# Interplay of Macroeconomic Factors

*Lab Project for the Econometric Analysis  Lab - II course*


***Done By:***

Group 21

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## *CONTEXT AND OBJECTIVE*

Foreign Direct Investment refers to an ownership stake in a foreign company or project made by an investor, financial institution, company or government from another country. Foreign Direct Investment helps in increasing international economic integration and is a source of new technologies, skills and capital. It also helps in improving the ease of accessing foreign markets. Thus, a positive impact on the host country's exports is also expected.

The New Economic Policy 1991 introduced economic reforms which affect India's external relations greatly. These were aimed at modernising India's industrial base and improving competitiveness. The 1990s' reforms witnessed the removal of the 40 percent cap on foreign direct investment. Further, the RBI was given the authority to grant automatic approval to foreign equity investment of up to 51 percent in more than 30 industries. The technology transfers also became easier. Institutions like Foreign Investment Promotion Board, Foreign Investment Implementation Authority, Secretariat for Industrial Assistance were set up to promote the inflow of FDI. Tax concessions and subsidies further encouraged foreign investors. Thus, all these reforms collectively attracted more Foreign Direct Investment to India during the post-reforms period.

Many research articles theoretically hint at a positive relationship between the Foreign Direct Investment of a country and its Gross Domestic Product. This seems intuitively true as well. However, there is no unanimous consensus regarding the same, among the empiricists. Hence, we attempt to use the available data to understand the nature and direction of the relationship between FDI and GDP. Along with this, we were also curious to find out if foreign reserves had any impact on FDI too, since the research in this regard seems to be limited.

## *A BRIEF REVIEW OF LITERATURE*

As noted by Feldstein (2000), global integration of capital markets helps in spreading the best practices in corporate governance, accounting rules, etc. It also limits the ability of governments to pursue bad policies. Feldstein (2000) and Razin and Sadka (forthcoming) also say that FDI helps in the transfer of technology, improve competition in the domestic input market and employee training. Hence, in principle, these studies suggest that FDI should contribute to growth in host countries and thus, lead to a positive impact on GDP of the host country.

A report by OECD mentions that FDI contributes to both factor productivity and income growth, more than what domestic investment would trigger. Thus the existence of an additional growth impact of FDI is widely accepted. However, it is difficult to assess the magnitude of this impact. Some researchers suggest that the positive effects of FDI are lessened due to the "crowding out" of domestic investment whereas others conclude that FDI actually increases domestic investment. FDI seems to have a smaller impact on growth in least developed countries. It is stated that the developing countries need to have already reached a certain level of development in the domains of education, technology, infrastructure and health in order to fully enjoy the benefits of FDI. Underdeveloped financial markets may lead to a scarcity of financial resources, and prevent the domestic enterprises' from seizing the business opportunities which occur due to the foreign presence.

Thus, the above suggests that FDI causes GDP. However, some studies show that GDP causes FDI. For instance, Oglietti (2007) and Abello (2010) conducted econometric studies for data of Argentina, with which they were able to conclude that FDI did not lead to economic growth. Instead, the GDP is what attracted the foreign direct investment inflows to occur in the first place. Villegas-Zermano (2012) concluded the same for Mexico. Thus, we wish to study the same for India.

In addition to this, we focus on the effect of Foreign Reserves on FDI too. Foreign exchange reserves are the assets held on reserve by a central bank in foreign currencies. They are needed to make sure a country will meet its obligations. While the research in this regard is limited, we intuitively feel higher foreign reserves would result in higher FDI, given that the confidence of the investors in the economic situation of the host country would grow stronger.

***SPECIFICATION OF THE ECONOMETRIC MODEL***

As discussed, we would be discussing the impact of Foreign Reserves. Thus, our dependent variable would be FDI (fdi) and the independent variables would be GDP (gdp) and Foreign Reserves (frx).

$$fdi = \alpha(gdp) + \beta(frx) + \mu$$

Scaling down the variables by taking their natural logarithm, we get

$$\ln(fdi) = \alpha \ln(gdp) + \beta \ln(frx) + \mu$$

The VAR model is established based on the statistical properties of data. In the VAR model, each endogenous variable in the system is considered as the lagged value of all endogenous variables in the system; thus the univariate autoregressive model is generalised to the "vector" autoregressive model consisting of multivariate time series variables

We would attempt to justify this model specification later using econometric tests, particularly the Granger causality test.

