Econometric Analysis of Foreign Direct Investment Impact on Economic Growth

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Abstract

In this paper we attempt to understand through regression analysis the relationship between Foreign Direct Investment (FDI) and Economic Growth (GDP). In order to improve the explanatory power of the estimated model we consider few other independent variables such as Inflation rate, Exchange rate and Time(T) In second part of this paper we estimate the logarithmic regression models between the dependent and independent variables to obtain the elasticity coefficients. The results indicate that , during the study period the inflation negatively influences the GDP and FDI is observed to have an insignificant impact on economic growth.

Keywords: *Economic Growth, Exchange Rate, Regression, Logarithmic regression*

Introduction

There are many factors that play important roles in capital formation and economic growth. These factors might be different across countries with respect to geographical, geological, technological progress, and institutional structures. The aim of this study is to investigate the relationship between foreign direct investment (FDI) and the economic growth of India over the period 2000-2020.

FDI plays a key role in the development of developing countries. One reason is that FDI helps in transferring advanced technologies know-how and increases employment levels in the host countries. Economists believe that FDI through new technologies and high standard management puts pressure on domestic firms while making the markets competitive. Furthermore, FDI brings significant and positive externalities to the developing economies such as labor management, and training opportunities, and thus increases the standard of the production function. By technology transfer, it boosts the economies of the developing countries to stand there on their feet they're by technology spillover. (Bauer, 1991; Easterly, 2006)

According to the world investment report, FDI boosts the economy by creating employment opportunities, transferring skills and technologies, increasing productivity, and continuous long-term development the developing countries. It also serves as a major source of external capital inflow for the host countries. It attracts innovation technology transfers, promotes international trade and management skills, and sustains economic development in the host countries.

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FDI may be more beneficiary for the host countries. The questions here are why FDI is important for a host country and why investors and other firms are willing to invest in other countries. The answer to the first question is, underdeveloped countries have almost a low literacy rate and a high rate of labor with less capital-intensive production. The countries having such characteristics cannot achieve their economic goal alone. One motive is also to increase the competition in the local market; the countries look for the FDI to retain their economies on an

equilibrium path. With the help of the transfer of knowledge and technology spillover, the FDI also trains the local labor to overcome future challenges related to production and economic growth. The answer to the second question is that foreign firms and investors are interested to invest in other countries due to the availability of cheap raw materials and cheap labor costs to maximize their profit. Low transport costs and low excise duties on imports and exports also encourage investors to invest in developing countries. A few product competitors and market structures also attract the inflow of the FDI.

This study aims to analyze empirically the impact of FDI on the economic growth in India from 2000 to 2020. Does Foreign Direct Investment show a significant impact on the economic growth of India both in the long-run and in the short-run? Previous studies investigatedthe impact of FDI on the economic growth of India from different approaches. The results are still ambiguous therefore this study is an attempt to find FDI's impact on economic growth alongwith the export, the inflation rate, and, the exchange rate. We expect a positive and significant impact of FDI on the growth rate of India.

The rest of the paper is structured as follows. Initially we review the theoretical framework in the next Section. After the review of relevant literature, the empirical results and discussions are presented. The paper ends with findings and conclusion.

Need of the Study

The foremost topic of this study is based on "Impact of Foreign Direct Investment on Indian Economic Growth." This dispenses the empirical results on how FDIs affect the economicgrowth in India with the help of data from 2000 to 2020. Further, this study helps to find out the factors and role of FDI on proliferating economic growth. Through this study, we can estimate the elasticity coefficients of all the variables included in the models.

Research Objectives

This research paper attempts to the identify the impact of foreign direct investment on economic growth. The specific objectives of the study are as follows:

1. To examine the impact of FDI on Economic Growth.
2. To estimate regression lines.
3. To investigate the empirical relationship between Foreign Direct Investment and Economicgrowth in India.
4. To see, whether or not, during the 20-year-period (2000-2020), changes in the value of FDIhad significantly explained variation in the value of GDP.

