

RESEARCH ARTICLE

IMPACT OF COVID-19 ON FDI INFLOWS INTO INDIA

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Abstract

..... In India, FDI inflows is a key indicator of the confidence investors have in its economy. The key purpose of this study is to evaluate the impact of COVID-19 on FDI inflows into India. A regression model was built using pre-COVID to predict the FDI growth in each month. It has been observed that changes in exchange rate and foreign reserve have a statistically significant impact on FDI growth, where-as changes in IIP (Index of Industrial Production) do not. The predicted values were then compared with the actual FDI growth, during the pandemic. Though the regression model was robust and sound, very large differences in predicted and actual FDI growth was found during the pandemic. This indicates that the pandemic has altered the dynamics of FDI growth in India.

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Introduction:-

As the COVID-19 rages in India, it has a telling effect on the Indian economy. Since liberalisation in 1991-92, India has seen a huge growth in FDI. FDI would often be seen as a good omen for Indian economy, as it was a sign of confidence the overseas investors had in India. In recent days, the Indian Govt. has put a strict cap on the Current Account Deficit, thereby reducing its own ability to spend. Private investment has always been low in India, except for the big business families. So, in order to fund the dreams of millions of aspiring youth and to sustain the growth, the reliance on FDI has only grown. Given this background, the pandemic is putting to test the confidence overseas investors have in India. It is especially important to monitor changes in FDI and understand underlying patterns of change, because the other two sources of investment in India namely Govt. spending and private investments have gone down. The Govt. can't really put money in the economy because of a fall in GST revenues and spending on public health during the pandemic. There is little private investment as many people have lost their jobs and the light at the end of the tunnel is not yet visible.

The objective of the study is to analyse the impact of COVID-19 on FDI in India. Data from Jan-2019 to Feb-2020 is used to build the model. Then, this model predicts the FDI growth for months from March-2020 to Jun-2020. The deviation in the predictions and actual FDI values is studied. In her article, Gujrati R.¹ explores qualitatively, the impact of COVID-19 on FDI in India. This study is a further improvisation using quantitative methods like regression analysis, and using it to see if there is a fundamental change in FDI's dynamics.

1) Nomenclature

'FDI_gth'	growth in FDI in consecutive months in \$million	
'ln (FDI_gth)'	natural logarithm of growth in FDI in consecutive months	

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'IIP_change'	change in IIP in consecutive months
'FXRate_change'	change in exchange rate in consecutive months
'FXReserve_change'	change in forex reserves in consecutive months in \$million
'IIP_change_lag1'	change in IIP in consecutive months with a lag of 1 month

Data

Data Collection

In this study, data from Jan-2019 to Jul 2020 was used for the following variables:

- 1. Growth in FDI in each month (\$ million) was collected from Trading Economics²
- 2. Forex Reserves in each month (\$ million) was collected from RBI's official website³
- 3. Exchange Rate on each month was collected from X-rates website⁴
- 4. IIP for each month was collected from monthly press releases of Indian Govt.⁵

Data Transformation and Feature Engineering

- 1. Natural Logarithm of FDI growth was taken, to correct the imbalance in ranges of variables.
- 2. IIP IIP in manufacturing only where FDI is permitted, was used. Since the dependent variable is growth in India, first difference of IIP was calculated. Also, for the purpose of model selection, a lag of 1 month was also introduced in IIP
- 3. Forex Reserves As the dependent variable is FDI growth, first difference of Forex Reserves (\$ million) was calculated
- 4. Exchange Rate As the dependent variable is FDI growth, the first difference of Exchange Rate (\$ million) was calculated

Model Specification

Preliminary Regression and Selection of Variables

Data from Jan-2019 to Feb-2020 is used to build the model, before building a regression model, first preliminary regression is run to get a fundamental understanding of the relationship between variables

Model 1:
$$\mathbf{Y}_t = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \mathbf{X}_{1t} + \boldsymbol{\beta}_2 \mathbf{X}_{2t} + \boldsymbol{\beta}_3 \mathbf{X}_{3t} + \boldsymbol{\varepsilon}_t(1)$$

