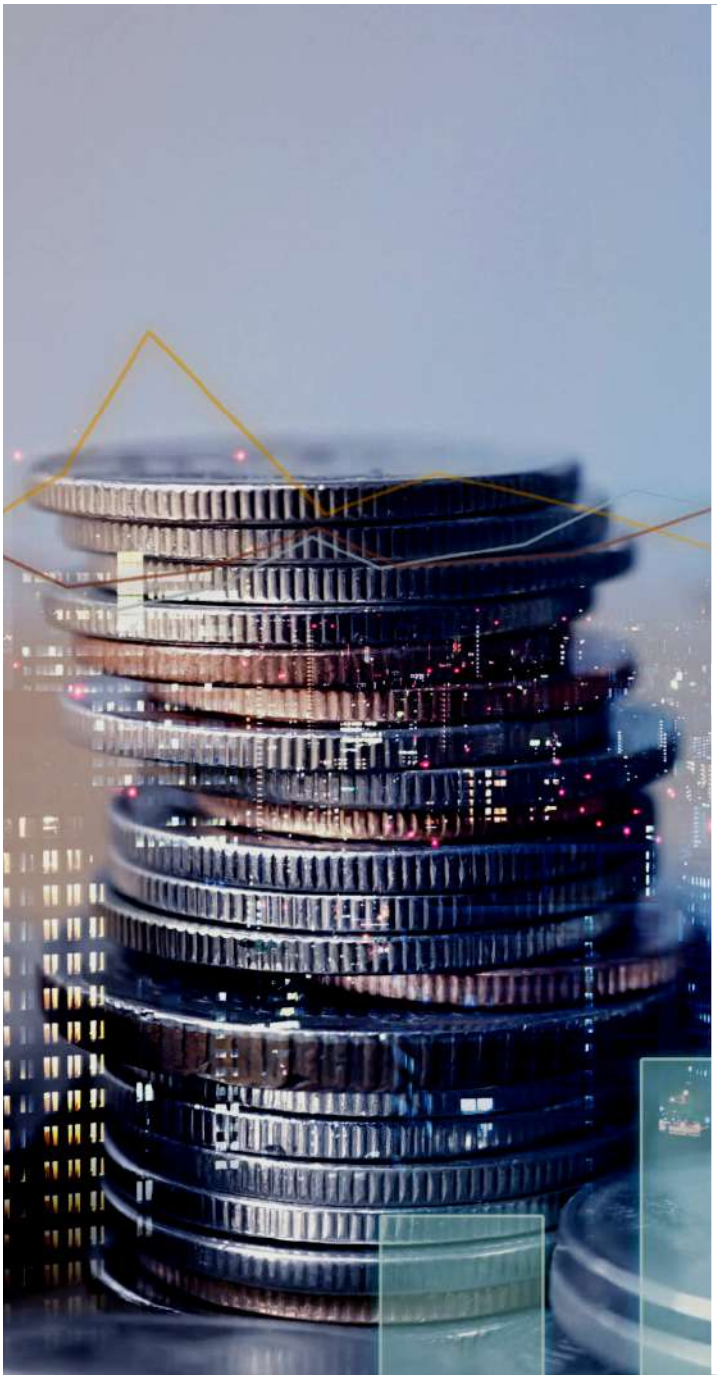


Data Report

DISSECTING FDI IN THE 21ST CENTURY

THE ECONOMICS SOCIETY, SRCC

INTRODUCTION

A foreign direct investment is an investment made by a person or a company located outside the national borders in a domestic company. Under FDI, the foreign investor owns at least 10% of the company in which the investment is made. Any investment below this limit is not considered as an FDI by the International Monetary Fund. Instead, it is considered as a foreign portfolio investment (FPI).

FDI is not merely a transfer of funds as at least 10% stake allows the investor to have an influence over the company's management, operations, and policies. This allows the investor to have a lasting interest in the business.

