Impact of Macroeconomic Variables on FDI: Regression Analysis and Forecasting using Time Series Data

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Abstract

Foreign Direct Investment (FDI) refers to investments made in a country by investors, companies, or governments of another country. It is of great importance to any economy for its growth. This paper studies the impact of inflation rate, GDP growth rate, trade openness, and real interest rate on FDI in India. Using data on the aforementioned variables collected for the years 1978-2021 from the open-source database of the World Bank, the paper focuses on finding a correlation between FDI and each macroeconomic variable considered in this paper. Further, this paper uses a multiple linear regression model and the data has been analysed based on that. The results of the study show a correlation between the FDI and the macroeconomic variables and the econometric rules out GDP growth rate from this model. Further, Dynamic Regression model has been used to predict the FDI (as a percentage of GDP) for the next 40 years.

Keywords: Foreign Direct Investment, Inflation Rate, Real GDP Growth Rate, Stability, Real Interest Rate, Trade

1. Introduction

Foreign Investment is of two broad types- Direct and Indirect. Direct investment gives a direct ownership to the investor. Foreign Direct Investment (FDI) is the main type of

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investment that falls into this category. When an investor spends to get direct ownership of assets in another country, the investment done is a Foreign Direct Investment (Osei et al. 2023) while Foreign Portfolio Investment (FPI), an indirect foreign investment, refers to equity investments, such as stocks and debt investments, such as bonds (Lipsey et al. 1999). A rapidly expanding economy with a stable political administration and other factors that lead to booming markets with high demand make a country attractive to foreign investors (Heise et al. 2015). The plethora of benefits that FDI brings with itself is what incentivizes a country to attract foreign investors. These benefits, accrued by both parties, include tax incentives, job creation, etc. The country where the investment is done, and the country of residence of investors, both the countries reap the benefits. So, the significance of FDI is acknowledged the world over (Kumari et al. 2023). FDI gives an impetus to economic cooperation and global integration as it sets the stage for long-lasting ties between various economies. International organisations like United Nations Conference on Trade and Development (UNCTAD) and World Trade Organisation (WTO) have prioritised FDI and have functioned towards helping developing countries attract foreign inflow (Scherer et al. 2000). The investor could be an individual, a firm, or a government. The investor, eyeing increases in profits, undertakes an expansion of operations to a new area. Another form of foreign investment is FPI (Sumathy, M. 2023). Unlike FDI, it is an indirect investment wherein the investor gets the ownership of securities issued by companies such as stock in foreign corporations and other similar financial assets (Lipsey et al. 1999)

It has been a common trend worldwide that countries with policies that facilitate foreign investment grow at faster rates (Luo et al. 2010). The People's Republic of China, for instance, was not in a good state in the early decades of its formation (Osei et al. 2020). Ineffective government policies, major famines, and natural disasters caused a deterioration of the economy. This changes the reforms of 1978 that liberalised the economy and allowed foreign investors to invest. The resulting rapid inflow of investments took the country to the path of prosperity from the ravages of poverty. From a comparatively minuscule amount of 80,000 current US$ in 1979, the FDI inflow of China leaped to 333.98 billion in 2021 (Source: World Bank, 2021).

India has also reaped the benefits of rapid FDI inflow, especially after the economic restructuring in the 1990s. The country was facing a major Balance of Payments (BOP) crisis at that time (Kolte et al. 1991) due to the government's policy of license Raj and closed economy which made it nearly impossible for foreigners to invest. The liberalisation policies undertaken in 1991 led to a drastic shift in the economy from a protective system to an open economy. Investments started pouring in and the country's growth and development saw a major boost which allowed it to recover from the crisis (Dinh et al. 2019).

FDI is an economic factor that is dependent on various factors and it has a two-way relationship with some variables (Basu et al. 2003). This leads to the central question of this paper, i.e., what are the fundamental macroeconomic factors that are responsible for determining FDI levels in the Indian economy? After a thorough review of the literature, the authors of this paper have decided to analyse the impact of the following variables - rate of inflation, growth rate of real GDP, trade openness and real rate of interest (Hayat et al. 2019). Data for 44 years (1978-2021) of the Indian economy has been collected for each of these four variables along with FDI inflows from the open-source database of the World Bank. The next section gives the details of how these variables impact FDI flows. Section 3 is a review of the recent literature. Section 4 explains the research methodology used which includes a discussion of the data, econometric modelling, and forecasting. Section 5 depicts the results of the descriptive analysis and econometric analysis. Section 6 concludes the results of the paper and discusses the limitations; Section 7 contains the reference list while Section 8 is the appendix which has the data used as the reference for the study.

2. Impact of the variables on FDI

2.1. Rate of Inflation

Many studies have stated that inflation is a major irritant for economies worldwide (Ayyoub et al. 2011). Though its impact on Foreign Direct Investment has been debated, many economists and researchers propose that inflation and FDI are negatively related (Agudze et al. 2021). They have stated that a low or controlled inflation is a sign of internal economic stability in a country, thereby making it suitable for investment by foreigners (Badwan 2021).

The returns on investment are higher in such a country. Notwithstanding this, several researchers have questioned these claims. They state that there is no clear relationship between inflation and FDI. Others have propounded a possible positive impact of inflation on FDI.