***SOURCES OF DATA***

In order to continue with our study, we decided to use data for 1981-2020. We used the World Bank Database to collect the data for Foreign Direct Investment and Gross Domestic Product of India from the year 1981 to 2020. However, we were not able to find the data for Foreign Reserves in the World Bank Database, thus we had to collate data from the Reserve Bank of India website and prowessIQ. In this way, we were able to collect sufficient data for our econometric analysis.

***DESCRIPTIVE STATISTICS***

The descriptive statistics are as follows:

```
. sum gdp fdi frx lngdp lnfdi lnfrx
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| gdp | 38 | 8.68e+11 | 7.74e+11 | 1.93e+11 | 2.70e+12 |
| fdi | 38 | 1.29e+12 | 1.64e+12 | 5.64e+08 | 4.45e+12 |
| frx | 38 | 131302.4 | 145712.1 | 3962 | 424545 |
| lngdp | 38 | 27.12006 | .8599176 | 25.98849 | 28.62536 |
| lnfdi | 38 | 26.11626 | 2.559676 | 20.15056 | 29.12299 |
| lnfrx | 38 | 10.50985 | 1.679145 | 8.284504 | 12.82114 |

```
. corrgram frx
```

| LAG | AC | PAC | Q | Prob>Q | -1 0 1 [Autocorrelation] | -1 0 1 [Partial Autocor] |
|---|---|---|---|---|---|---|
| 1 | 0.9217 | 1.0297 | 34.903 | 0.0000 | | |
| 2 | 0.8368 | 0.2226 | 64.47 | 0.0000 | | |
| 3 | 0.7667 | 0.1331 | 90 | 0.0000 | | |
| 4 | 0.6851 | -0.3136 | 110.99 | 0.0000 | | |
| 5 | 0.6029 | -0.1681 | 127.73 | 0.0000 | | |
| 6 | 0.5314 | 0.0512 | 141.14 | 0.0000 | | |
| 7 | 0.4623 | 0.3354 | 151.62 | 0.0000 | | |
| 8 | 0.3831 | 0.0843 | 159.05 | 0.0000 | | |
| 9 | 0.2926 | -0.1488 | 163.54 | 0.0000 | | |
| 10 | 0.2118 | 0.0486 | 165.97 | 0.0000 | | |
| 11 | 0.1286 | -0.4598 | 166.9 | 0.0000 | | |
| 12 | 0.0194 | -4.9692 | 166.93 | 0.0000 | | |
| 13 | -0.0512 | 3.9096 | 167.08 | 0.0000 | | |
| 14 | -0.1093 | -9.6050 | 167.84 | 0.0000 | | |
| 15 | -0.1682 | -3.8259 | 169.71 | 0.0000 | | |
| 16 | -0.2172 | -1.5041 | 172.97 | 0.0000 | | |
| 17 | -0.2544 | -20.5770 | 177.65 | 0.0000 | | |

