Foreign Direct Investment (FDI) dynamics in India: what do ARIMA models tell us?

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FOREIGN DIRECT INVESTMENT (FDI) DYNAMICS IN INDIA: WHAT DO ARIMA MODELS TELL US?

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Abstract

Using annual time series data on net FDI inflows in India from 1960 to 2017, the study examines net FDI inflows using the Box – Jenkins ARIMA methodology. The ADF tests reflect that India FDI net FDI inflows data is I (1). Based on the AIC, the study presents the ARIMA (1, 1, 0) model. The diagnostic tests further show that the presented parsimonious model is not only stable but also suitable for explaining net FDI dynamics in India. The results of the study indicate that, net FDI inflows in India are likely to weaken over the next 10 years. The study identifies two (2) significant policy recommendations in an effort to aid policy makers on how to promote and stimulate the much expected net FDI inflows in India.

Key Words: Foreign Direct Investment, Forecasting, India

JEL Codes: C53, E27, F21

1.0 Introduction

In the vein of enhancing economic growth, one of the contemporary policies adopted by developing countries is the attraction of Foreign Direct Investment (FDI). This can be in the form of both human and financial capital inflows. Foreign direct investment and foreign investment sound to be synonyms. However, the main difference is that, foreign direct investment requires control of the enterprise whilst foreign investment will just influence the management of the enterprise, (Cambazoglu & Karaalp, 2014). Domestic capital in emerging economies is usually confined to low risk investments which are not enough to sustainably boost economic growth. Due to these apparent reasons, many developing economies now focus on policies needed to attract FDI inflows to supplement their limited domestic capital.

To this end, FDI can be defined as an investment option that comprises a long term relationship, interest and management influence by a resident of one country (foreign direct investor / parent enterprise) in an enterprise residing in a foreign economy (Prasanna, 2015). This may allow foreign investors to gain access to the economies which are highly regulated. FDI is also critical in the development of any economy as it facilitates the transfer of financial resources, technology and innovative & improved management strategies along with raising productivity (Nyoni, 2018). Thus, FDI supplements domestic investments by bringing in the required capital stock and boost the overall capital formation of any economy (Gupta & Chaturvedi, 2017).

Historically, India has adopted a vigilant and selective approach regarding foreign capital. This has seen the economy experiencing unmanageable balance of payments crisis characterized with socially intolerable high rates of inflation prior to 1991, forcing the liberalization of economic policies inclusive of the FDI policy, (Palit, (2009) and Wadhva (1991)). There have been delays and reverses in the adoption of new economic policies to allow the interaction of democratic politics, coalition governments, and pressure groups which had vested much interest in the economy. Based on Suriyakanth (2016), from the year 1991-1992 to 2014 – 2015, India has realized US $ 426,318 million FDI inflows, becoming the most preferred investment destination after China and the US. This stimulated Indian's domestic investments and facilitated improvement in both human capital and local institutions, making India an investment hub over the past decade, (Chopra & Sachdeva, 2014).

According to the Indian Brand Equity Foundation (IBEF, 2019), the government's policy regime and a robust business environment have warranted that foreign capital keeps flowing into the country. The key identified Indian sectors that require to be resuscitated through FDI now include defense, PSU oil refineries, telecom, power exchanges and stock exchanges. Apart from being a critical driver of economic growth, FDI is a major source of non-debt financial resource for the economic development of India (IBEF, 2019). In return, foreign companies benefit from relatively lower wages and special investment privileges such as tax exemptions. Whilst the host country achieves the technical know-how, making locally produced products competent in the global market and improving the well-being through employment of the Indian citizens. To ensure sustainable economic growth through FDI inflows, this study seeks to model and forecast net FDI inflows in India using the Box-Jenkins ARIMA technique.

