EA-II Lab Assignment Report

Group 27

Context and Objective

Balance of Payments is an integral tool to gauge a country's status in international trade, since it is a record of monetary transactions over a period globally. BoP speaks of all the payments and liabilities rendered and all payments and obligations rendered by the foreigners. BoP accounting also indicates a country's competency and weakness, thereby contributing to balanced economic germination. It is a critical equipment that influences the economy itself, which is why countries strive to have a sustainable and favorable Balance of Payments.

During the time of India's entry into the Liberalized trade regime, the country's BoP position was quite adverse. The dictating factors on which a nation's balance of payment pivots are: balance of trade, exchange rate movement, industrial production and manufacture, inflation and Gross Domestic Product (GDP). Unfavorable BoP pronounces crisis for an economy by creating disequilibrium between the demand and supply in the money market. This monetary equilibrium is tackled in one of the following ways:

- If there is excess supply of money in the public, it's dissipated by passing its excess cash balance to foreign countries, transacting in goods and services.
- If the public is desirous of keeping more money than it has in stock, absorption is reduced and consequently money is received from foreign countries in exchange of goods and services.

So far into the context there's an incumbent question raised: What are some plausible causes and solutions to the BoP fluctuations occurring in India?

The **objective** of our report revolves around attempting to answer this very question. We try to examine the impact of macroeconomic variables such as balance of trade, exchange rate movement, industrial produce and manufacture, inflation and Gross Domestic Product (GDP); addressing the Balance of Payments situation existing in India.

Brief review of Literature

We referred to a paper by Dr. Anupreet Kaur Mavi and Dr. Nishi Sharma titled "Macro-Economic Determinants of Balance of Payment in India" to assist with our project. This report evaluates the impact of certain macroeconomic variables such as balance of trade, exchange rate movement, industrial produce and manufacture, inflation and Gross Domestic Product (GDP) etc on Balance of Payments in India between 1981 and 2013 through correlation and regression. They concluded that BoP is significantly influenced by the aforementioned factors, but for exchange rate movement the impact was concluded to be statistically insignificant.

Specification of the econometric model

Justification

The variables we considered for our model are balance of payments (bop), exchange rate (exr), inflation{GDP deflator} (igd), inflation{consumer prices} (icp), GDP and balance of trade(bot).

We couldn't find satisfactory data for industrial production, hence we had to omit it from our model. We also thought of considering the impact of government restrictions on balance of payments and decided to use tariff rates as a measure for the same. Due to a lack of data points, this variable was dropped.

The first thing we did is make all the variables stationary. The results were as follows:

1. bop : I(0)
2. exr : I(1)
3. igd : I(1)
4. icp : I(0)
5. ln(gdp) : I(1)
6. bot : I(1)

Our reasoning for considering the variables mentioned is supported by our literature review and pre-existing theory.

Possible Impact of Independent Variables

The main question we want to address is whether macro-economic variables such as exchange rate, inflation rate, GDP etc have an impact on BoP and how significant is the impact of above mentioned macro economic variables on the BoP in Indian context. We expect that exchange rate and inflation will affect BoP negatively over time in India. Conversely, we expect balance of trade and GDP to maintain a positive relationship with BoP during the sample period.

Measurement of the variables

All variables apart from GDP were taken as is.

1. bop : 1000 US$
2. exr : INR/$
3. igd : annual %
4. icp : annual %
5. bot : current US$

For GDP (current US$), we took the natural log to help achieve stationarity and because the plot of GDP v/s time approximated an exponential distribution.

Estimation Techniques

Step 1 : Making all the variables stationary
Step 2 : Using “varsoc” to ascertain optimal number of lags for Vector Autoregression (VAR) mode
Step 3 : Estimating VAR model
Step 4 : Dropping icp due to lack of significance
Step 5 : Estimating revised VAR model
Step 6 : Checking for autocorrelation and stability
Step 7 : Running Granger Causality test to check for direction of causality

Sources of Data

The data was sourced from the database on the World Bank’s website.

Results, Discussions, and Implications

We ascertained the lag length for estimating the VAR model using the “varsoc” command

varsoc bop d1exr d1igd d1lngdp d1bot

```
varsoc bop dlexr dligd dllngdp dlbot

 Selection-order criteria
 Sample:  6 - 47                               Number of obs      =        42
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 | -2224.68                       8.9e+39   106.175   106.251   106.382  |
|  1 | -2162.85  123.67   25  0.000  1.6e+39*  104.421   104.876*  105.663* |
|  2 |  -2139.4  46.886   25  0.005  1.8e+39   104.495    105.33   106.771  |
|  3 | -2121.51  35.793   25  0.075  2.8e+39   104.834   106.047   108.144  |
|  4 | -2086.86  69.294*  25  0.000  2.4e+39   104.374*  105.967   108.719  |
+---------------------------------------------------------------------------+
 Endogenous:  bop dlexr dligd dllngdp dlbot
  Exogenous:  _cons
```