The dependent variable is 'ln (FDI_gth)' and the independent variables are 'FXRate_change', 'FXReserve_change' and 'IIP_change'. Upon running the regression, the following resultswere seen

parameter	value
R-squared	0.37
Adj. R-squared	0.181
F-statistic	1.957
Prob (F-statistic)	0.185
Log-likelihood	-12.918

Table 2:- Regression Coefficients for Model 1.

variable	Coefficient	Std. Error	t-statistic	p-value
Intercept	8.2135	0.428	19.168	0.000
FXRate_change	-0.5921	0.295	-2.009	0.072
FXReserve_change	-0.0139	0.006	-2.151	0.057
IIP_change	-0.0042	0.033	-0.13	0.899

From tables 1 & 2, the model is statistically insignificant with Probability of F-stat being greater than 10%, also, none of the independent variables are significant at a level of 5%

So, the next candidate model is evaluated, where a one-month lag in IIP is introduced,

Model 2: $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3(t-1)} + \epsilon_t(2)$

The dependent variable is 'ln (FDI_gth)' and the independent variables are 'FXRate_change', 'FXReserve_change' and 'IIP_change_lag1'. Upon running the regression, the following resultswere seen

Table 3:- OLS	Regression	Results	for	Model 2	2.
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parameter	value
R-squared	0.369
Adj. R-squared	0.18
F-statistic	1.953
Prob (F-statistic)	0.185
Log-likelihood	-12.923

Table 4:- Regression Coefficients for Model 2.

variable	Coefficient	Std. Error	t-statistic	p-value
Intercept	8.2087	0.427	19.234	0.000
FXRate_change	-0.5875	0.29	-2.024	0.071
FXReserve_change	-0.0138	0.006	-2.154	0.057
IIP_change_lag1	0.0032	0.032	-0.099	0.923

From tables 3 & 4, the model's results are similar to that of Model 1 and statistically insignificant with Probability of F-stat being greater than 10%. Also, none of the independent variables are significant at a level of 5%

So, the variable involving IIP is dropped, as it is the most insignificant variable.

Final Model

Based on the results of run preliminary regressions, the variable involving IIP is droppedfrom the model

Model 3:
$$\mathbf{Y}_t = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \mathbf{X}_{1t} + \boldsymbol{\beta}_2 \mathbf{X}_{2t} + \boldsymbol{\varepsilon}_t$$
 (3)

The dependent variable is 'ln (FDI_gth)' and the independent variables are 'FXRate_change' and 'FXReserve_change'. Upon running the regression, the following resultswere obtained

 Table 5:- OLS Regression Results for Model 3.

parameter	value
R-squared	0.369
Adj. R-squared	0.254
F-statistic	3.214
Prob (F-statistic)	0.0796
Log-likelihood	-12.93

Table 6:- Regression Coefficients for Model 3.

variable	Coefficient	Std. Error	t-statistic	p-value
Intercept	8.20873	0.407	19.234	0.000
FXRate_change	-0.5787	0.264	-2.196	0.05
FXReserve_change	-0.0137	0.006	-2.256	0.045

From tables 5 & 6, the model's results are statistically significant similar. There is lesser difference between R^2 and Adjusted R^2 . The probability of F-stat Is less than 10%, so the null hypothesis stands rejected. Also, all the independent variables are significant at a level of 5%.

So, the final model is

$$\ln (FDI_gth) = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_t$$

Before we proceed with prediction, we have to validate the model

Model Validation

For the estimators to be Best Linear Unbiased estimators, we check several conditions and statistics

Mean of residuals

Mean of residuals must be zero.

Table 7:-	Descriptive	Statistics	for	Residuals.
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parameter	value
Count	14
Mean	4.44e-16
Standard deviation	6.32e-01

Fig. 1:- Model residuals plot.

From table 7 and Fig. 1, the mean of residuals is very close to zero, so, there is no specification error in the model



4.2.Zero correlation between residuals and independent variables

Table 8:- Correlation between residuals and independent

variable	Correlation with residuals
FXRate_change	1.91e-15
FXReserve change	-1.44e-15



Fig. 2:-FXRate_change vs residuals plot



Fig. 3:-FXReserve_change vs residuals plot.

From table 8 and Fig. 2 & 3, the independent variables are not correlated with residuals.So, there is no endogenity in the model and the regression coefficients are consistent.