2.0 Literature Review

2.1 Theoretical Literature Review

The nexus between FDI and economic growth has been extremely researched, though there are still some contradictory findings. One of the well-established orthodox theoretical viewpoints on FDI is the Ownership, Location and Internal (OLI) paradigm (Aydin & Kulali 2016) as propounded by Dunning (1980). It is almost important to recognize that there are quite a number of theories that can easy the understanding of why FDI exists. These include the Hecksher – Ohlin model (Hecksher and Ohlin, 1933), the Product Life Cycle theory (Vernon, 1966), the market imperfections theory, the path dependence theory (Martin & Sunley, 2006) and the internalization theory (Buckley and Casson, 1976; Dunning & Rugman, 1985, Hennart, 1985).

In their uniqueness in interpreting the flow of FDI, The Hecksher – Ohlin model, a well-known model of International Economics (Trade), argues that countries will import products that use their limited factors and export those products that use their abundant and cheap factors of production. The Product Life Cycle theory, another popular model in International Economics (Trade), basically argues that a product passes through four (4) consecutive stages of development namely: the innovative stage, the take off stage, the maturity stage and the decline stage. The firm will begin producing for its domestic market in the innovative and take off stages but as the product matures, the firm will export to other countries. In the final stage, rival firms produce the same product and sell it to other countries including the innovating firm back in the originating domestic market. In this theory, via this channel, FDI can move from developed countries to developing countries and vice-versa.

2.2 Empirical Literature Review

2.2.1 Vector Error Correction Model (VECM)

Using Pedroni co-integration test and VECM, Erickson and Owusu-Nantwi (2019) found that there is a positive relationship between FDI and economic growth in South America. Their conclusion conquered with many researchers such as Anyanwu & Yameogo (2015), Saqib *et al* (2013), Lonzi & Abadi (2011) and Alfaro *et al* (2004). Palamalai *et al* (2011) established a bidirectional causal link between FDI and economic growth for all SAARC nations except India. Gupta & Singh (2016) in their study of the BRICS nations using VECM and Granger Causality test concluded that in Brazil, India and China, there exist a unidirectional long-run causality running from GDP to FDI.

2.2.2 Autoregressive Integrated Moving Average (ARIMA) and The Box – Jenkins models

In India, Biswas (2015) investigated net FDI inflows using the Box-Jenkins technique over the period 1992 – 2014 and concluded that FDI in India will follow an increasing trajectory over the period 2015 – 2034. Dhingra *et al* (2015), in yet another Indian study, analyzed foreign institutional investment inflows to India using the Box-Jenkins ARIMA models over the period January 2004 – September 2012 and finalized that the various AR and MA terms influence the current inflow or outflow of foreign institutional investment. In Africa, Jere *et al* (2017) forecasted FDI inflows using Box-Jenkins ARIMA models over the period 1974 – 2014 and established that there will be a gradual increase in annual net FDI inflows of about 44.36% by 2024 in Zambia. More recently, and in yet another African study, Nyoni (2018) analyzed net FDI inflows in Zimbabwe using the Box-Jenkins ARIMA technique over the period 1980 – 2017 and revealed that net FDI inflows in Zimbabwe over the next 2 decades will follow a relatively poor and unimpressive growth trend.

3.0 Materials & Methods

3.1 ARIMA Models

ARIMA models are often considered as delivering more accurate forecasts then econometric techniques (Song *et al*, 2003b). ARIMA models outperform multivariate models in forecasting performance (du Preez & Witt, 2003). Overall performance of ARIMA models is superior to that of the naïve models and smoothing techniques (Goh & Law, 2002). ARIMA models were developed by Box and Jenkins in the 1970s and their approach of identification, estimation and

diagnostics is based on the principle of parsimony (Asteriou & Hall, 2007). The forecasting equation for net Foreign Direct Investment (FDI) with ARIMA (p, d, q) models, where the p denotes the order of the autoregressive part, the d, the order of integration and the q, the order of the moving average part of the model, can be given, in terms of the lag operator notation as:

$$\emptyset_p(L)\Delta^d FDI_t = \theta_q(L)\mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [1]$$