2.2. Growth of Real GDP

The Gross Domestic Product (GDP) after the adjustment of prices is Real GDP. Countries with high real GDP growth generally see higher FDI inflows as compared to low-growing economies (Boateng et al. 2015). This has been attributed to the greater profitability of investment and larger market and demand in rapidly growing economies (Mughal et al. 2011). Countries like China have been cited as examples. However, another idea is that often countries with lower growth rates of Real GDP have unused resources like labour in large amounts which attracts foreign investors intending to tap the potential.

2.3. Trade Openness[2]

Taxes, import and export duties, customs duties, etc. come in the purview of openness of trade (Squalli et al. 2011). Heavily taxed products have a low demand in the country, making it unprofitable for investors to invest. For instance, the PLI scheme of the Indian Government put a 100 percent import duty on Tesla vehicles. This has been a leading cause, among others, of Tesla not investing in India. Special Economic Zones are now being provided to facilitate foreign investment in the country (Zeng 2015). Several studies have formed a general consensus on the openness of trade being crucial for FDI inflow. Many nations have taken measures to open up trade as a result.

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[2]The proxy variable for trade openness used in the model is Imports as a percentage of GDP

2.4. Real Rate of Interest

Inflation adjusted interest rate is the real rate of interest. Any investor or firm is concerned about the real rate as it determines the returns they receive from the investment. Hence, not only fiscal policy but a sound monetary policy also plays an important role in garnering investment from other countries (Albulescu et al. 2018).

3. Literature Review

Various literatures have defined FDI as an ownership stake in a company or project abroad (Duce et al. 2003). Typically, the phrase refers to a corporate decision to buy a sizable portion of a foreign company or to buy it altogether in order to expand operations to a new area. The phrase is typically not used to refer to a stock purchase in a single overseas firm. FDI is a crucial component of global economic integration (Lane et al. 2018) since it forges strong, long-lasting ties between nations' economies. This accounts for major movements in global capital (Lipsey et al. 1999). FDI capital can account for a sizable portion of the GDP of smaller and emerging nations (Adeniyi et al. 2012). In contrast to direct capital investments, foreign portfolio investment (FPI) entails the ownership of securities issued by companies such as stock in foreign corporations (Sabir et al. 2019).

Mergers, acquisitions, or joint ventures in the retail, service, logistics, or manufacturing sectors may be part of foreign direct investments (McCaleb et al. 2017). They point to a global business expansion plan. Some literatures state that the One Belt One Road (OBOR) of China is a monumental initiative in FDI and a major example of it (Sarker et al. 2018). This initiative, also known as the Belt and Road Initiative, entails China's promise to significant FDI in a number of infrastructure projects throughout Africa, Asia, and even some regions of Europe. Typically, the program is supported by Chinese state-owned businesses and other entities with strong ties to the Chinese government (Sarker et al. 2018). Other countries and international organizations, such as the United States, the European Union, and Japan, run initiatives of a similar nature. They may also encounter regulatory issues. For instance, the U.S. business Nvidia announced in 2020 that it would buy the British chip

designer ARM. The U.K.'s competition authority stated in August 2021 that it would investigate whether the $40 billion transaction would lessen competition in sectors that depend on semiconductor processors. The agreement was terminated in February 2022 (Elster et al. 2022).

An infusion of FDI aimed at China's high-tech industries and services has boosted the country's economy (Chen et al. 2011). The government no longer needs to approve 100 percent of foreign direct investment in single-brand retail in India due to more recently loosened FDI restrictions.

Horizontal, vertical, and conglomerate categories are frequently used to describe foreign direct investments. A company operates abroad by extending the business activities in a foreign nation that it does in its own country using a horizontal FDI. An example would be a U.S.-based cell phone company purchasing a Chinese chain of phone shops. A company purchases a complementary company in another nation through vertical FDI. For instance, a US business may buy stock in a foreign firm that provides it with the raw resources it requires. In a conglomerate FDI, a company makes an investment unrelated to its main line of operation. This frequently takes the form of a joint venture because the investing business may not have undertaken such activities with the level of expertise as of the foreign company (Moritz et al. 2019).

Based on a sample of 32 developing nations, a study was conducted by Khachoo et al (2012). In the analysis, FDI inflows are modelled as a function of the host countries' economic and socioeconomic factors. The panel data estimator reveals that the primary predictors of FDI inflows to developing nations are the size of the market, total reserves, infrastructure, and labour costs using data from 1982 to 2008 (Khachoo et al., 2012).

FDI has seen a major upsurge in recent decades across the world. The rise has been even greater than that of global trade (Lin et al. 2017). This has been an established trend with the rise of globalization. Blonigen (2005) has argued that firms can utilize their services to a larger extent and generate more wealth with less effort (Blonigen 2005). The UNCTAD in 1998 stated three types of factors influencing FDI inflow to a country: Economic factors,

Political Factors, and Business Facilitation. Among various factors, the economic cycle, political and economic stability, development of financial markets and institutions, law and order, trade openness, and restrictions on capital mobility determine FDI inflow (Boateng et al. 2015; Petri et al. 2012). Several authors such as Almsafir et al (2011) and Chhandran et al (2008) among many others have highlighted the contribution of the Exchange Rate, Inflation, Foreign Exchange Reserves, and manufacturing growth of a country to the growth of FDI in it. This has been observed in various economies (Almsafir et al. 2011; Chandran et al. 2007).