Autocorrelation Test

From Fig. 1 we see that auto-correlation is absent, however we confirrm it using Durbin-Watson Test

From the following table 9, the Durbin-Watson test statistic is comfortably below $(4-d_U)$. So, we fail to reject the null hypothesis that the residuals are not correlated. So, it can be confidently said that the model has no auto-correlation problem

Table 9:- Durbin	Watson Test	Statistic	for Model	3.
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Level of Significance	Durbin-Watson Statistic	$4-d_U$	$4-d_L$		
0.01	2.003	2.746	3.34		

Heteroscedasticity Test

From Fig. 1 there is no difference in variance of residualsHowever, we confirm it mathematically by employing White's test for heteroscedasticity

Table 10:- White's Test for Model 3.

LM Statistic	p-value (LM Statistic)	F-statistic	p-value (F-statistic)
6.169	0.290	1.2605	0.366

From table 10, both Lagrange Multiplier and F-statistics p-values are very high. So, we fail to reject the null hypothesis that the residuals have a constant variance. So, there is no heteroscedasticity problem which means hypothesis tests for the model and variables are reliable.

Multicollinearity Test

For the model to be valid, the independent variables should not be correlated, the check for Multi-collinearity is done using VIF (Variance Inflation Factor) test.

Table 11:- VIF Test for Model 3.

Variable	VIF
FXReserve_change	1.417
FXRate_change	1.417

From table 11, VIF < 5 for all predictors, So, there is no multi-collinearity and the model is valid

Normality of residuals

Normality of residuals is required for the F-test on the model to be valid, so we proceed to conduct the Jarque-Berra Test.

Table 12:-Jarque-Berra Test for Model 3.

Parameter	Value
JB test statistic	0.149
p-value (JB)	0.928

From table 12, the p-value is very high for JB test statistic, this implies that the null hypothesis that the residualsare indeed normally distributed cannot be rejected. So, the F-tests on the model are valid.

Test for stuctural breaks

As the data is time-series data, there is a chance that there are structural breaks in the data. So, to check for any structural breaks, the Chow Test is done.

There are 14 periods (months), so, the check for structal break is done at periods 6,7,8. Period 0 is Jan-2019

 Table 13: Test for structural break.

period	F-statistic	p-value
6	1.1564	0.6157
7	2.6554	0.8802
8	2.6609	0.8806

The p-values are very high, so null hypothesis that there is no structural break and all the coefficients including intercept are equal, can't be rejected. So, theere are no structural breaks.

From sections 4.1 to 4.7, the model is completely valid and can be used for prediction

Prediction and Results:-

Predicted and Actual FDI:

FDI was predicted using the coefficients obtained from the regression model, these were compared to the Actual FDI inflows.

Table 14: Summary of results.

Month	FXRate_change	FXReserve_change	predicted_ln	FDI_predicted	FDI	Error_Prediction
			(FDI)		(actual)	
Mar'20	2.938795	19	6.247319334	516.6238936	1868.1	-1351.476106
Apr'20	1.832658	-16	7.366940815	1582.776496	887.9	694.876496
May'20	-0.624754	106	7.11764514	1233.536285	1310.4	-76.863715
Jun'20	0.075214	180	5.698773658	298.4999678	-544.7	843.1999678

The standard error in prediction is calculated to be 1739 (million \$)

Results:-

Fig. 4:- Comparison of actual and predicted FDI.



Interpretation

Though the regression model was robust and without defects, we see that the predictions miss their mark by a mile. So, we can say that the pandemic has altered the dynamics of what determines FDI. This is particularly true as the model has both types of errors (over-prediction and under-prediction) on data from Mar'20 to Jun'20

Conclusion:-

From the study, it was seen that the growth in FDI was a general downward trend as the pandemic progressed. Also, the growth in FDI was lower than predicted. It is seen that growth in FDI varies exponentially with changes in ForexReserves and changes in Exchange Rate. As expected, the coefficients are negative, meaning decrease in these two indicates better investment opportunities. Also, movement of IIP was seen to be a very poor indicator of changes in FDI. A robust regressionmodel was built, to see if the predictions of the modelduring the pandemic are accurate. It was noted that the predictions are off, indicating a significant change in FDI's growth pattern.

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