```
. corrgram fdi
```

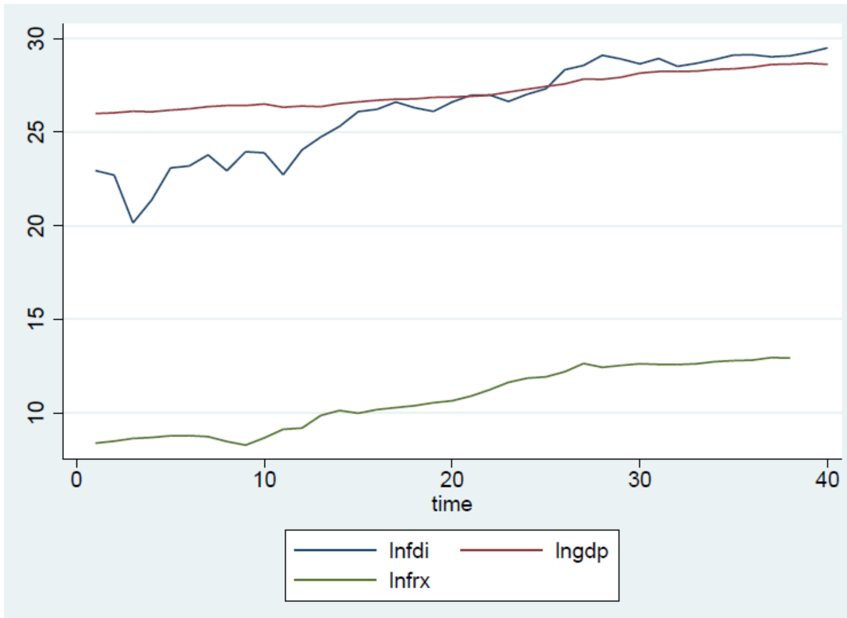
| LAG | AC | PAC | Q | Prob>Q |
|---|---|---|---|---|
| 1 | 0.8948 | 0.9821 | 32.893 | 0.0000 |
| 2 | 0.8011 | 0.0859 | 59.99 | 0.0000 |
| 3 | 0.6883 | -0.0103 | 80.566 | 0.0000 |
| 4 | 0.5725 | -0.0088 | 95.216 | 0.0000 |
| 5 | 0.5121 | 0.3725 | 107.3 | 0.0000 |
| 6 | 0.4669 | 0.1283 | 117.65 | 0.0000 |
| 7 | 0.4466 | 0.2551 | 127.43 | 0.0000 |
| 8 | 0.3549 | -0.6472 | 133.81 | 0.0000 |
| 9 | 0.2770 | -0.0475 | 137.83 | 0.0000 |
| 10 | 0.1708 | -0.1179 | 139.42 | 0.0000 |
| 11 | 0.0372 | 4.7696 | 139.49 | 0.0000 |
| 12 | -0.0435 | -9.8990 | 139.6 | 0.0000 |
| 13 | -0.1092 | 13.9898 | 140.33 | 0.0000 |
| 14 | -0.1395 | -1.4519 | 141.56 | 0.0000 |
| 15 | -0.1683 | -19.2561 | 143.43 | 0.0000 |
| 16 | -0.1900 | -21.3249 | 145.93 | 0.0000 |
| 17 | -0.2139 | -1.5829 | 149.24 | 0.0000 |