Large economies like India have immensely benefited from high amounts of FDI. They have seen unprecedented economic growth when policies favour FDI inflow (Kumar 2014). So, analysis of all the indicators affecting FDI is important for any country trying to attract Foreign Investors and increase investment.

3.1. Inflation Rate and FDI:

Sayek's dynamic modelling of a multinational company's investment choices has made it possible to examine how the multinational company responds to sudden changes in local and international inflation (Melitz 2003). The cost of investing during period t is reflected in the foregone consumption, while the benefit is shown in higher consumption in period $t + 1$ due to more capital that has not been depreciated and higher consumption in period $t + 2$ as a result of higher production in period $t + 1$.

A study has found that low inflation implies a lower cost of capital, enabling the investors to utilize its resources easily (Bodea et al. 2015). The net benefit of investing decreases as inflation increases because, during this time, the purchasing power of the profits becomes diminished before they are used for consumption. The model's key prediction, which is based on a consumer's lifetime utility and has empirical ramifications, is that the actual effects of nominal variables rely on the type of foreign investment (vertical or horizontal), the foreign investment's financing patterns, and the components of production's interchangeability (Devereux et al. 2001).

The findings have stated that FDI is useful for reducing the severity of inflation's negative real impacts. This conclusion adds to the body of research supporting the potential advantages of permitting more capital account liberalization and FDI flow freedom (Bacchetta et al. 2000).

3.2. Real GDP growth rate and FDI:

Much of the relevant literatures agree that FDI and Real GDP growth have an implication on each other (Kisswani et al. 2015).From the data of 31 developing nations spanning 31 years, Hansen et al. examined the Granger causal linkages between for FDI and GDP (Aizenman et al. 2004). They find bi-directional causality between the FDI-to-GDP ratio and GDP level using estimators for heterogeneous panel data. GDP does not cause the FDI-to-GDP ratio in the long run, whereas FDI-to-GDP causes GDP. That is how FDI causes growth. In a model for GDP and FDI, Gironi et al (2005) find the long-term impact of FDI on GDP taking the former as a proportion of gross capital formation (GCF) (Gironi et al. 2005).

This result may be seen as supporting the theory that FDI affects GDP through knowledge transfers and the adoption of newer and improved technology. Inferring that the predicted gain from FDI to the African region should, in theory, be comparable to how FDI has impacted the regions of Asia and Latin America, they found no major differences in the total impact across regions (Sayek et al. 2009). Furthermore, they conclude that the suggested thresholds are difficult to find when country-specific elements and GDP levels are taken into account in the model through more informal analyses of whether the influence varies with particular development indices. Overall, they show that regardless of the level of development, FDI generally has a large long-term influence on GDP (Mustafa 2019).

3.3. Openness of Trade and FDI:

In a study on India, Pakistan and Iran, it was observed that India and Pakistan have seen an increase in trade openness during the past five years (from 2008 to 2012), but FDI inflows have decreased over the same period for India, Iran, and Pakistan. All three nations have distinct borders, diverse governmental structures, and distinct monetary systems (Agudze et al. 2021).

The liberalization of policies in trade is significant since it affects the economic activity and output levels. It has been obvious that high duties dis-incentivize investors from investing in a country (Rolfe et al. 1993). International investors are always willing to put their money into countries with good infrastructure, markets, and policies. Thus, FDI inflows are solely induced by the environment of the host country (Hansen et al. 2006).

In order to confirm that the research study supports the idea that there is headroom for developing nations to correct and maintain the economic development indicators, so the FDI inflows would be sustainable, Donghui et al. (2018) examined data sets from three countries between 1982 and 2012 periods. They have concluded that openness of trade is important to inflow of FDI. Therefore, the conclusion shows that greater trade openness enhances the inflow of FDI both in the short- and long term. (Carkovic et al. 2005)

Similarly, a study by Liargovas et al. (2012) has focused on how impactful the trade openness for luring Foreign Direct Investment (FDI) inflows, using a sample of 36 developing economies for the years 1990-2008. It directly examines the question of the relationship between trade openness, FDI inflows, and other significant variables in Latin America, Asia, Africa, the Commonwealth of Independent States (CIS), and Eastern Europe. Eight distinct metrics are used to gauge trade openness. The panel regression analysis's key empirical findings show that, over time, openness of trade has a beneficial impact on the flow of FDI into emerging economies (Basu et al. 2003).

3.4. Real Rate of Interest and FDI:

Real interest rates have an impact on the direction of investments across the world. Foreign investors, looking for high returns, increase investment in response to high interest rates (Siddiqui, 2014). Interest is a cost of borrowing but a return on saving. Investors tend to resort to the borrowing sources charging low rates of interest and invest in an environment where the rates are high. Therefore, foreign capital moves from countries with low rates to those with a comparatively higher rate of real interest (Siddiqui, 2014). Chakrabarti (2001) found a positive relation between interest rate and FDI in India. But this was not the case for some other countries like Zimbabwe.

While there are differing results from various studies about the impact of these variables on FDI, this paper contributes to the body of literature by providing a detailed analysis of the behaviour of these macroeconomic variables in terms of their impact on FDI in India. It establishes the unidirectional impact of these variables on FDI using an econometric model. The model and analysis have been explained in the following section.