A foreign investor can make FDI in India in the following ways:
a) Acquiring voting stock in a domestic company
b) Mergers and Acquisitions
c) Joint ventures with domestic companies
d) Starting a subsidiary of a foreign firm in the domestic country

In 1991, Trinidad & Tobago, Costa Rica and Pakistan were among the 64 countries that received a higher FDI than India. Fast forward to 2020, as per United Nations Conference on trade and development, India was the 5th largest FDI recipient in the world. According to the official data released by RBI, India's FDI increased from $97 million in 1990-91 to $81,722 million in 2020-21, in absolute terms.

There are various factors, both domestic and foreign, which influence the FDI levels in a country, such as US bond returns, the amount a government spends on the infrastructure development in a country, the internet penetration, the youth workforce and many more. For this report, we have decided to go ahead with the following three indicators:
a) Inflation Rates
b) Political Stability
c) Government Capital Expenditure

The three variables were chosen to represent a comprehensive picture of the factors impacting foriegn investments in the country. Inflation impacts consumer expenditure and has a correlation with prevalent interest rates in a country, which can highly influence FDI. Political Stability is a matter of great debate in India, representing global confidence in the country's governance and policies. Lastly, government capital expenditure acts as an important indicator of the government's commitment towards infrastructure development, which provides stimulus to foriegn investments.

This study aims to analyze how such factors affect the FDI levels in a country through a quantitative and statistical approach. This report aims to study how these factors have affected the FDI in India, especially in the 21st century using the OLS regression technique.

METHODOLOGY

The objective of the study was to determine the impact of some key macroeconomic indicators on the inflow of Foreign Direct Investment in India. Using multivariable regression analysis, we analyse the respective impacts of three selected indicators, viz., inflation rates, political stability and government capital expenditure, on the FDI of the country in the twenty-first century.

The same is done by utilising historic data for the last twenty years (2002-2019) from official data sources of the Indian Government and global bodies like World Economic Forum to formulate a multivariable linear regression model, taking Inflation, Political Stability and Total Government Capital Expenditure as key independent variables.

Hence, the regression model aims to analyse the statistical significance of each of these indicators. The multivariable regression is carried out using OLS methodology. We aim the result to be statistically significant at the 95% confidence level with $P < 0.05$.

In order to study the collinearity between the independent variables and FDI, their respective scatter plots are constructed with the data of the past twenty years using Python. Upon studying the various trends across the two decades, their relationship with FDI and how they have affected the inflow of investment in the country is studied and analysed. The scatter plots along with the regression coefficients statistically prove and signify that all the variables have had a considerable impact.

We proceed to interpret the charts and formulate an equation with each indicator's corresponding coefficient and analyse their individual significance on FDI.

OLS Regression

Ordinary Least Square regression, commonly known as OLS regression, is a method of statistical analysis that estimates the relationship between one or more independent variables and a dependent variable; the method estimates the relationship by minimizing the sum of the squares in the difference between the observed and predicted values of the dependent variable configured as a straight line.

The logic of OLS regression is easily extended to the multivariate model in which there are two or more independent variables.

DATA ANALYSIS

The model which specifies that Foreign Direct Investment is significantly influenced by the indices; Inflation, Political Stability & Government Capital Expenditure is are formulated as follows;

FDI = f (IN, PS, CE)

Here FDI is the dependent variable and remaining are the independent variables.

$LnFDI = \beta 0 + \beta 1 LnIN + \beta 2 LnPS + \beta 3 LnCE$

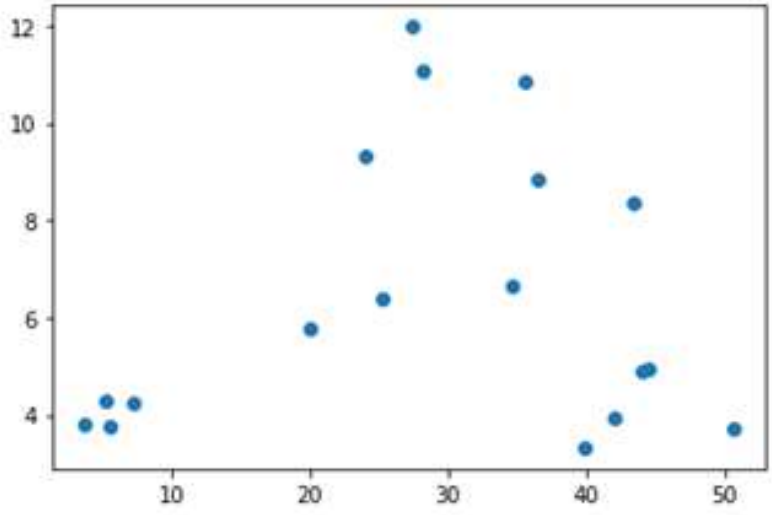
LnFDI = Foreign Direct Investment
LnIN = Inflation
LnPS = Political Stability
LnCE = Government Capital Expenditure
$\beta 0$ = intercept
$\beta 1, \beta 2, \beta 3$ = Coefficient of the independent variables