```
. corrgram gdp
```

| LAG | AC | PAC | Q | Prob>Q |
|---|---|---|---|---|
| 1 | 0.9026 | 1.0713 | 33.469 | 0.0000 |
| 2 | 0.7971 | 0.0644 | 60.296 | 0.0000 |
| 3 | 0.7129 | 0.2975 | 82.369 | 0.0000 |
| 4 | 0.6325 | -0.3298 | 100.25 | 0.0000 |
| 5 | 0.5477 | 0.0343 | 114.07 | 0.0000 |
| 6 | 0.4711 | 0.1256 | 124.61 | 0.0000 |
| 7 | 0.3884 | -0.0485 | 132.01 | 0.0000 |
| 8 | 0.2941 | -0.6228 | 136.39 | 0.0000 |
| 9 | 0.2051 | 0.8263 | 138.6 | 0.0000 |
| 10 | 0.1392 | 0.8907 | 139.65 | 0.0000 |
| 11 | 0.0756 | -0.1916 | 139.97 | 0.0000 |
| 12 | 0.0048 | -0.3915 | 139.97 | 0.0000 |
| 13 | -0.0479 | 0.9386 | 140.11 | 0.0000 |
| 14 | -0.0934 | 0.2363 | 140.66 | 0.0000 |
| 15 | -0.1316 | 2.3965 | 141.81 | 0.0000 |
| 16 | -0.1628 | 0.1924 | 143.64 | 0.0000 |
| 17 | -0.1869 | 1.6029 | 146.17 | 0.0000 |

From the graphs as well as Correlograms , we see that both the series are non-stationary. So, both of them are to be made stationary first to make a meaningful relationship between them. For checking stationarity statistically, we go in for Unit Root Test and with the help of "Augmented Dickey Fuller Test", we check stationarity in the level first including an intercept in the equation. Here we observe that the series becomes stationary after 1st differencing. We further make use of their graphical representations to remark upon the forecasting parameters.

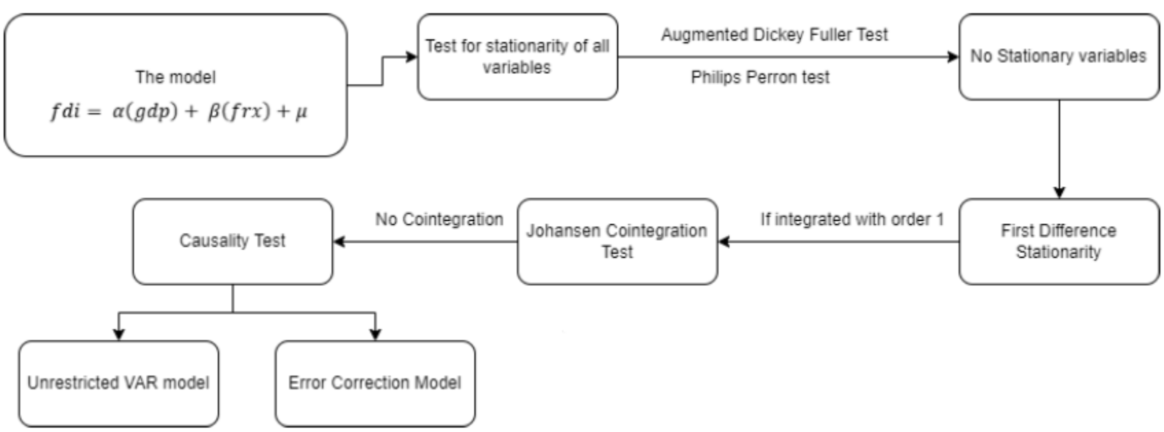
Given below is a graph of our three variables plotted against time. There is an overall positive trend in all the three variables, which is to be expected, given the Indian economy has experienced an overall growth over these years. The curves are not smooth; there are sharp peaks and lows. In particular, we can observe that there are sharp points around the year 1991, which was when the National Economy Policy was introduced, thus having a great impact on FDI and the economic variables in general.




***METHODOLOGY***

Our main objective with this report was to establish a model, test its stability and forecast the ARIMA model for the Forex Reserves as the end goal.

The following flowchart elaborately explains the steps which we used in our analysis.



***RESULTS, DISCUSSIONS AND IMPLICATIONS***

**Empirical tests:**

1. *Stationarity Test*: The commonly accepted ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root test are adapted to stationary tests of the GDP, FDI and Forex Reserves series.

```
. reg lnfdi lngdp lnfrx

      Source |       SS       df       MS              Number of obs =      38
-------------+------------------------------           F(  2,    35) =  184.35
       Model |  221.403881     2  110.701941           Prob > F      =  0.0000
    Residual |  21.0179348    35  .600512422           R-squared     =  0.9133
-------------+------------------------------           Adj R-squared =  0.9083
       Total |  242.421816    37  6.55194097           Root MSE      =  .77493

------------------------------------------------------------------------------
       lnfdi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lngdp |  -.8917398   .6682546    -1.33   0.191    -2.248369    .4648892
       lnfrx |   1.898601   .3422242     5.55   0.000     1.203849    2.593353
       _cons |   30.34629   14.63816     2.07   0.046     .6292533    60.06333
------------------------------------------------------------------------------