4. Research Methodology

The methodology of this paper is primarily based on a collection of data from the database of the World Bank. The data was collected on the inflation rate (GDP deflator), GDP growth rate, real interest rate, trade openness (using imports as a % of GDP), and FDI (as a % of GDP). It is to be noted that the variables are taken in percentage form.
The data collected is for 44 years, from 1978 to 2021.

Firstly, descriptive statistics have been used to check whether a correlation between FDI and each of the macroeconomic variables exists or not. The correlation has been measured using Karl Pearson's Correlation Coefficient.

Further an Econometric Model has been developed for the dependent variable (foreign direct investment) in terms of the independent variables. In this model, OLS regression is used as

all the variables have been taken in percentage form {Inflation rate, Trade Openness (Imports as a % of GDP), GDP growth rate (annual %), and real interest rate (%)}.

The econometric model is as follows:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + ... + \beta_p x_{ip} + \epsilon$$

(1)

In the above model, the dependent variable has been chosen as $\hat{Y}$ whereas x_{i1}, x_{i2}, x_{i3} and x_{i4} are the independent variables.

x_{i1} = Inflation Rate

x_{i2} = Real GDP Growth Rate

x_{i3} = Trade Openness

x_{i4} = Real Interest Rate

4.1. Hypotheses

There are four hypotheses that are tested in the paper:

- Null Hypothesis, H_0: There is no impact of these variables on FDI ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$)
- Alternative Hypothesis, H_A: FDI is affected by at least one of other macroeconomic variables ($\beta_i \neq 0$, for i = 1, 2, 3, 4)

As a result, the following hypotheses are being tested:

- H_1: The inflation Rate does not have any impact on FDI($\beta_1 = 0$); H_{A1}: Inflation Rate has an impact on FDI ($\beta_1 \neq 0$)
- H_2: Growth Rate of real GDP does not have any impact on FDI($\beta_1 = 0$); H_{A2}: Growth Rate of real GDP has an impact on FDI ($\beta_2 \neq 0$)
- H_3: Trade Openness does not have any impact on FDI ($\beta_3 = 0$); H_{A3}: Trade Openness has an impact on FDI ($\beta_3 \neq 0$)

- H_4: Real Interest Rate does not have any impact on FDI ($\beta_4 = 0$); H_{A4}: Real Interest Rate has an impact on FDI ($\beta_4 \neq 0$)

4.2. Data Analysis

Further, the data was organized in the form of a table in Microsoft Excel in order to analyze the mean values of each of the above-mentioned variables. The study revolves around the factors affecting Foreign Direct Investment. Thus, Karl Pearson's correlation coefficient has been calculated for FDI with each of the other macroeconomic variables used. After analyzing the degree of correlation between the FDI and other macroeconomic variables, an econometric model has been used keeping FDI as the dependent variable while keeping all other macroeconomic variables as explanatory variables. After categorizing the variables, multivariate regression was applied in order to find a linear relationship between the dependent and the explanatory variables.

4.3. Formula and calculation

Table 1 depicts the descriptive statistics of all variables studied in this paper. It is also to be noted that the correlation has been calculated between net inflows of FDI (as a percentage of GDP) and the other variables considered, as shown in Column 7. The other columns depict the mean, standard error, median, standard deviation, and sample variance of all the five variables.

Table 1: Descriptive Statistics

VARIABLE	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Correlation
Foreign direct investment, net inflows (% of Gross Domestic Product)	0.926	0.136	0.695	0.906	0.821	-
Trade Openness (Imports as a % of Gross Domestic Product)	15.974	1.191	13.399	7.905	62.493	0.875
Real interest rate (%)	5.671	0.423	5.839	2.807	7.884	-0.364
Inflation, GDP deflator (annual %)	7.225	0.47	7.749	3.12	9.735	-0.331
GDP growth (annual %)	5.595	0.474	6.095	3.149	9.916	0.027

Source: Authors' calculations based on World Bank data

Table 2 gives the results of the regression. It shows the coefficient of each variable, also known as partial slope coefficients; and a standard error that is useful in determining the width of the confidence interval and also in detecting the presence of any violation of the assumptions of multiple linear regression models. Further, this table also gives the t-stat, essentially the critical t-value and the p-value for testing the significance of partial slopes of each variable in the study.

Table 2: Coefficients, t-stat, and p-value

Variables	Coefficients	Standard Error	t-stat	p-value
Intercept	-0.911	0.765	-1.189	0.241
Imports of goods and services (% of Gross Domestic Product)	0.116	0.015	7.346	7.21E-09
Real interest rate (%)	0.058	0.051	1.155	0.255
Inflation, GDP deflator (annual %)	-0.0008	0.04	-0.021	0.983
GDP growth (annual %)	-0.061	0.021	-2.826	0.007
R^2	0.8132			
Observations	44			

Source: Authors' calculations based on World Bank data

Here, the coefficient of each variable, β_i, explains the percent change in FDI due to a percent change in a particular independent variable, keeping other variables constant. The coefficient of the intercept term represents the expected value of FDI (%) when all independent variables are zero. The sign of the coefficients suggests that liberalizing trade and higher real interest rates have a positive impact on FDI, i.e., it increases in a more liberal economy or an economy with a high-interest rate. Furthermore, inflation rate and GDP growth rate of the Indian economy has a negative impact on FDI. However, the coefficient of GDP growth rate is not significant. It has been further explained in Section 5.