3.2 The Box – Jenkins Methodology

The first step towards model selection is to difference the series in order to achieve stationarity. Once this process is over, the researcher will then examine the correlogram in order to decide on the appropriate orders of the AR and MA components. It is important to highlight the fact that this procedure (of choosing the AR and MA components) is biased towards the use of personal judgement because there are no clear – cut rules on how to decide on the appropriate AR and MA components. Therefore, experience plays a pivotal role in this regard. The next step is the estimation of the tentative model, after which diagnostic testing shall follow. Diagnostic checking is usually done by generating the set of residuals and testing whether they satisfy the characteristics of a white noise process. If not, there would be need for model re – specification and repetition of the same process; this time from the second stage. The process may go on and on until an appropriate model is identified (Nyoni, 2018).

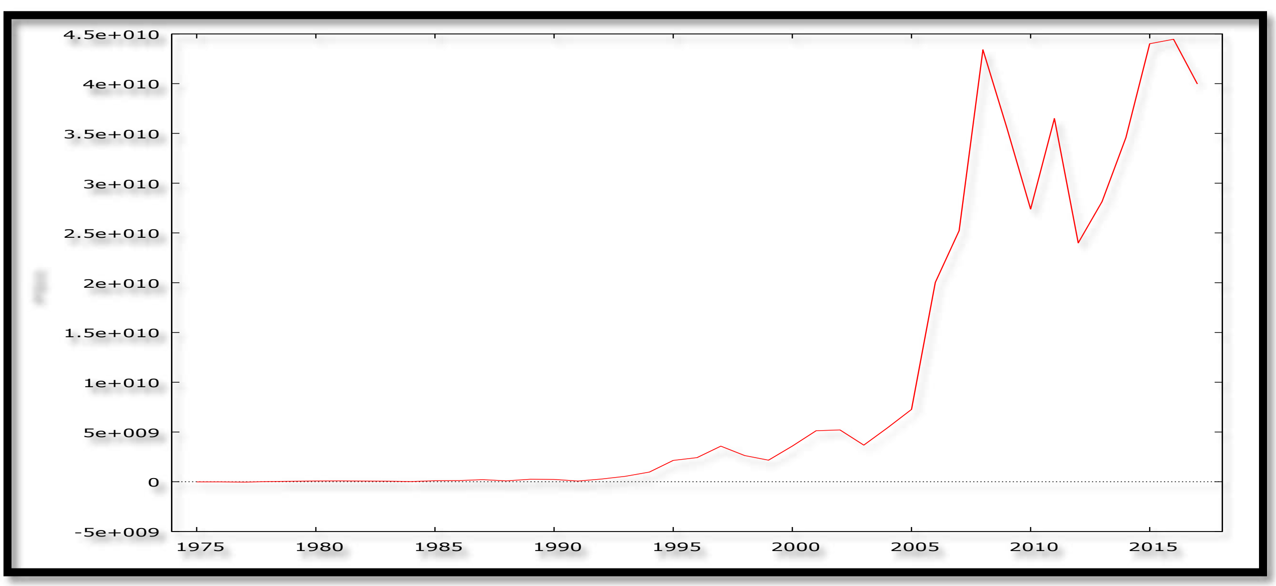
4.0 Data Collection

This research article is based on 42 data points [observations] (1975 – 2017) of net FDI (USD) in India. The data was taken from the World Bank online database, whose integrity and reliability is well known, especially in academia.