. estat dwatson

Durbin-Watson d-statistic(  3,    38) =  .8068905
```

Here,the R>DW shows that there is spurious regression. We further test the first difference model to test for its stationary and check the order of Integration.

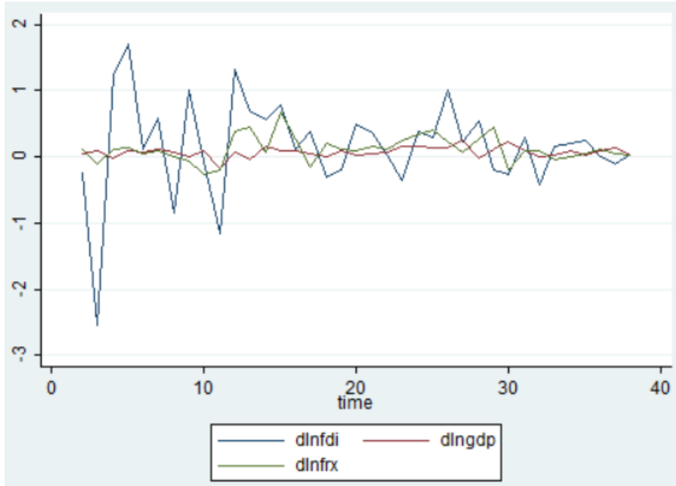
```
. dfuller lngdp,trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.534            -4.279            -3.556            -3.214
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8172
```

The result shows that the series is stationary with the order 1 i.e I(1).

Similarly we test for stationarity of all the series and they all turn out to be stationary with order and finally get the Line Plot for the same as follows:




2. *Tests for Cointegration*: To establish a long-run relationship in the model we perform the Johansen Cointegration test on the series integrated with order 1.

H0: no cointegrating equation

Ha: We have a cointegrating equation

The results are as follows:

```
. vecrank lnfdi lngdp lnfrx, trend(constant) max

                     Johansen tests for cointegration
Trend: constant                                        Number of obs =      36
Sample:  3 - 38                                                 Lags =       2
-------------------------------------------------------------------------------
                                                        5%
maximum                                      trace    critical
  rank    parms      LL         eigenvalue  statistic   value
    0      12    18.459501          .        30.5770*   29.68
    1      17    24.847552       0.29875      7.8009    15.41
    2      20    28.663471       0.19103      0.1691     3.76
    3      21    28.748019       0.00469
-------------------------------------------------------------------------------
                                                        5%
maximum                                       max     critical
  rank    parms      LL         eigenvalue  statistic   value
    0      12    18.459501          .        22.7761    20.97
    1      17    24.847552       0.29875      7.6318    14.07
    2      20    28.663471       0.19103      0.1691     3.76
    3      21    28.748019       0.00469
-------------------------------------------------------------------------------
```

Here both the trace statistic and max statistic suggest that the null hypothesis is rejected and that the rank to be 1.This means there are stable and long-term equilibrium relationships among the variables. On the premise of the existence of cointegration relationships, VEC modelling can be further conducted. Whereas for the short-run model VAR can be estimated.

3. *Estimation of VAR Model*:

$$\boldsymbol{\ln fdi_t} = \sigma + \sum_{i=1}^{k} \boldsymbol{\beta_i \ln fdi_{t-i}} + \sum_{j=1}^{k} \emptyset_j \ln frx_{t-j} + \sum_{m=1}^{k} \varphi_m \ln gdp_{t-m} + \mu_{1t}$$

$$\boldsymbol{\ln frx_t} = a + \sum_{i=1}^{k} \beta_i \ln fdi_{t-i} + \sum_{j=1}^{k} \boldsymbol{\emptyset_j \ln frx_{t-j}} + \sum_{m=1}^{k} \varphi_m \ln gdp_{t-m} + \mu_{2t}$$

$$\boldsymbol{\ln gdp_t} = b + \sum_{i=1}^{k} \beta_i \ln fdi_{t-i} + \sum_{j=1}^{k} \emptyset_j \ln frx_{t-j} + \sum_{m=1}^{k} \boldsymbol{\varphi_m \ln gdp_{t-m}} + \mu_{3t}$$

The first issue of the VAR model is to determine Lag Intervals for Endogenous. The larger the Lag Intervals for Endogenous is, the more it can entirely reflect the dynamic nature of the model. But in this case, more parameters will be needed to be estimated to constantly reduce freedom degrees of the model. This is a contradiction in the selection of proper Lag Intervals for Endogenous. There are many methods that can determine the optimal lag period for the VAR model. In comprehensive consideration of selecting Lag Intervals for Endogenous, we have determined it on the basis of *varsoc* in lieu of the log-likelihood, AIC and BIC criterion.