Table 3 depicts the results of regression analysis which have been later explained in the results. Multiple regression (OLS) has been used in the model from the data available for 44 years.

Table 3: Regression Statistics

Regression Statistics	Values
Multiple R	0.9018
R Squared	0.8132
Adjusted R Squared	0.7940
Standard Error	0.4115
Observations	44

Source: Authors' calculations based on World Bank data

4.4. Forecasting of FDI using Dynamic Regression Model

Further, this study uses the Dynamic Regression Model to forecast the amount of FDI using the estimated values of the independent variables for the years 2022-2061. The dynamic regression statistics are shown in Table 9 (Appendix). Firstly, a dynamic regression model is built keeping FDI as the dependent variable while keeping trade openness, inflation rate, GDP growth rate and real interest rate as the independent variables.

Further, the independent variables have been forecasted using Auto-Regressive Integrated Moving Average (ARIMA) and then these forecasted values have been used in the dynamic regression model created earlier to determine the dependent variable, i.e., FDI.

ARIMA has three components: Autoregression, that is the autocorrelation present in the model (AR); differencing (I), and moving average (MA). The notation of these components is in the form of (p, d, q), where p represents the nature of correlation, d represents the order of differencing used in making the data stationary, and q represents the order of moving average that is based on capturing the relationship between the observation and past forecast errors.

A dynamic regression model analyzes the relationship between the dependent and the independent variable and forecasting using this model captures the impact of the forecasted values of the independent variables on the values of the dependent variable (that are to be forecasted). This model also takes into account the dynamic nature of the relationships

between these variables, unlike the multiple regression models, which assumes the relationship to be stationary.

Different ARIMA models have been used for different independent variables:

Trade Openness – ARIMA (0,1,0)

Real Interest Rate – ARIMA (0,1,1)

Inflation Rate – ARIMA (1,1,0)

GDP Growth Rate – ARIMA (0,0,0) with non-zero mean

The forecasted values have been used in the dynamic regression model which is shown in Section 5.4.

On forecasting the independent variables using ARMIA, the following values are obtained:

Table 4: Forecasted values of the Independent Variables

Imports	GDP Growth	Inflation	Real Interest Rate
23.892	5.595931818	7.934658489	2.798256573
23.892	5.595931818	8.879984568	2.798256573
23.892	5.595931818	8.440057854	2.798256573
23.892	5.595931818	8.644786696	2.798256573
23.892	5.595931818	8.549511967	2.798256573
23.892	5.595931818	8.593849999	2.798256573
23.892	5.595931818	8.573216394	2.798256573
23.892	5.595931818	8.582818662	2.798256573
23.892	5.595931818	8.578350051	2.798256573
23.892	5.595931818	8.58042961	2.798256573
23.892	5.595931818	8.579461845	2.798256573
23.892	5.595931818	8.579912214	2.798256573
23.892	5.595931818	8.579702626	2.798256573
23.892	5.595931818	8.579800162	2.798256573
23.892	5.595931818	8.579754772	2.798256573
23.892	5.595931818	8.579775895	2.798256573
23.892	5.595931818	8.579766065	2.798256573

23.892	5.595931818	8.57977064	2.798256573
23.892	5.595931818	8.579768511	2.798256573
23.892	5.595931818	8.579769501	2.798256573
23.892	5.595931818	8.57976904	2.798256573
23.892	5.595931818	8.579769255	2.798256573
23.892	5.595931818	8.579769155	2.798256573
23.892	5.595931818	8.579769202	2.798256573
23.892	5.595931818	8.57976918	2.798256573
23.892	5.595931818	8.57976919	2.798256573
23.892	5.595931818	8.579769185	2.798256573
23.892	5.595931818	8.579769187	2.798256573
23.892	5.595931818	8.579769186	2.798256573
23.892	5.595931818	8.579769187	2.798256573
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23.892	5.595931818	8.579769187	2.798256573
23.892	5.595931818	8.579769187	2.798256573
23.892	5.595931818	8.579769187	2.798256573

Source: Authors' calculations

5. Results and Analysis

5.1. Correlation between Foreign Direct Investment and the Macroeconomic Variables affecting it

This section analyses the results of descriptive statistics of the study - the correlation between FDI and each of the macroeconomic factors considered in the study, and the average value of all variables considered in the study.