Methodology of the study

This study aims to investigate the effect of Foreign Direct Investment on the Economic Growth of India using the annual time series data from 2000 to 2020. The empirical analysis in the present study is based on the study evaluating the data by using econometrics tools like regression analysis, trend analysis and estimating the logarithmic regression equations.

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List of the variables in study

1) Gross Domestic Product (GDP).
2) Exchange rate (ER).
3) Inflation rate (IR).
4) Foreign Direct Investment (FDI).
5) Exports.(X)

Time period of the study

The study uses annual data associated with a time period of 20 years, which is starting from the year 2000 to 2020.

Sources of the data

This study is based on secondary data. FDI data were collected from The Department of Industrial Policy and Promotion (DIPP), the Ministry of Industry and Commerce. The GDP data was collected from RBI Bulletin. Data on export and, inflation rates is collected from World bank reports for the year 2000 to 2020.

Hypothesis of study

To study the change in the annual FDI and its impact on FDI based on the following hypothesis.

H_0: FDI has no significant impact

on GDP.H_1: FDI has a significant

impact on GDP.

Methodology and econometric technique:

Regression Analysis

Regression analysis is a statistical tool for the investigation of relationships between variables. Usually, the investigator seeks to ascertain the effect of one variable upon another. Short-run analysis using the ordinary least squares regression method to see the impact of the independent variables on the dependent variable. Therefore, this study specifies thefollowing multiple regression equation using aggregate data for the variables.

$$\mathbf{GDP}_t = \beta_0 + \beta_1(\mathbf{FDI}) + \beta_2(\mathbf{Inflation})_t + \beta_3(\mathbf{Exchange\ rate})_t + \beta_4(\mathbf{Export})_t + \varepsilon_t$$

Where,

GDP is an economic growth indicator, FDI indicates the level of foreign direct investment inflow, Inflation rate indicates the total inflation rate annually, and the exchange rate indicator of one US Dollar is equal to how many rupees value in the particular year export shows the total export of the country from year 2000 to 2020. ε_t represents a standard residual term and β_0, β_1, β_2, β_3, β_4 denotes the coefficients associated with the different explanatory variables.

b) Logarithmic Regression Model

A regression model will have unit changes between the x and y variables, where a single unit change in x will coincide with a constant change in y. Taking the log of one or both variableswill effectively change the case from a unit change to a percent change. This is especially important when using medium to large datasets. Another way to think about it is when taking a log of a dataset is transforming your model(s) to take advantage of statistical tools such as linear regression that improve on features that are normally distributed.

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To study the individual impact and elasticity behavior between variables we used the model log regression to check the direct relationship between the dependent and independent variables. The logarithmic model is specified as given below:

$$\log(GDP)_t = \beta_0 + \beta_1(\log FDI)_t + \beta_2(\log inflation)_t + \beta_3(\log exchange\ rate)_t + \beta_4(\log export)_t + \varepsilon_t$$

Results and Discussion: Regression Analysis

Following we see the estimation and analysis for selected variables under study for the time period year 2000 to 2020. We consider 'GDP' as the dependent variable, while, 'FDI, 'ExchangeRate', Export 'and, Inflation Rate are the independent variables. On the basis of the ordinary least square method, we obtain the estimated regressionmodel as given below

A) GDP and FDI

$$GDP_t = \alpha + \beta_1 FDI_t + e_t$$

Regression Statistics	
Multiple R	0.934632
R Square	0.873537
Adjusted R Square	0.866881
Standard Error	247.3275
Observations	21

	Coefficients	Standard Error	t-Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	864	95.257	9.07	2.508	664.66	1063.41	664.661	1063.413
FDI	35.65	3.1115	11.5	5.06	29.133	42.1583	29.1333	42.15827

(Source: excel)

The estimated econometric model is as given below:

$$GDP_t = 864 + 35.65\ FDI_t$$

(t = 11.06)

$R^2 = 0.87$

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We have estimated the regression equation of the above variables i.e., GDP and FDI. In the above equation, GDP is considered a dependent variable, and FDI is considered an independent variable.