```
. varsoc lnfdi  lngdp lnfrx

   Selection-order criteria
   Sample:  5 - 38                          Number of obs      =        34
```

| lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | -77.1297 | | | | .022369 | 4.71351 | 4.75944 | 4.84819 |
| 1 | 41.0172 | 236.29 | 9 | 0.000 | .000037* | -1.70689* | -1.52317* | -1.16818* |
| 2 | 43.2504 | 4.4666 | 9 | 0.878 | .000055 | -1.30885 | -.987344 | -.366098 |
| 3 | 54.2421 | 21.983 | 9 | 0.009 | .000051 | -1.42601 | -.966713 | -.079218 |
| 4 | 63.8798 | 19.275* | 9 | 0.023 | .000053 | -1.46352 | -.866437 | .287306 |

```
   Endogenous:  lnfdi lngdp lnfrx
    Exogenous:  _cons
```

```
. var lnfdi lngdp lnfrx, lags(1/2)

Vector autoregression

Sample:  3 - 38                              No. of obs      =        36
Log likelihood =  28.74802                   AIC             = -.4304455
FPE            =  .0001325                   HQIC            = -.1080427
Det(Sigma_ml)  =  .0000406                   SBIC            =  .4932739

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
lnfdi                 7     .76401   0.9229   430.7144   0.0000
lngdp                 7    .063745   0.9952   7523.089   0.0000
lnfrx                 7    .209135   0.9867   2668.469   0.0000
----------------------------------------------------------------
```

4. *Diagnostic Tests*:

The diagnostic tests for the VAR model show us a stable, and normally distributed model.

```
. varlmar, mlag(2)
```

Lagrange-multiplier test

| lag | chi2 | df | Prob > chi2 |
|---|---|---|---|
| 1 | 37.7501 | 9 | 0.00002 |
| 2 | 11.7723 | 9 | 0.22645 |

H0: no autocorrelation at lag order

```
. varnorm, jbera
```

Jarque-Bera test

| Equation | chi2 | df | Prob > chi2 |
|---|---|---|---|
| lnfdi | 107.550 | 2 | 0.00000 |
| lngdp | 2.188 | 2 | 0.33493 |
| lnfrx | 0.235 | 2 | 0.88897 |
| ALL | 109.973 | 6 | 0.00000 |

```
. varstable

   Eigenvalue stability condition
```

| Eigenvalue | Modulus |
|---|---|
| .9836553 | .983655 |
| .8276833 | .827683 |
| .6639783 | .663978 |
| .2017599 | .20176 |
| -.1176923 + .02022447*i* | .119417 |
| -.1176923 - .02022447*i* | .119417 |

```
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```

5. *Three-Way Granger Causality*: Cointegration test indicates a long-term equilibrium relationship between the three variables, but, in terms of causal relationship, further testing is needed. If variable A is helpful in predicting B, namely, the regression of B is based on past values of B and past values of A are added, this can greatly enhance the explanatory ability of the regression. Then A can be called Granger cause of B; otherwise it can be called non-Granger cause. P value is less than the significant level of 5%, which indicates the need to accept the null hypothesis, namely the existence of Granger cause. Similarly we check if the Variable C is the Granger cause to A and simultaneously to determine the causal relationship.