Graph 1 shows the scatter plot of FDI (to India) and the annual rate of inflation in India from 1978-2021. Through analysis, the value of Karl Pearson's correlation coefficient, r, for these two variables was determined to be -0.331. This is a moderately low value and shows a

relationship between FDI and the Inflation Rate is weak. Further, a negative value of the correlation coefficient also suggests that as the inflation rate increases in the economy, FDI falls.
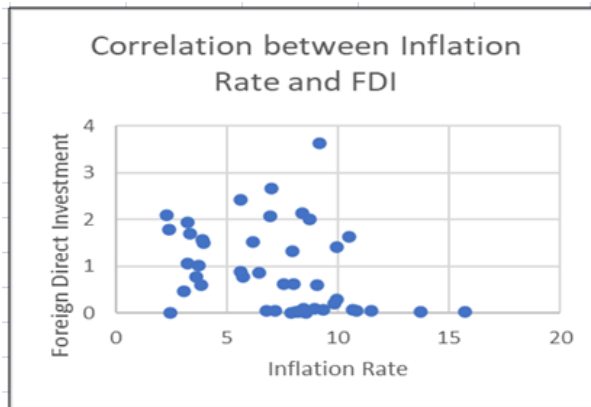
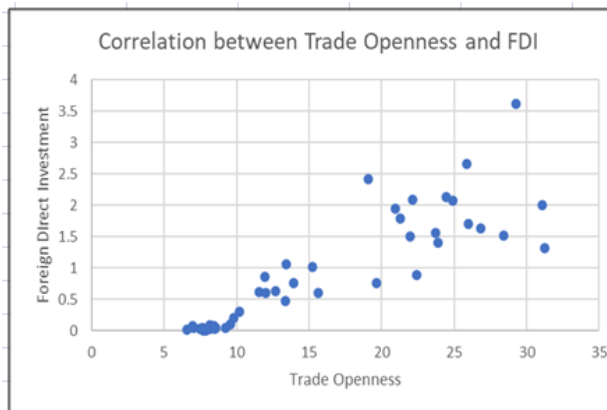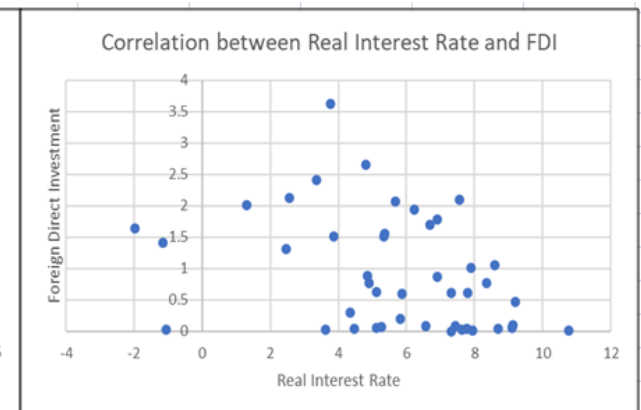Graph 1   Graph 2
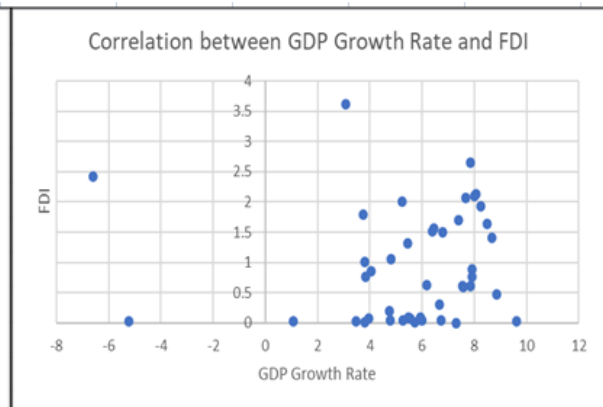
Graph 3   Graph 4

Source: Authors' calculations

Graph 2 depicts the scatter plot of FDI of India and the GDP Growth Rate of India for the years 1978-2021. The value of Karl Pearson's correlation coefficient, r, for these two variables was determined to be 0.027. This is a low value and shows that the relationship between FDI and the GDP growth rate is weak. Further, the positive value of the coefficient shows that the two variables move in the same direction.

Graph 3 depicts the scatter plot of FDI and the Trade Openness of India from 1978-2021. The value of Karl Pearson's correlation coefficient, r, for these two variables, was determined to be 0.875. This is a high value and confirms a strong relationship between FDI and Trade Openness.

Graph 4 depicts the scatter plot of FDI and the Real Interest Rate of India from 1978-2021. The value of Karl Pearson's correlation coefficient, r, for these two variables was determined to be -0.364. This is a moderately low value and suggests that the relationship between FDI in India and Trade Openness is moderately weak. The negative value also suggests that an increase in the real interest rate in the economy decreases the amount of FDI in India.

5.2. Results of Econometric Analysis

From Table 3, the R Squared obtained has the value of 0.813 which is considered to be high. This explains that roughly 81.3% of the variability in the Foreign Direct Investment of India can be explained by the independent variables for the given time period of 1978-2021. Thus, the macroeconomic variables - inflation rate, GDP growth rate, trade openness, and real interest rate together have a considerable impact on the variability of Foreign Direct Investment. In addition to this, the adjusted R squared (with adjustment of the degrees of freedom) is 0.794 or 79.4%. This further confirms the above conclusion.

Further, the level of significance for this study is taken as 1% or 0.01 and as per the table, F is 42.435 (refer to Table 2), which is significantly higher than the critical F value. Thus, the null hypothesis that these variables do not impact the FDI is rejected. Now, this suggests that FDI is dependent upon at least one of the independent variables. We further test the hypothesis of whether the partial slopes are significant or not.

Thus, the results of the P-value in Table 3.2 are considered. On basis of the results of table 3.2, the hypothesis that intercept term is zero in this study is rejected. Further, the null hypothesis that the inflation rate does not impact the FDI of India is rejected. Thus, the inflation rate has an impact on FDI for the years 1978-2021.