4.1 Diagnostic Tests & Model Evaluation

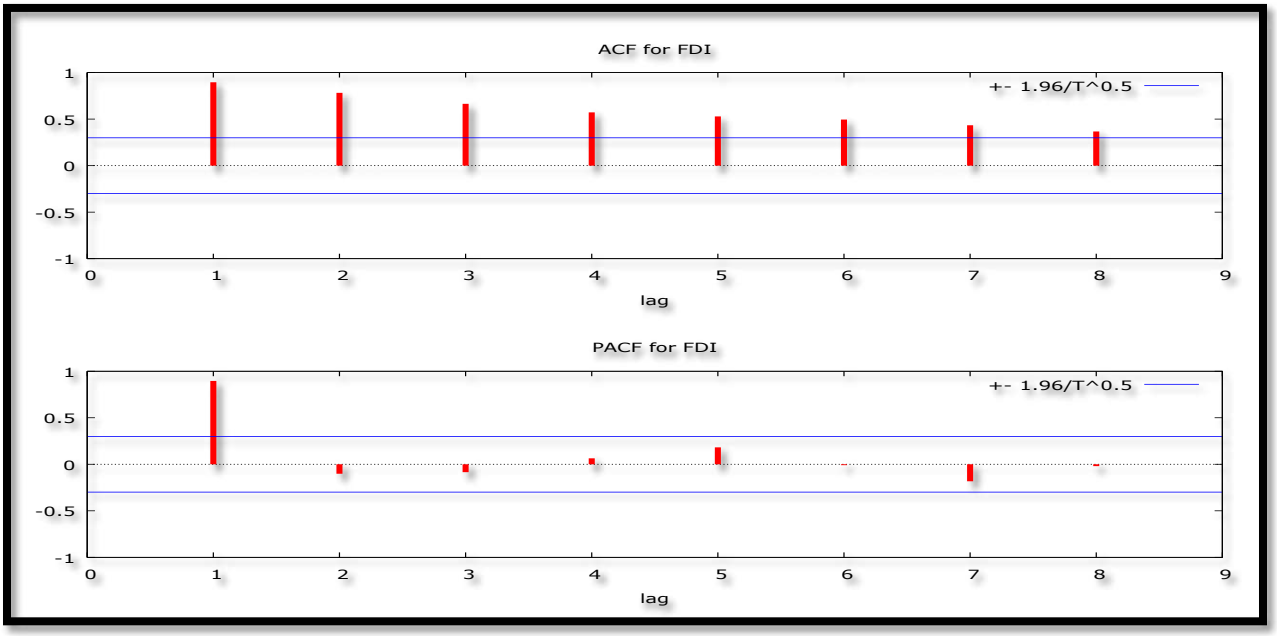
4.1.1 Stationarity Tests: Graphical Analysis

Figure 1



The Correlogram in Levels

Figure 2



4.1.2 The ADF Test

Table 1: Levels-intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	4.102105	1.0000	-3.646342	@1%	Not stationary
			-2.954021	@5%	Not stationary
			-2.615817	@10%	Not stationary

Table 2: Levels-trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	3.554059	1.0000	-4.262735	@1%	Not stationary
			-3.552973	@5%	Not stationary
			-3.209642	@10%	Not stationary

Table 3: Without intercept and trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	4.200696	1.0000	-2.636901	@1%	Not stationary
			-1.951332	@5%	Not stationary
			-1.610747	@10%	Not stationary

Figure 1 and 2 and tables 1 – 3 indicate that the Indian FDI series is non-stationary in levels and hence not I (0). The researcher will proceed to test for stationarity in first differences.