We estimated the Vector Autoregressive (VAR) Model, with variables Balance of Payment(bop), first difference of Exchange Rate(d1exr), first difference of GDP deflator (d1igd), first difference of log of GDP (d1lngdp) and first difference of Balance of Trade (d1bot). In a 95% confidence interval or, at a 5% significance level, the null hypothesis of the Wald test for each of the individual equations was rejected, indicating combined statistical significance of each of the equations.

var bop d1exr d1igd d1lngdp d1bot, lags(1)

```
. var bop dlexr dligd dllngdp dlbot, lags(1)

Vector autoregression

Sample:  3 - 47                                   No. of obs      =        45
Log likelihood = -2330.659                        AIC             =  104.9182
FPE            =  2.55e+39                        HQIC            =  105.3672
Det(Sigma_ml)  =  6.67e+38                        SBIC            =  106.1226

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
bop                    6     1.8e+10   0.4502   36.84414   0.0000
dlexr                  6     1.80175   0.4207   15.52057   0.0084
dligd                  6     2.69552   0.2383    11.2867   0.0460
dllngdp                6     .071884   0.2628   12.05906   0.0340
dlbot                  6     1.8e+10   0.2809   17.57495   0.0035
------------------------------------------------------------------
```

After implementing a Lagrange multiplier (LM) test for autocorrelation in the residuals of VAR models, the results came to be statistically significant.

```
. varlmar

  Lagrange-multiplier test
+--------------------------------------+
| lag  |      chi2     df   Prob > chi2 |
|------+-------------------------------|
|   1  |   25.7542     25      0.42081  |
|   2  |   18.2309     25      0.83243  |
+--------------------------------------+
 H0: no autocorrelation at lag order
```

We cannot reject the null hypothesis of no residual autocorrelation at orders 1 through 4 at any conventional significance level, so we have no evidence to contradict the validity of our VAR.

Further, to check the stability of the estimated VAR model, we used varstable, and the results were as follows :

```
. varstable

   Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue         |  Modulus  |
  |---------------------------+-----------|
  |  -.2910174 +  .2393647i   |   .376811 |
  |  -.2910174 -  .2393647i   |   .376811 |
  |   .3701447                |   .370145 |
  |   .1450002 +  .2250454i   |   .267713 |
  |   .1450002 -  .2250454i   |   .267713 |
  +---------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```

Because the modulus of each eigenvalue is strictly less than 1, the estimates satisfy the eigenvalue stability condition.

After performing Granger Causality Test, we came up with the following results :

```
. vargranger

  Granger causality Wald tests
+-------------------------------------------------------------------------+
|          Equation           Excluded |    chi2     df Prob > chi2 |
|-------------------------------------+-------------------------------|
|               bop              dlexr |   .00929     1     0.923     |
|               bop              dligd |   .54305     1     0.461     |
|               bop            dllngdp |   .44716     1     0.504     |
|               bop              dlbot |   1.2163     1     0.270     |
|               bop                ALL |   3.7478     4     0.441     |
|-------------------------------------+-------------------------------|
|             dlexr                bop |          .     0         .     |
|             dlexr              dligd |   5.5077     1     0.019     |
|             dlexr            dllngdp |    12.55     1     0.000     |
|             dlexr              dlbot |          .     0         .     |
|             dlexr                ALL |   14.774     2     0.001     |
|-------------------------------------+-------------------------------|
|             dligd                bop |          .     0         .     |
|             dligd              dlexr |   1.8748     1     0.171     |
|             dligd            dllngdp |   .02432     1     0.876     |
|             dligd              dlbot |          .     0         .     |
|             dligd                ALL |   3.5507     2     0.169     |
|-------------------------------------+-------------------------------|
|           dllngdp                bop |          .     0         .     |
|           dllngdp              dlexr |   3.9006     1     0.048     |
|           dllngdp              dligd |   10.521     1     0.001     |
|           dllngdp              dlbot |          .     0         .     |
|           dllngdp                ALL |   11.942     2     0.003     |
|-------------------------------------+-------------------------------|
|             dlbot                bop |   4.7149     1     0.030     |
|             dlbot              dlexr |   .67787     1     0.410     |
|             dlbot              dligd |   2.4412     1     0.118     |
|             dlbot            dllngdp |   .31307     1     0.576     |
|             dlbot                ALL |   17.081     4     0.002     |
+-------------------------------------------------------------------------+
```

As we can see, bop is granger caused by all of the variables individually and combined, which follows the results expected from our literature review. Moreover, there is unidirectional causality from all the aforementioned variables to balance of payments. An unexpected result was the difference of inflation (gdp deflator) getting granger caused by the other variables combined.

Concluding remarks

Lack of data for some crucial variables hindered our approach to modeling the problem at hand. However, the results we garnered from our model more or less mirrored those from the literature we reviewed. Exchange rate and inflation affected BoP negatively in our VAR model, as per our expectations. We also expected balance of trade to maintain a positive relationship with BoP

during the sample period, which turned out to be true. The one result which deviated from our expectations was GDP affecting BoP negatively. All in all, this was a very enriching experience for all of us and we were very grateful to get an opportunity to work on a project such as this.

Signatures

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