Results:

```
. vargranger
```

Granger causality Wald tests

| Equation | Excluded | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| lnfdi | lngdp | .07868 | 2 | 0.961 |
| lnfdi | lnfrx | 2.2687 | 2 | 0.322 |
| lnfdi | ALL | 3.6443 | 4 | 0.456 |
| lngdp | lnfdi | 2.1486 | 2 | 0.342 |
| lngdp | lnfrx | 19.971 | 2 | 0.000 |
| lngdp | ALL | 27.926 | 4 | 0.000 |
| lnfrx | lnfdi | 1.3006 | 2 | 0.522 |
| lnfrx | lngdp | .30027 | 2 | 0.861 |
| lnfrx | ALL | 1.6281 | 4 | 0.804 |

6. *Estimation of VECM*:

$$\Delta lnfdi_t = \sigma + \sum_{\boldsymbol{i=1}}^{\boldsymbol{k-1}} \boldsymbol{\beta_i \Delta lnfdi_{t-i}} + \sum_{j=1}^{k-1} \phi_j \Delta lnfrx_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta lngdp_{t-m} + \lambda_1 ECT_{t-1} + u_{1t}$$

$$\Delta lnfdi_t = a + \sum_{i=1}^{k-1} \beta_i \Delta lnfdi_{t-i} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{k-1}} \boldsymbol{\phi_j \Delta lnfrx_{t-j}} + \sum_{m=1}^{k-1} \varphi_m \Delta lngdp_{t-m} + \lambda_2 ECT_{t-1} + u_{2t}$$

$$\Delta lnfdi_t = \vartheta + \sum_{i=1}^{k-1} \beta_i \Delta lnfdi_{t-i} + \sum_{j=1}^{k-1} \phi_j \Delta lnfrx_{t-j} + \sum_{\boldsymbol{m=1}}^{\boldsymbol{k-1}} \boldsymbol{\varphi_m \Delta lngdp_{t-m}} + \lambda_3 ECT_{t-1} + u_{3t}$$

VECM imposes additional restrictions due to the existence of non-stationary but co-integrated data forms. It utilises the co-integration restriction information into its specifications. After the cointegration is known then the next test process is done by using error correction method. Through VECM we can interpret long term and short term equations. We need to determine the number of cointegrating relationships. The advantage of VECM over VAR is that the resulting VAR from VECM representation has more efficient coefficient estimates.

Results

```
Vector error-correction model

Sample:  3 - 38                                   No. of obs      =        36
                                                  AIC             = -.4359751
Log likelihood =  24.84755                        HQIC            = -.1749824
Det(Sigma_ml)  =  .0000505                        SBIC            =  .311797

```

```
Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                   2   102.4998   0.0000
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
       lnfdi |          1          .        .       .            .           .
       lngdp |   4.601222   1.887203     2.44   0.015     .9023713    8.300072
       lnfrx |   -4.08294   .9634002    -4.24   0.000     -5.97117   -2.194711
       _cons |  -110.0553          .        .       .            .           .
------------------------------------------------------------------------------
```

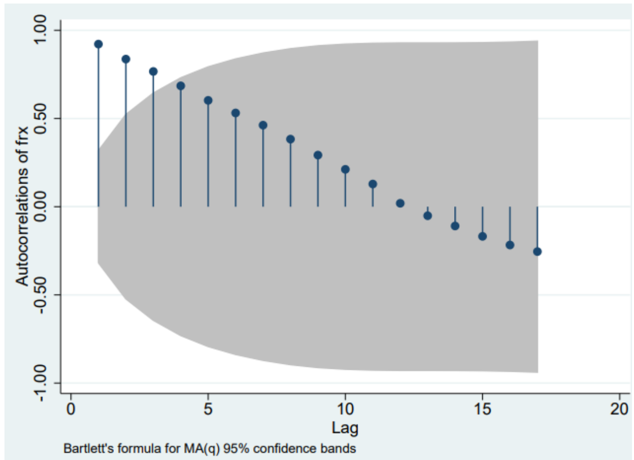
The obtained equation:

$$\ln fdi = 4.4601222 \ln gdp + \ -4.08294 \ln frx - 110.0553$$

7.*Forecasting*: Identification of model:

| **Model** | **ACF Pattern** | **PACF Pattern** |
|---|---|---|
| AR(p) | Exponential decay or damped sine wave pattern or both | Significant spikes through first lag |
| MA(q) | Significant spikes through first lag | Exponential decay |
| ARMA(1,1) | Exponential decay from lag 1 | Exponential decay from lag 1 |

| | | |
|---|---|---|
| ARMA(p,q) | Exponential decay | Exponential decay |




From this we can infer that the following models are to be estimated: ARIMA (1,0,1) ARIMA (1,0,2) ARIMA (1,0,3)