The result obtained using the Ordinary Least Square (OLS) estimation technique.

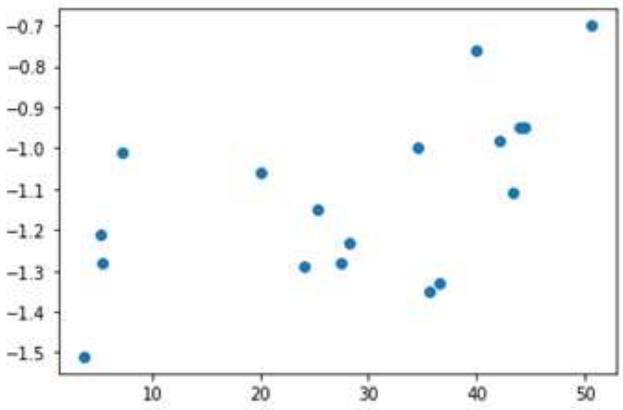
FDI = 33.02 + 2.73IN + 34.48PS + 0.0001CE

The predictor variables jointly explained 77.23% of FDI, while the remaining 22.77% could be due to the effect of extraneous variables. To further our case, it can be inferred from the results obtained that the constant parameter in the long – run is positive. This implies that if all the explanatory variables are held constant, FDI will increase by 33.02 units.

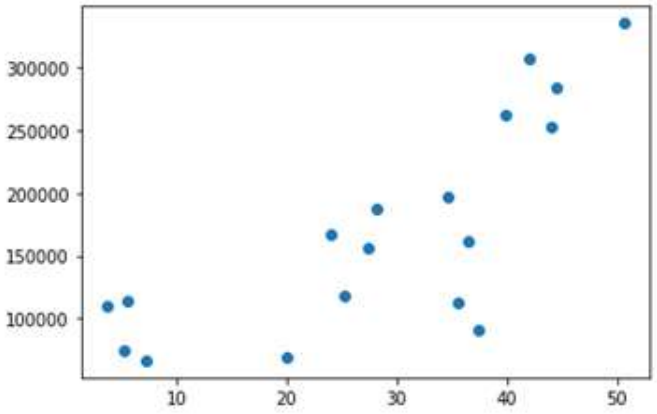
The coefficient of Inflation is 2.73, it has a positive relationship with FDI showing that a unit increase in inflation will increase FDI by 2.73 units. The coefficient of political stability is 34.48, it has a position relationship with FDI showing that a unit increase in political stability will rise FDI by 34.48 units. The coefficient of government capital expenditure is 0.0001, it has a positive relationship with FDI showing that a unit increase in government capital expenditure will increase FDI by 0.0001 units.



a) FDI and Inflation



(b) FDI and Political Stability



c) FDI and Capital Expenditure

Coming up with a prediction equation like this is a useful exercise only if the independent variables in our dataset have some correlation with the dependent variable. So in addition to the prediction components of our equation - the coefficients on our independent variables and the constant - we need some measure to tell how strongly each independent variable is related to our dependent variable.

When running our regression, we try to discover whether the coefficients on our independent variables are really different from 0 (so the independent variables are having a genuine effect on your dependent variable) or if alternatively any apparent differences from 0 are just due to random chance. The null hypothesis is always that each independent variable is having no effect whatsoever (has a coefficient of 0) and we are looking for a reason to reject this theory.