The intercept or the constant term value is 864.80 and the coefficient of the FDI is 35.65 which indicates that 1 billion increases in FDI lead to 35.65 billion increase in GDP.As per our estimation the value of R-Square is 0.87 which is comparatively high and the value of t-statistic is also significant. So, we can conclude that there is significant relationship exists between GDP and FDI during the study period.

B) GDP and Export:

The Econometric model being estimated is:

$$GDP_t = \alpha + \beta_1 Export_t + \beta_2 T + e_t$$

Regression Statistics	
Multiple R	0.986114
R Square	0.972421
Adjusted R Square	0.969356
Standard Error	118.6655
Observations	21

	Coefficients	Standard Error	t-Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-189134	39540.54	-4.78329	0.000149	-272205	-106062	-272205	-106062
Export	0.000107	0.000161	0.662567	0.516003	-0.00023	0.000446	-0.00023	0.000446
Time	94.91046	19.76505	4.801933	0.000143	53.38562	136.4353	53.38562	136.4353

(Source: excel)

The estimated econometric model is as given below:

$$GDP_t = -189134 + 0.00010\ Export_t + 94.91T$$

After estimating the regression equation of the above variables i.e., GDP, export, and time period. We can estimate the regression model as the GDP is considered as the dependent variableand the remaining both are considered to be the independent variables. We get the coefficient of export is 0.00010 which indicates that a 1 crore increase in export leads to a 0.000107 crore increase in GDP. The value of t- statistic is 0.66 which is less than the t-statistic significant value. So, we can conclude that the export variable does not significantly influence the GDP during the study period.

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C) GDP, Export, Inflation Rate:

The Econometric model estimated is of the form:

$$GDP_t = \alpha + \beta_1(Export) + \beta_2(Inflation\ rate) + \beta_3(Time) + e_t$$

Regression Statistics	
Multiple R	0.994869
R Square	0.989764
Adjusted R Square	0.987958
Standard Error	74.38764
Observations	21

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-178530	24865.33	-7.17989	1.54E-06	-230992	-126069	-230992	-126069
Export1	0.000167	0.000102	1.637986	0.119799	-4.8E-05	0.000381	-4.8E-05	0.000381
I. Rate2	-33.5759	6.255881	-5.3671	5.12E-05	-46.7747	-20.3772	-46.7747	-20.3772
Time 3	89.703	12.42802	7.217802	1.44E-06	63.48217	115.9238	63.48217	115.9238

(Source: excel)

$$GDP_t = -178530 + .000167\ Export_t - 33.57\ Inflation\ rate_t + 89.70\ Time$$

(t = 1.63) (t = -5.36) (t=7.21)

Since the computed t-statistic value of export is not significant so we attempt to increase the explanatory power of the model by including one more additional independent variable which is the inflation rate. On the basis of the ordinary least square we obtained the regression equation as given above. From the above-estimated regression equation, the estimated coefficient of export is 0.000167, and the coefficient of the inflation rate is -33.5759. This indicates that a 1 % change in inflation rate decreases GDP by -33.5759 billion US $.

But the estimated value of the t statistics is -5.36 is highly significant. So, we can say that GDP and inflation have a significant relationship during the study period. Also, the estimated value of R square is also high so the estimated model can be considered to be a good fit..

D) GDP, Export, Inflation Rate, and FDI.