Results:

The "appropriate" model should have:

1. Most significant coefficients
2. Lowest volatility
3. Highest log-likelihood statistic
4. Lowest AIC and SBIC

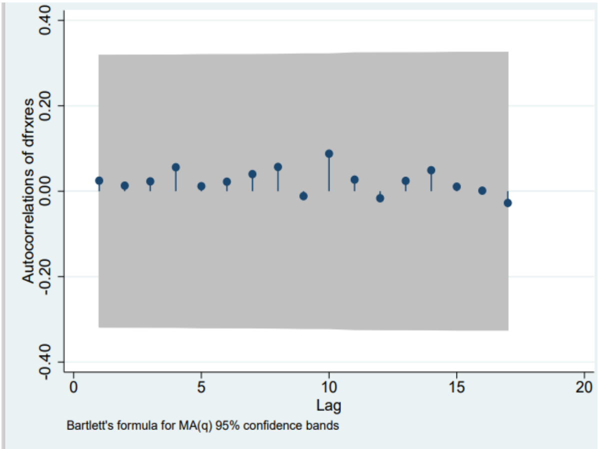
| Differenced ppi | ARIMA(1,0,1) | ARIMA(1,0,2) | ARIMA(1,0,3) |
|---|---|---|---|
| Forecasting | 101 | 102 | 103 |
| Sigma Coefficients | 0.2718011 | 0.2701693 | 0.2257044 |
| Log-Likelihood | -443.8707 | -443.6819 | -437.8541 |
| AIC | 895.7414 | 897.3638 | 887.7082 |
| BIC | 902.2918 | 905.5517 | 897.5337 |

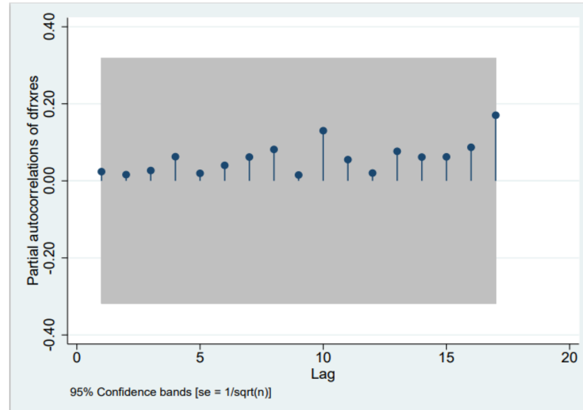
Hence we select **ARIMA(1,0,3)** as our optimal model and further run diagnostics to test its validity for forecasting.

Diagnostics:

The correlogram of the **PACF** for the residuals is not so flat. It is showing some significance at some points. But those lags will not be considered. Therefore the forecast will be based on this model.

The correlogram of the **ACF** for the residuals is flat which indicates that all information has been captured. So, the forecast will be based on this model.






Hence we can plot the forecasted values based on the ARIMA(1,0,3) model

***CONCLUDING REMARKS:***

Thus, with our study, we were able to make the following concluding remarks:

- There are sharp points in the curve around the year 1991, indicating a significant change in the economic variables after the implementation of NEP 1991.
- The time series are not stationary initially, but become stationary after the first differencing which suggests that Foreign Direct Investment, the GDP and Forex Reserves have widely varying statistics over time but are cointegrated over the first difference.
- The Granger Causality Test suggests a unidirectional relationship between FDI and GDP (GDP causes FDI) and FDI and Foreign Reserves (Foreign Reserves cause FDI). There exists no causal relationship between GDP and Foreign Reserves as of this model but it might have been the case due to insufficient data points for the Forex Reserves.
- There is no presence of autocorrelation, and the model follows the assumption of normality, skewness and kurtosis.
- We could have improved the model by adding more independent variables to the mix to verify the impact of Foreign Direct Investment across the Indicators. Rather than just using graphical analysis, we could have tested for structural breaks. However, due to the limitation of time, we were not able to do the same.