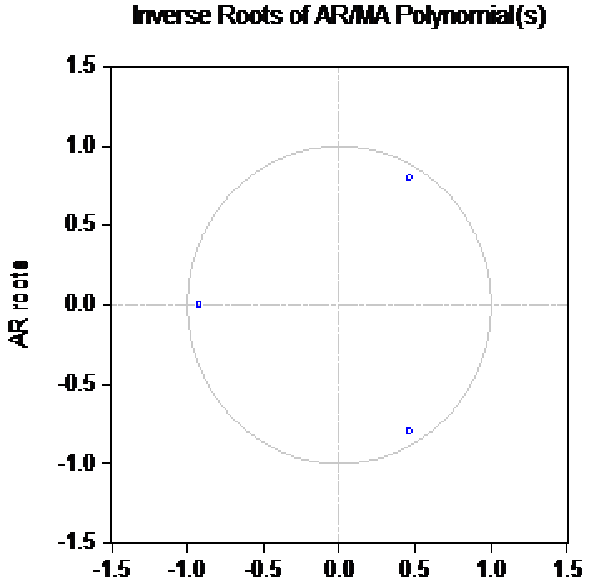
Static Forecast of the data- D (FDI)



Now the blue lines are within the upper and lower red lines, hence the Model is stable.

Figure 1.4

Static Forecast of the data- D (FDI)



All dots are within the circle, hence the prediction is reliable.

confirmed that the null hypothesis of a unit root could be rejected at the 5% significance level, supporting the appropriateness of the data for further time series modeling.

The ARMA Maximum Likelihood estimation results indicated that the third-order autoregressive term (AR (3)) plays a significant role in explaining the FDI series. With a coefficient of -0.780450 and a t-statistic of -3.466077 (p-value = 0.0071), the model suggests a negative relationship between FDI in one period and the value of FDI three periods prior, implying that FDI exhibits a mean-reverting tendency. The model demonstrated an R-squared value of 0.5059, indicating that approximately 50.6% of the variation in the differenced FDI series is explained by the model, while the Adjusted R-squared value of 0.3961 suggests that the explanatory power of the model could be improved with additional factors or a more refined specification.

Forecasts for the period 2025-2028 suggest a steady increase in FDI inflows, with projections of approximately 68.4 billion USD for 2025, 71.1 billion USD for 2026, 76.4 billion USD for 2027, and 84.1 billion USD for 2028. This upward trajectory is consistent with India's favorable economic environment, recent policy reforms, and its increasing appeal as an investment destination. However, these predictions are based on the assumption that there will be no major external shocks or significant changes in domestic policy that could drastically alter the course of FDI inflows.

Conclusion

In conclusion, the use of the ARIMA and ARMA models to analyze FDI inflows into India has yielded important information on the patterns and future directions of FDI. The initial difference of FDI is confirmed to be stationary by the Augmented Dickey-Fuller (ADF) test, which qualifies it for time series forecasting. About 50.6% of the variance in FDI can be explained by the ARMA model, which fits the data reasonably well thanks to its strong AR (3) term and stable roots. According to forecasts, FDI inflows are expected to expand steadily from 68.4 billion USD in 2025 to 84.1 billion USD in 2028. These findings highlight the possibility of sustained FDI expansion in India, propelled by stable economic circumstances and legislative changes. Future swings, however, will be influenced by changes in domestic policy and worldwide economic conditions, underscoring the necessity of constant observation and tactical adaptation.

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