4.1.3 The Correlogram (at 1st Differences)

Figure 3

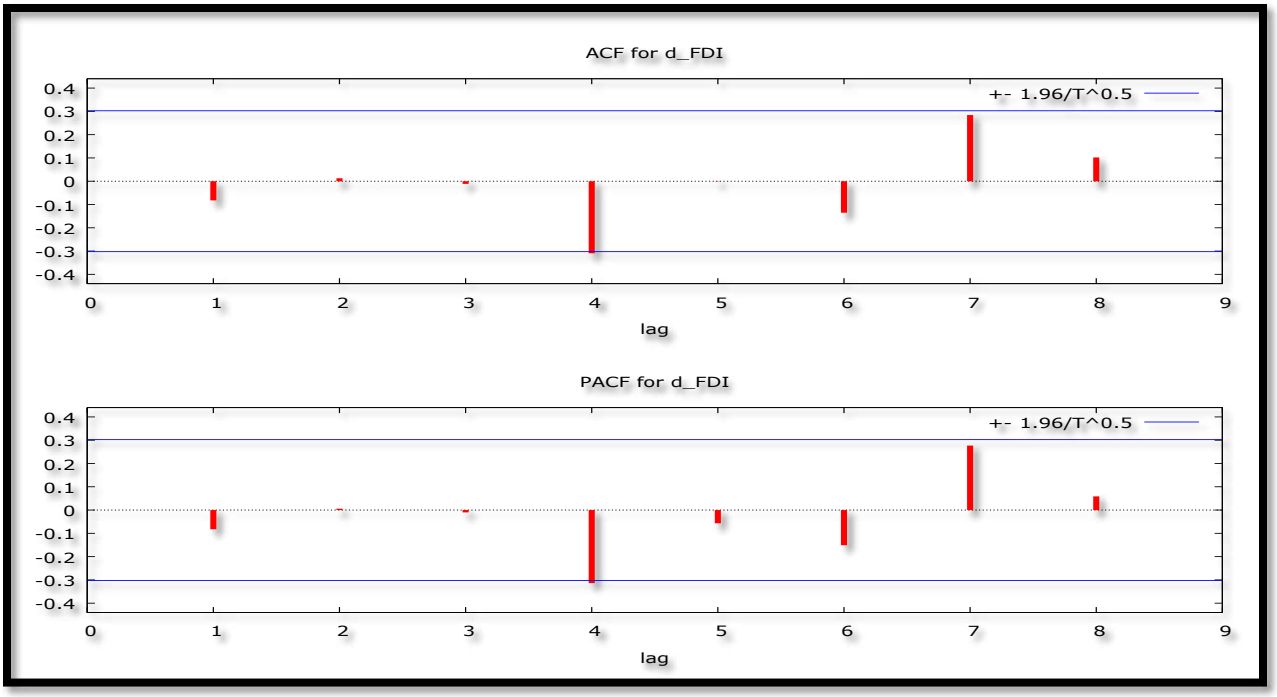


Table 4: 1st Difference-intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	-6.701686	0.0000	-3.600987	@1%	Stationary
			-2.935001	@5%	Stationary
			-2.605836	@10%	Stationary

Table 5: 1st Difference-trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	-6.817384	0.0000	-4.198503	@1%	Stationary
			-3.523623	@5%	Stationary
			-3.192902	@10%	Stationary

Table 6: 1st Difference-without intercept and trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
FDI	-6.519517	0.0000	-2.622585	@1%	Stationary
			-1.949097	@5%	Stationary
			-1.611824	@10%	Stationary

Figure 3 and tables 4 – 6 demonstrate that the Indian FDI series is stationary in first differences and thus I (1).

4.2 Evaluation of ARIMA models (without a constant)

Table 7

Model	AIC	U	ME	MAE	RMSE	MAPE
ARIMA (1, 1, 1)	2001.964	**0.9925**	990300000	2688600000	5049300000	51.333

ARIMA (1, 1, 0)	**1999.985**	0.99276	993010000	2685700000	5050600000	51.293

A model with a lower AIC value is better than the one with a higher AIC value (Nyoni, 2018). The researcher will only make use of the AIC in selecting the optimal model. Thus, the ARIMA (1, 1, 0) model was preferred.