If 95% of our t distribution is closer to the mean than the t-value on the coefficient we are looking at, then we have a p-value of 5%. This is also referred to as a significance level of 5%. The p-value is the probability of seeing a result as extreme as the one we are obtaining (a t value as large as ours) in a collection of random data in which the variable had no impact. A p-value of 5% or less is the general accepted point at which to reject the null hypothesis.

With a p-value of 5% (or .05) there is only a 5% chance that results we are seeing would have come up in a random distribution, so we can say with a 95% probability of being right that the variable is having some impact, assuming our model is specified correctly. For inflation, a p-value less than 0.05 (0.003) is statistically significant. It indicates strong evidence against the null hypothesis, as there is less probability the null is correct (the results are random). Therefore, we reject the null hypothesis, and accept the alternative hypothesis, which is that Inflation does impact FDI. For political stability, a p-value less than 0.05 (0.02) is statistically significant.

It indicates strong evidence against the null hypothesis, as there is less probability the null is correct (the results are random). Therefore, we reject the null hypothesis, and accept the alternative hypothesis, which is that political stability impacts FDI as well. For government capital expenditure, a p-value less than 0.05 (0.005) is statistically significant. It indicates strong evidence against the null hypothesis, as there is less probability the null is correct (the results are random).Therefore, we reject the null hypothesis, and accept the alternative hypothesis, which is that government capital expenditure impacts FDI as well. Generally speaking, since all our independent variables are statistically significant, the overall F-test is also statistically significant.

Multicollinearity refers to the condition when two or more of the independent variables, or linear combinations of the independent variables, in a multiple regression are highly correlated with each other. While multicollinearity does not represent a violation of regression assumptions, its existence compromises the reliability of parameter estimates. There is a very simple test to assess multicollinearity in our regression model, the Variance Inflation Factor (VIF) which identifies correlation between the independent variables and the power of that correlation.

We can calculate the VIF for each of the three independent variables by performing separate regressions using one explanatory variable as the response variable and the other two as the explanatory variables.

Why to check for Multicollinearity?

A key goal of regression analysis is to isolate the relationship between each independent variable and the dependent variable. However, when independent variables are correlated, it indicates that changes in one variable are associated with shifts in another variable.

The stronger the correlation, the more difficult it is to change one variable without changing another. It becomes difficult for the model to estimate the relationship between each independent variable and the dependent variable independently because the independent variables tend to change in unison.

The VIF for points is calculated as 1 / (1 – R2)
It turns out that the VIF for the three explanatory variables are as follows:

Inflation: 1.34
Political Stability: 2.16
Government Capital Expenditure: 1.73

The value for VIF has no upper limit and starts at 1. A value close to 1 indicates moderate correlation between a given explanatory variable and other explanatory variables in the model, but this is often not severe enough to require attention and to warrant corrective measures.

STATISTICAL TESTS

In order to ensure that our findings are statistically correct and relevant, we performed the following tests in order to reject the null hypothesis.

R-Squared

The R-squared, also known as the coefficient of determination, is a statistical measure that represents the degree to which input variables explain the variation of output variables in a regression model. While correlation explains the strength of the relationship between the variables, R-squared explains to what extent the variance of one variable explains the variance of the second variable. The usefulness of R2 is its ability to find the likelihood of future events falling within the predicted outcomes. It gives you an idea of how many data points fall within the results of the line formed by the regression equation. The higher the coefficient, the higher percentage of points the line passes through when the data points and line are plotted.

It ranges from 0 to 1. So, if the R-squared is 0.9, it means that 90% of the observed variation in the dependent variables is explained by the independent variables.

The definition of a “good” R-squared varies depending upon the kind of analysis that has been undertaken. In social sciences, an R-squared of 0.5 is also considered extremely strong while in other fields, the standards of an acceptable R-squared can be as high as 0.9. Generally speaking, a higher R-squared indicates a better fit for the model. However, the quality of the statistical measure depends on many factors, such as the nature of the variables employed in the model, the units of measure of the variables, and the applied data transformation.