The estimated Econometric model is of the following form:

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$$GDP = \alpha + \beta_1 Export_t + \beta_2 Inflation\ rate_t + \beta_3 FDI + \beta_4 Time + e_t$$

Regression Statistics	
Multiple R	0.995036
R Square	0.990097
Adjusted R Square	0.987622
Standard Error	75.41977
Observations	21

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-157379	38304.79	-4.10861	0.000822	-238582	-76176.8	-238582	-76176.8
Export	0.000201	0.000113	1.774246	0.09505	-3.9E-05	0.000441	-3.9E-05	0.000441
I.Rate	-33.7531	6.347281	-5.31773	6.94E-05	-47.2087	-20.2975	-47.2087	-20.2975
FDI	2.391974	3.261435	0.733412	0.473917	-4.52196	9.305908	-4.52196	9.305908
Time	79.13044	19.1463	4.132936	0.000781	38.5421	119.7188	38.5421	119.7188

(Source: excel)

$$GDP_t = 157379 + 0.00020\ Export_t - 33.75\ Inflation\ rate_t + 2.39\ FDI_t + 79.13\ Time$$

(t = 1.77) (t = -5.31) (t=0.73) (t =4.1329)

From the previous model, we observe that there is a significant relationship between the inflation rate and GDP. To improve the results, we add one more independent variable called FDI and prepare a model as given above. After estimating the regression, we obtain the coefficient of FDI as 2.39. It indicates that a 1 billion US $ increase in FDI leads to a 2.399 billion US$ increase in GDP. But the estimated t-statistic value is 0.7334 which is less than the critical value of t-statistic. When we observe the value of R-Square which seems to be very high i.e., 0.99 indicating that 99% variations is explained by the above regression model.

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E) GDP, Export, IR, FDI, and ER.

The Econometric model estimated is of the following form:

$$GDP_t = \alpha + \beta_1 Export_t + \beta_2 Inflation\ rate_t + \beta_3 FDI_t + \beta_4 Exchange\ Rate_t + \beta_5 Time + e_t$$

Regression Statistics	
Multiple R	0.995048
R Square	0.990121
Adjusted R Square	0.986828
Standard Error	77.79918
Observations	21

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-156877	39601.3	-3.9614	0.001254	-241285	-72468.5	-241285	-72468.5
Export	0.000191	0.000129	1.480441	0.159453	-8.4E-05	0.000465	-8.4E-05	0.000465
I. rate	-32.5041	9.266985	-3.50751	0.003174	-52.2562	-12.7519	-52.2562	-12.7519
FDI	2.381802	3.364754	0.707868	0.489881	-4.79	9.553605	-4.79	9.553605
E. Rate	0.956795	5.023488	0.190464	0.851499	-9.75052	11.66411	-9.75052	11.66411
Time	78.85696	19.80247	3.982178	0.001202	36.649	121.0649	36.649	121.0649

Source : Excel

$$GDP = -156877 + 0.000191\ Export_t - 32.50\ Inflation\ rate_t + 2.38\ FDI_t + 0.95\ Exchange\ Rate_t + 78.85\ Time$$

(t = 1.48) (t = -3.5) (t=0.70) (t =0.19) (t= 3.98)

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Based on the method of OLS we can obtain the estimated regression equation as above. From the above-estimated regression equation, the estimated coefficient of the additional independent variable is the exchange rate is 0.9567. This indicates that a 1 Rs change in the exchange rate leads to a 0.9567 Rs change in the value of GDP. But the value of estimated t statistics is 0.190 which is less than 1.96 which is less than the significant level so we can say that the foreign exchange rate as compared to U.S $ is not as significantly influence by the variable GDP. During the study period which is the year 2000 to 2020.

SECTION II: Log Regression Model

Logarithmic transformation is a convenient means of transforming a highly skewed variable into a more normalized dataset. When modeling variables with non-linear relationships, the chances of producing errors may also be skewed negatively. In theory, we want to produce the smallest error possible when making a prediction, while also taking into account that we should not be over fitting the model. Over fitting occurs when there are too many dependent variables in play that it does not have enough generalization of the dataset to make a valid prediction. Using the logarithm of one or more variables improves the fit of the model by transforming the distribution of the features to a more normally-shaped bell curve.