Residual & Stability Tests

ADF Tests of the Residuals of the ARIMA (1, 1, 0) Model

Table 8: Levels-intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
ε_t	-6.361404	0.0000	-3.605593	@1%	Stationary
			-2.936942	@5%	Stationary
			-2.606857	@10%	Stationary

Table 9: Levels-trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
ε_t	-6.471011	0.0000	-4.205004	@1%	Stationary
			-3.526609	@5%	Stationary
			-3.194611	@10%	Stationary

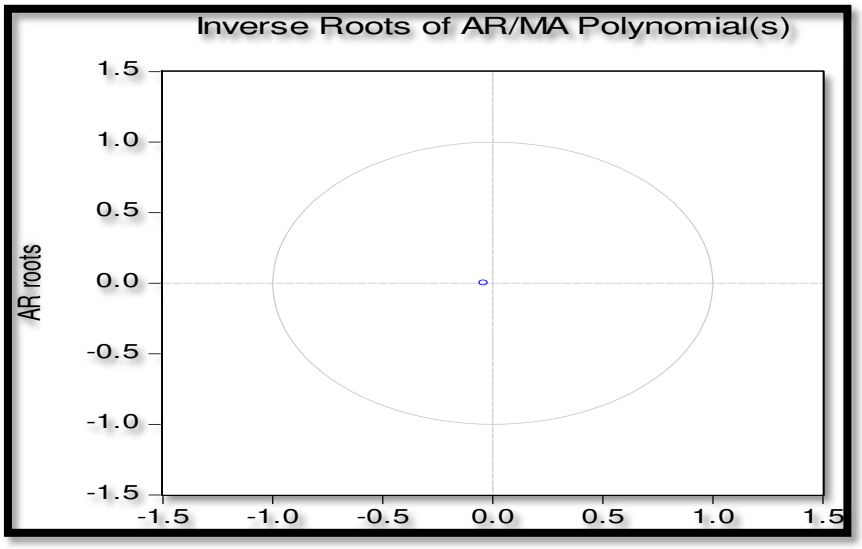
Table 10: without intercept and trend & intercept

Variable	ADF Statistic	Probability	Critical Values		Conclusion
ε_t	-6.173446	0.0000	-2.624057	@1%	Stationary
			-1.949314	@5%	Stationary
			-1.611711	@10%	Stationary

The residuals of the chosen optimal model are stationary as illustrated in tables 8 – 10 above.

Stability Test of the ARIMA (1, 1, 0) Model

Figure 4



As illustrated in figure 4 above, the ARIMA (1, 1, 0) model is stable as the corresponding inverse roots of the characteristic polynomial lie in the unit circle.

5.0 FINDINGS

Descriptive Statistics

Table 11

Description	Statistic
Mean	10460000000
Median	2168600000
Minimum	-36060000
Maximum	44459000000
Standard deviation	15306000000
Skewness	1.1932
Excess kurtosis	-0.22068

The average net FDI in India over the study period is positive, i.e 10460000000 USD. The minimum net FDI is -36060000 USD while the maximum is 44459000000 USD. Skewness is 1.1932 and it's positive, meaning that the India's net FDI over the period under study, is positively skewed and non-symmetric. Excess kurtosis is -0.22068, meaning that the FDI series is not normally distributed.

Results Presentation[1]

Table 12

ARIMA (1, 1, 0) Model:

$$\Delta FDI_{t-1} = -0.0389045\Delta FDI_{t-1} \ldots \ldots \ldots \ldots [2]$$

P: (0.8026)

S. E: (0.155654)

Variable	Coefficient	Standard Error	z	p-value
AR (1)	-0.0389045	0.155654	-0.2499	0.8026