From the values in the same table, it can be concluded that Foreign Direct Investment is accepted as it is statistically significant. Thus, in this study the real GDP growth rate does not have an impact on the Foreign Direct Investment for the years 1978-2021.

For trade openness, the null hypothesis is rejected and thus trade openness impacts the Foreign Direct Investment of India for the years 1978-2021. For the real interest rate, the null hypothesis which states that real interest does not impact Foreign Direct Investment is rejected. Thus, the real interest rate has an impact on the Foreign Direct Investment of India for the years 1978-2021.

The results of this model show that in this study the GDP growth rate does not have a considerable impact on FDI. Thus, we drop this variable from the model and run the OLS regression again.

5.3. Regression analysis and hypothesis testing after dropping the insignificant variable

The regression results are depicted in Table 5:

Table 5: Results after removing the insignificant variables from the model

	Coefficients	Standard Error	t-Stat	p-value	Lower 95%	Upper 95%	Lower 99.0%	Upper 99.0%
Intercept	-0.76	0.828	-0.918	0.364	-2.433	0.913	-2.999	1.479
Imports of goods and services (% of GDP)	0.103	0.016	6.293	1.83E-07	0.069	0.136	0.058	0.147
Real interest rate (%)	0.022	0.053	0.412	0.682	-0.086	0.13	-0.122	0.166
Inflation, GDP deflator (annual %)	-0.011	0.043	-0.27	0.787	-0.099	0.075	-0.128	0.105

Source: Authors' calculations

According to the results (Table 8, Appendix), F is calculated and found to be 45.89, indicating that the null hypothesis that inflation rate, trade openness, and real interest rate do not have an impact on the FDI is rejected. Thus, these three variables still have a significant impact, even when the GDP growth rate has been dropped from the model.

Further, it can be seen that on testing the significance of partial slopes of these three variables at a level of significance of 1% in this study the p-values of the inflation rate, trade openness, and real interest rate are 0.78, 1.827E-07, and 0.68 respectively. Thus, the null hypothesis of this study that the partial slopes do not have impact FDI individually is rejected in the three cases. Thus, in this study, these variables have an impact on the FDI. Lastly, the p-value of the intercept term is 0.36, and thus, the null hypothesis is again rejected.

The coefficient of the partial slopes is as follows:

$\beta = -0.760$

$\beta_1 = -0.012$

$\beta_2 = 0$ **(removed from the model)**

$\beta_3 = 0.103$

$\beta_4 = 0.022$

5.4. Results of forecasting of FDI using the Dynamic Regression Model

Table 6: Results of forecasting of FDI

Year	Predicted FDI
2022	1.674043908
2023	1.673279513
2024	1.67363524
2025	1.673469695
2026	1.673546735
2027	1.673510883
2028	1.673527567
2029	1.673519803
2030	1.673523416
2031	1.673521734
2032	1.673522517
2033	1.673522153
2034	1.673522322
2035	1.673522243

Year	Value
2036	1.67352228
2037	1.673522263
2038	1.673522271
2039	1.673522267
2040	1.673522269
2041	1.673522268
2042	1.673522269
2043	1.673522268
2044	1.673522268
2045	1.673522268
2046	1.673522268
2047	1.673522268
2048	1.673522268
2049	1.673522268
2050	1.673522268
2051	1.673522268
2052	1.673522268
2053	1.673522268
2054	1.673522268
2055	1.673522268
2056	1.673522268
2057	1.673522268
2058	1.673522268
2059	1.673522268
2060	1.673522268
2061	1.673522268

Source: Authors' calculations based
on World Bank data

Table 6 shows the results of forecasting FDI (as a % of GDP) for the next 40 years (2022-2061) using dynamic regression analysis. Graph 5 depicts the forecasting of FDI (as a percentage of GDP) using a dynamic regression model. A very small change is observed in the forecasted values of the FDI and eventually becomes constant from 2043-2061.

Graph 5
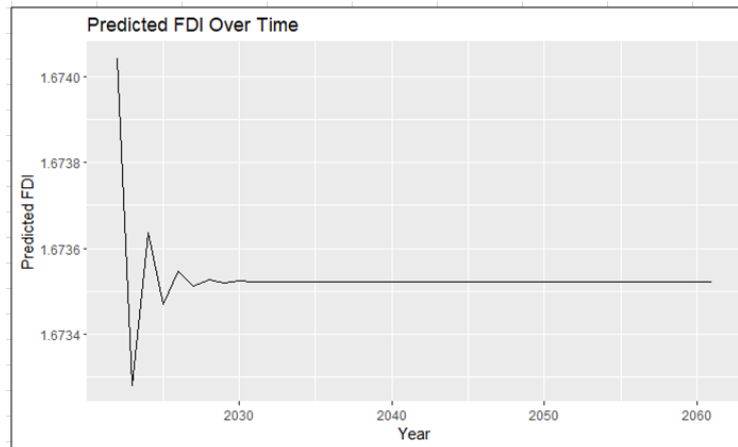
Source: Author's calculations based on World Bank data

6. Conclusion

Using Karl Pearson's Correlation Coefficient, this study reveals some key findings regarding the correlation between various economic indicators and FDI in India using the annual data from1978-2021. The analysis indicates a moderately low and negative correlation between the Inflation Rate and FDI. The correlation between GDP Growth Rate and FDI is observed to be low and positive. Moreover, FDI and Trade Openness display a significantly high positive correlation, while Real Interest Rate and FDI exhibit a moderately low negative correlation.