The value of R-squared in our analysis is 0.7722 This means that approximately 77.22% of the variation in the independent variable is explained which is a moderately good fit.

Adjusted R-Squared

R-Squared only works as intended in a simple linear regression model with one explanatory variable. With a regression model made up of several independent variables, the R-Squared must be adjusted.

The adjusted R-squared compares the descriptive power of regression models that include a number of predictors. Every predictor added to a model will increase the R-squared. Thus, a model with more terms may seem to have a better fit just because it has more terms. The adjusted R-squared only increases if the new term enhances the model above what would be obtained by probability and decreases when a predictor enhances the model less than what is predicted by chance.

The adjusted R-Squared can be used to include a more appropriate number of variables, thwarting temptation to keep on adding variables to your data set. Adjusted R-Squared doesn't include all data points, is always lower than R-Squared and can be negative (although it's usually positive). Negative values will likely happen if R-Squared is close to zero — after the adjustment, the value will dip below zero a little.
The Adjusted R-Squared of our model is 0.7235 which shows that the variability is well explained by the predictors used in the model.

Multiple R

The multiple correlation coefficient between three or more variables. Multiple R is 0.8787 in our model which shows a strong correlation between the variables.

P-value

The F statistic must be used in combination with the p-value while deciding if the overall results are significant. The p-value is computed from the F ratio which is computed from the ANOVA table. Even if the results are significant, it doesn't mean that all the variables are significant. The F statistic is just comparing the joint effect of all the variables together.

The p-value can be calculated for individual variables to determine whether they are statistically significant. For it to be significant, the p-value must be less than the alpha level. A common alpha level is 0.05.

The p-value is a probability, while the f ratio is a test statistic. A large f statistic (one that is bigger than the F critical value found in a table) shows that something is significant, while a small p-value means all the results are significant. The F statistic just compares the joint effect of all the variables together.

We see that in our analysis the p-value of the intercept and the three independent variables is much below 5% which shows that they are all statistically significant.

CONCLUSION

The findings reveal that political stability, inflation and government capital expenditure are in direct relation to the FDI levels in India and statistically significant at 5% level. This implies that foreign investors view the political stability in the country as a major factor before investing in the country because a more stable political environment is conducive to business and economy. Hence, the government should look to make the political environment favorable to business through its policies and less red tapism. Further, Inflation also helps in bringing in FDI in India, however, the government should ensure that the inflation rates remain within the levels recommended by RBI and monetary policy committee. An inflation rate, higher or lower than the recommended levels, hurts the general public. Hence, caution should be exercised with respect to the inflation levels. Finally, we conclude through our study that if the government spends money to improve the infrastructure development in the country, FDI levels are bound to increase as it encourages investors to set up new ventures.

ANNEXURE

Preliminary Data Source

Years	FDI (in Billion US$)	Inflation	Political stability	Capital Expenditure (Rs Cr.)
2002	5.209	4.297	-1.21	74,535
2003	3.682	3.806	-1.51	1,09,228
2004	5.429	3.767	-1.28	1,13,331
2005	7.269	4.246	-1.01	66,362
2006	20.029	5.797	-1.06	68,778
2007	25.228	6.373	-1.15	1,18,238
2008	43.406	8.349	-1.11	90,158
2009	35.581	10.882	-1.35	1,12,678
2010	27.397	11.989	-1.28	1,56,605
2011	36.499	8.858	-1.33	1,61,732
2012	23.996	9.312	-1.29	1,66,858
2013	28.153	11.064	-1.23	1,87,675
2014	34.577	6.650	-1	1,96,681
2015	44.009	4.907	-0.95	2,53,022
2016	44.459	4.948	-0.95	2,84,610
2017	39.966	3.328	-0.76	2,63,140
2018	42.117	3.945	-0.98	3,07,714
2019	50.611	3.723	-0.7	3,35,726

Summary Output

Regression Statistics	
Multiple R	0.878794343
R Square	0.772279497
Adjusted R Square	0.723482246
Standard Error	7.983631327
Observations	18