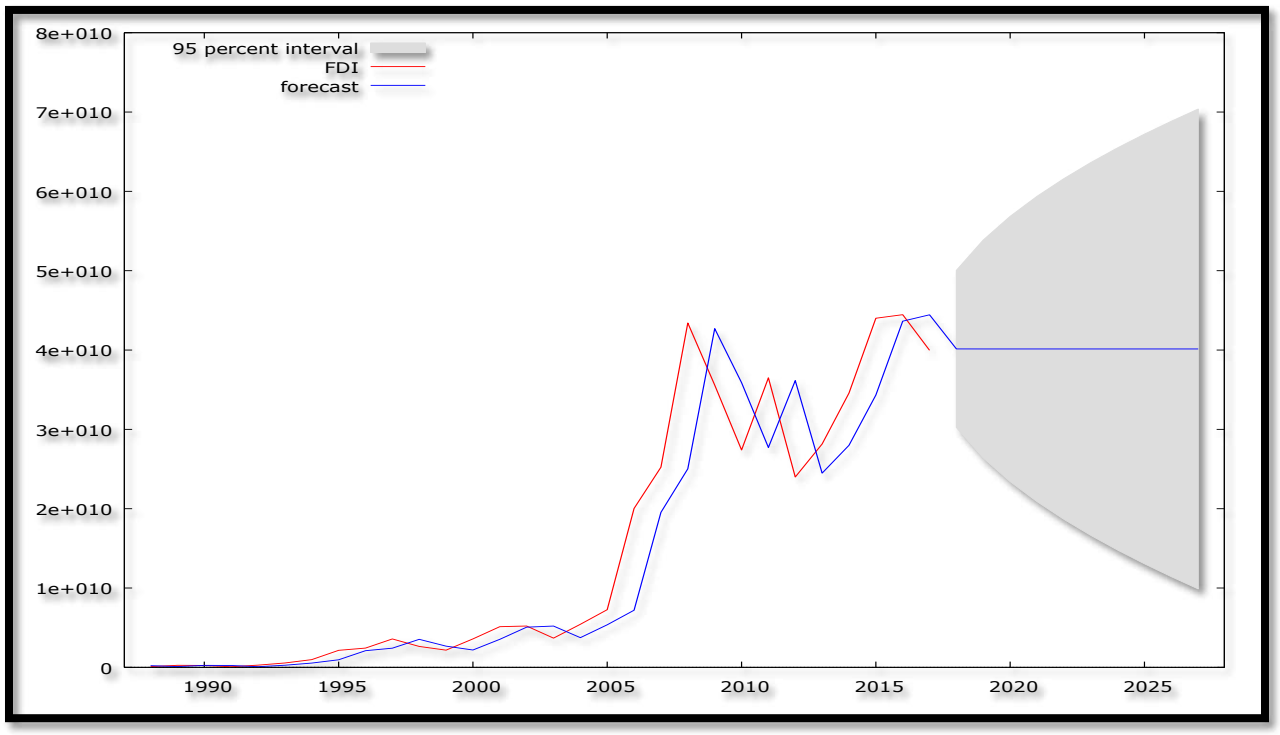
6.0 Interpretation of Results

The coefficient of the AR (1) is positive and statistically insignificant. The model shows that a 1% increase in previous period net FDI inflows will lead to approximately 0.04% decrease in the current net FDI inflows in India, but since the AR (1) coefficient is insignificant, it again reveals another salient issue: that the described interaction is less important in explaining current and future values of net FDI inflows in India.

[1] *The *, ** and *** means significant at 10%, 5% and 1% levels of significance; respectively.*

Forecast Graph

Figure 5



Our best-fit model, the ARIMA (1, 1, 0) model predicts that India's net FDI is likely to be lingering somewhere around USD 40 134 300 000 per year over the next decade. This may be rectified in the event that comprehensive policy actions are made in terms of improving not only the general investment environment but also the particular FDI policy stance of India.

6.1 Policy Implications

I. The Indian government should thrive to create a general investor friendly environment if FDI inflows are to increase in India. This may be through strengthening a one-stop window clearance system to easy the approval processes.

II. The Indian government should also take more stern measures against corruption, especially political corruption which continues to frustrate both domestic and foreign investors in India.

7.0 CONCLUSION

This study showed that the ARIMA (1, 1, 0) model is the optimal model to model and forecast net FDI inflows in India. The study illustrates that net FDI inflows in India are expected to degenerate over the next decade, as long as nothing is done to improve the investment environment in the Indian economy.

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