The econometric analysis further shed light on whether these variables have an effect on FDI in India. The null hypothesis, H_0, is rejected, suggesting that at least one of the variables has an impact on FDI. H_1 is rejected, indicating that the inflation rate indeed influences FDI in India. On the other hand, H_2 is not rejected, implying, in this study GDP Growth Rate does not significantly impact FDI. However, H_3 is rejected, indicating that Trade Openness significantly impacts FDI. Additionally, H_4 is rejected, indicating that, for this study, the real interest rate affects FDI in India.

After removing the GDP Growth Rate variable from the model, the analysis demonstrates that all other variables remain significant and influential on FDI in India. Specifically, these

three variables (Inflation Rate, Trade Openness, and Real Interest Rate) account for approximately 88% of the variability in FDI.

Lastly, FDI has been forecasted using a dynamic regression model and the results show a very small change in the future values of the variable. It has been done by first forecasting the independent variables using the suitable ARIMA models determined from the time series data and then using these forecasted values in the dynamic regression model.

In conclusion, this research provides valuable insights into the relationship between economic indicators and FDI in India. The study highlights the significance of inflation rate, trade openness, and real interest rate as key determinants of FDI. However, it also underscores the need for more comprehensive modelling approaches to enhance the accuracy and robustness of FDI forecasts. The authors suggest further investigations to delve deeper into the complexities of FDI dynamics and encourage more detailed studies in this domain.

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Appendix

Table 7: Data on all the variables analyzed in this paper

Years	Foreign direct investment, net inflows	Imports of goods and services (% of GDP)	GDP growth (annual %)	Inflation, GDP deflator (annual %)	Real interest rate (%)
1978	0.013	6.588	5.713	2.46	10.775
1979	0.032	8.169	-5.238	15.728	-1.061
1980	0.042	9.245	6.736	11.508	4.477
1981	0.048	8.571	6.006	10.828	5.118
1982	0.036	8.143	3.476	8.096	7.775
1983	0.003	7.853	7.289	8.553	7.321
1984	0.009	7.726	3.821	7.923	7.947
1985	0.046	7.645	5.254	7.194	8.682
1986	0.047	7.023	4.777	6.789	9.093
1987	0.076	6.98	3.965	9.328	6.56
1988	0.031	7.455	9.628	8.233	7.639
1989	0.085	8.152	5.947	8.437	7.436
1990	0.074	8.453	5.533	10.668	5.27
1991	0.027	8.493	1.057	13.752	3.625
1992	0.096	9.59	5.482	8.965	9.133
1993	0.197	9.817	4.751	9.862	5.815
1994	0.297	10.19	6.659	9.98	4.337
1995	0.595	12.023	7.574	9.063	5.864
1996	0.617	11.544	7.55	7.575	7.793
1997	0.86	11.929	4.05	6.476	6.91
1998	0.625	12.681	6.184	8.01	5.121
1999	0.473	13.364	8.846	3.068	9.191
2000	0.765	13.904	3.841	3.645	8.343
2001	1.056	13.435	4.824	3.216	8.591
2002	1.012	15.244	3.804	3.716	7.907
2003	0.606	15.645	7.86	3.868	7.308
2004	0.766	19.645	7.923	5.725	4.91

2005	0.886	22.396	7.923	5.622	4.855
2006	2.13	24.457	8.061	8.401	2.571
2007	2.073	24.887	7.661	6.944	5.682
2008	3.621	29.271	3.087	9.194	3.772
2009	2.652	25.872	7.862	7.04	4.809
2010	1.635	26.854	8.498	10.526	-1.984
2011	2.002	31.083	5.241	8.734	1.318
2012	1.313	31.259	5.456	7.934	2.474
2013	1.516	28.413	6.386	6.187	3.866
2014	1.696	25.954	7.41	3.332	6.695
2015	2.092	22.11	7.996	2.28	7.556
2016	1.937	20.924	8.256	3.238	6.233
2017	1.507	21.951	6.795	3.969	5.328
2018	1.558	23.689	6.454	3.884	5.362
2019	1.787	21.272	3.738	2.391	6.91
2020	2.413	19.096	-6.596	5.601	3.361
2021	1.408	23.892	8.681	9.966	-1.153

Table 8: Regression statistics after removing the insignificant variables from the model

Regression Statistics	
Multiple R	0.88
R Squared	0.775
Adjusted R Squared	0.758
Standard Error	0.446
Observations	44

Source: Author's calculations based on World Bank data

Table 9: Dynamic Regression Model (Independent variables are shown)

Variables	Coefficients	R squared	Adjusted R squared	F statistic	p-value	AIC	BIC
Intercept	-0.9114	0.8132	0.7940	42.4346	4	53.4183	64.1235
Import	0.1159						
GDP Growth Rate	-0.0612						
Inflation Rate	-0.0008						
Real Interest Rate	0.0590						

Source: Author's calculations based on World Bank data