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	3026.225969	1008.74199	15.82629118	0.000089275
Residual	14	892.3371683	63.73836916		
Total	17	3918.563137			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	33.02291865	17.31183772	1.907533977	0.077177926	-4.107280434	70.15311774	-4.107280434	70.15311774
Inflation	2.72767847	0.777449044	3.508498068	0.003476009	1.060216109	4.395140831	1.060216109	4.395140831
Political Stability	34.48340061	13.43567112	2.566555873	0.022386493	5.666752059	63.30004916	5.666752059	63.30004916
Capital Expenditure	0.000098130	0.000029643	3.310437005	0.005154132	0.000034553	0.000161707	0.000034553	0.000161707

REFERENCES

- Zach. (2021, February). Multiple R vs. R-squared: What's the difference? Statology. Retrieved September 2021, from https://www.statology.org/multiple-r-vs-r-squared/
- F statistic / F value: Simple definition and interpretation. Statistics How To. (2021, June). Retrieved September 2021, from https://www.statisticshowto.com/probability-and-statistics/f-statistic-value-test/
- R-squared. Corporate Finance Institute. (2020, June). Retrieved September 2021, from https://corporatefinanceinstitute.com/resources/knowledge/other/r-squared/
- Team, T. I. (2021, July). R-squared vs. adjusted R-squared: What's the difference? Investopedia. Retrieved September 2021, from https://www.investopedia.com/ask/answers/012615/whats-difference-between-rsquared-and-adjusted-rsquared.asp https://www.investopedia.com/terms/r/r-squared.asp
- Coefficient of determination (R squared): Definition, calculation. Statistics How To. (2021, June). Retrieved September 2021, from https://www.statisticshowto.com/probability-and-statistics/coefficient-of-determination-r-squared/
- Tenny, S. (2021, May). Statistical significance. StatPearls [Internet]. Retrieved September 2021, from https://www.ncbi.nlm.nih.gov/books/NBK459346/
- Tests of statistical significance. (n.d.). Retrieved September 2021, from https://web.csulb.edu/~msaintg/ppa696/696stsig.htm#3
- Adjusted R squared. IBM. (n.d.). Retrieved September 2021, from https://www.ibm.com/docs/en/cognos-analytics/11.1.0?topic=terms-adjusted-r-squared
- Union budget at a glance (timeseries) from 1995-1996(actuals) to 2021-2022 (budget estimates). Datasets - Open Budgets India. (n.d.). Retrieved September 2021, from https://openbudgetsindia.org/dataset/union-budget-at-a-glance-timeseries
- Political stability by country, around the world. TheGlobalEconomy.com. (n.d.). Retrieved September 2021, from https://www.theglobaleconomy.com/rankings/wb_political_stability/#India
- India Foreign Direct Investment 1970-2021. MacroTrends. (n.d.). Retrieved September 2021, from https://www.macrotrends.net/countries/IND/india/foreign-direct-investment
- India inflation rate 1960-2021. MacroTrends. (n.d.). Retrieved September 2021, from https://www.macrotrends.net/countries/IND/india/inflation-rate-cpi
- Kunle, A. (n.d.). Impact of Foreign Direct Investment on Nigeria Economic Growth. Retrieved from http://dx.doi.org/10.6007/IJARBSS/v4-i8/1092
- Encyclopedia.com. (2021, September). ." International encyclopedia of the social sciences. . encyclopedia.com. 8 sep. 2021 . Encyclopedia.com. Retrieved September 2021, from https://www.encyclopedia.com/social-sciences/applied-and-social-sciences-magazines/ordinary-least-squares-regression#:~:text=Ordinary%20least%20squares%20(OLS)%20regression,and%20predicted%20values%20of%20the

THE ECONOMICS SOCIETY, SRCC

A DataLab Initiative

DATALAB DIRECTOR

Hardik Kapoor

TEAM MEMBERS

Ananya Dhanuka
Maithili Sharma
Srishti Jain
Surabhi Agarwal

CONTACT US:

www.ecosocsrcc.com

datalab@ecosocsrcc.com

Hardik Kapoor
(+91-98119-68969)
Abhiram Lokanathan
(+91-97448-33853)
Neeyati Fitwariwala
(+91-99208-16304)