To obtain the elasticity coefficients we estimate the log transformation model (log regression model). Through this model we attempt to find out the percentage change in independent variable on dependent variable. Using R software, the following results are obtained.

GDP and FDI

The estimated Logarithmic Econometric Model is of the following form:

$$\text{Log GDP} = \alpha + \beta 1 \text{ Log FDI} + \mu$$

```
Call:
lm(formula = LOG$gdp ~ LOG$fdi)

Residuals:
     Min       1Q   Median       3Q      Max
-0.34310 -0.13479  0.03316  0.10360  0.22758

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.50453    0.09956  65.330  < 2e-16 ***
LOG$fdi      0.32068    0.03311   9.684  8.8e-09 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1671 on 19 degrees of freedom
Multiple R-squared:  0.8315,    Adjusted R-squared:  0.8227
F-statistic: 93.79 on 1 and 19 DF,  p-value: 8.799e-09
```

(Source: R Software)

$$\text{Log GDP} = 6.50 + 0.32 \text{ Log FDI}$$
$$(t=9.68)$$

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$$R^2 = 0.83$$

From the above results it observed that R square value is 0.82 which indicates that thereis strong relationship exists between GDP and FDI. The coefficient value of FDI is 0.32. The constant or intercept value is 6.50. Similarly, the value of t-statistic is also greater than 1.96, whichis 9.68 for coefficient FDI which is considered as highly significant. From the above estimation we can conclude that 1% change in FDI leads to 0.32% change in the GDP. Overall, we can say that FDI affects significantly on the GDP.

GDP, FDI& TIME

The estimated Econometric Model is of the following form:

$$\textbf{Log (GDP)}=\alpha + \beta 1\text{Log(FDI)} + \beta 2\text{Log(TIME)} + \mu$$

```
Call:
lm(formula = LOG$gdp ~ LOG$fdi + LOG$YEAR)

Residuals:
      Min        1Q    Median        3Q       Max
-0.126412 -0.004537  0.005492  0.015806  0.043056

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -911.13362   46.65588 -19.529 1.45e-13 ***
LOG$fdi        0.02187    0.01680   1.302    0.209
LOG$YEAR     120.75836    6.13977  19.668 1.29e-13 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03619 on 18 degrees of freedom
Multiple R-squared:  0.9925,    Adjusted R-squared:  0.9917
F-statistic:  1193 on 2 and 18 DF,  p-value: < 2.2e-16
```

(Source: R Software)

$$\textbf{Log (GDP)} = -911.13 + 0.02\ \text{Log (FDI)} + 120.75\ \text{Log (TIME)}$$
$$(t=1.30) \qquad (t=19.66)$$

From the Above results it observed that R-Square is 0.99 which indicates that strong relationship between GDP and both the independent variables, namely FDI and time. The coefficient value of FDI is 0.02 while the coefficient value of the time is 120.75. The value of t-statistic for the coefficient FDI is 1.30 which is less than 1.96 and for coefficient time is 19.6. Hence coefficient of time is significant.

Overall, we can say that trend variable has comparatively more significant effect on GDP than FDI. For 1% change in FDI, the GDP increases by 0.02% and similarly 1 year change in time the GDP increased by120.75%.

GDP, FDI, Inflation Rate, Export, ER& TIME:

The estimated Econometric Mode is of the following form:

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$$\text{Log(GDP)} = \beta 0 + \beta 1(\text{log FDI}) + \beta 2(\text{log Time}) + \beta 2(\text{log inflation rate}) + \beta 3\ (\text{log export}) + \beta 3(\text{log exchange rate}) + \varepsilon t$$

```
Call:
lm(formula = LOG$gdp ~ LOG$fdi + LOG$YEAR + LOG$`INFLATION RATE` +
    LOG$export + LOG$`exchange rate`)

Residuals:
      Min        1Q    Median        3Q       Max
-0.047248 -0.013499 -0.003912  0.018502  0.044596

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)         -598.31437  112.10072  -5.337 8.30e-05
LOG$fdi                0.02846    0.01751   1.626 0.124872
LOG$YEAR              79.37392   14.82929   5.353 8.06e-05
LOG$`INFLATION RATE`  -0.09696    0.02331  -4.160 0.000839
LOG$export             0.15895    0.04050   3.924 0.001353
LOG$`exchange rate`   -0.02071    0.09135  -0.227 0.823750

(Intercept)          ***
LOG$fdi
LOG$YEAR             ***
LOG$`INFLATION RATE` ***
LOG$export           **
LOG$`exchange rate`
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02563 on 15 degrees of freedom
Multiple R-squared:  0.9969,    Adjusted R-squared:  0.9958
F-statistic: 955.6 on 5 and 15 DF,  p-value: < 2.2e-16
```

(Source: R Software)

$$\text{Log(GDP)} = -598.31 + 0.028(\text{log FDI}) + 79.37(\text{log Time}) - 0.09\ (\text{log inflation rate}) + 0.15\ (\text{log export})$$

(t=1.62) (t=5.35) (t=-4.16) (t=3.92)

$$-0.02\ (\text{log exchange rate})$$

(t=-0.22)

Based on the method of logarithmic regression we can obtain the estimated equation as given above. From the regression equation, the estimated coefficient of the additional independent variable is exchange rate is 0.028. This indicates that 1% change in the exchange rate leads to 0.02 % change in GDP. Likewise, one %change in inflation leads to -0.09% change in GDP. So, inflation rate has negative impact on GDP. Also, we can observe that 1% change in export leads to 0.15 % change in GDP. But the value of estimated t-statistic of each variable is satisfactory rather except exchange rate, which is less than 1.96 .Overall model is good fit model as value of R Square is high at 0.99.

Findings

I) The Export value is found to be significantly influencing the GDP.

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II) Inflation rate was showing slightly positive relation with GDP but not significantly influence the GDP because the value of R^2=0.017 which is less than significant value.

III) There is an increasing trend in FDI observed during the study period.

IV) The Exchange rate is found to be increasing during the study period, but there was not any significant relationship was observed between exchange rate and GDP because oflow value of R^2which is 0.077

V) After adding the multiple independent variables in the regression equation, the explanatory power of the model is increased and the value of $R^2$is near to 0.99. during the observed time period.

VI) When we taking log values of all variables and estimated regression we observe that GDP and FDI are associated positively. When add time as independent variable we observe that t value become insignificant.

VII) FDI has a significant effect on GDP.

Suggestions:

The current study is revealing the linkage between FDI and GDP in the Indian context using techniques like simple regression and logarithmic regression. A respective time span of the study is chosen for year 2000 to 2020 using annual data. Based on the estimated results following are some suggestions are made as follows:

- We mainly study the relation between the FDI and GDP. It is also importance to understand how others institutional factors impact the economic growth.
- FDI should be guided so as to establish deeper linkages with the economy, which would stabilize the economy (e.g., improves the financial position, facilitates exports, stabilize the exchange rates, supplement domestic savings and foreign reserves, stimulates R&D activities and decrease interest rates and inflation etc.) and providing to investors a sound and reliable macroeconomic environment.
- It is suggested that the policy makers should ensure optimum utilization of funds and timely implementation of projects. It is also observed that the realization of approvedFDI into actual disbursement is quite low.

Conclusion

We attempted to study the impact of the FDI on the economic growth in India over the period of 2000 to 2020. The FDI has an overall positive and significant impact on Indian economy. One of the reasons to explain the positive impact is that the FDI inflow brings the advanced technology and the investment enhancing the country economy.

The Inflation Rate and Exchange Rate both are significantly negative correlated with the economy in the long run while the Export showing positive and significant impact. Finally, we conclude that FDI is

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positively impacts economic growth of the country. FDI also plays very crucial role in developing countries. It helps poor and developing countries to switch towards faster growth path.

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