CHAPTER VII
EMPIRICAL ANALYSIS

Trade and balance of payments are interrelated to each other. Balance of payments can be improved by improving the export trade. With the increase in the export trade, the trade deficit declines and hence the balance of payments improves. This is the notion of the traditional balance of payments adjustment approaches.

The elasticity approach advocates the devaluation of the domestic currency vis-à-vis foreign currencies for the improvement in the trade account and hence in balance of payments of a country. In fact, enhancing export trade through devaluation and thereby improving the balance of payments of a country has been sought as major tool in the elasticity and absorption approaches to balance of payments. These approaches consider only in the improvement in the current account but not on the overall balance of payments. However, on the contrary, the monetary approach to the balance of payments studies the overall balance of payments, that is, factors bearing directly on the balance on the international reserves of a country.

As Nepalese trade and balance of payments with India has been suffering from severe deficit, it has become imperative to find out the major determinants of Nepalese trade and balance of payments with India. Therefore, an attempt has been made in this chapter to explore the determining factors of Nepalese trade and balance of payments with India.
7.1 Determinants of Nepalese trade with India

The equations of estimates for exploring the determinants of Nepalese trade with India are assumed to be–

\[ XI_t = b_0 + b_1 Y_t + b_2 NDA_t + b_3 P_t + b_4 P_t^* \] ........................................... 1

The signs of the coefficients are expected to be,
\( b_1 > 0, b_2 > 0, b_3 < 0, \) and \( b_4 > 0 \)

\[ MI_t = c_0 + c_1 Y_t + c_2 NFA_S + c_3 NFAI_t + c_4 NDA_t + c_5 P_t + c_6 P_t^* \] ............. 2

The signs of the coefficients are expected to be,
\( c_1 < 0, c_2 > 0, c_3 > 0, c_4 > 0, c_5 > 0, c_6 < 0. \)

Where,
\[ t = \text{time} \]

\( XI = \text{Nepalese exports to India, and} \)

\( MI = \text{Nepalese imports from India.} \)

\( Y = \text{Nepalese GDP,} \)

\( NFA_S = \text{Reserves of convertible currencies of monetary authority of Nepal,} \)

\( NFAI = \text{Reserves of inconvertible currencies (Indian rupees) of monetary authority of Nepal,} \)

\( NDA = \text{Net domestic assets of Nepalese economy,} \)

\( P = \text{Nepalese consumer price index, and} \)

\( P^* = \text{Indian consumer price index.} \)
Results

1) Taking Unlagged Variables

Table 7.1

Nepalese Exports to and Imports from India with unlagged variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>Yt</th>
<th>NFA$ t</th>
<th>NFAI t</th>
<th>NDA t</th>
<th>P t</th>
<th>P* t</th>
<th>R²</th>
<th>F</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>XI</td>
<td>1967.583</td>
<td>-.025</td>
<td>-1.467</td>
<td>7.734</td>
<td>-287.103</td>
<td>261.243</td>
<td>.987</td>
<td>235.48</td>
<td>1.077</td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>.416</td>
<td>2.645</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>.264</td>
<td>7.347</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| MLI               | 9480.88   | -.078| -1.047 | .829   | 330.19 | -313.57| .996  | 459.09| 2.160 |
| t-value           | 1.28      | 2.294|        |        |       |       |       |      |       |      |
| P                 | 213       | .416 |        |        |       |       |       |      |       |      |

Note: the “t” in the subscripts denotes time and p denotes the level of significance.

i) Table 7.1 shows that Nepalese exports to India at time period “t” is inversely related to its GDP and price at the same time period “t”. However, it is positively related to the NDA (= total credit supplied to the economy) and the Indian price index of the same time period “t”. The result suggests that Nepalese exports to India increases with the fall in Nepalese GDP and Nepalese price, and with the rise in NDA and Indian price. As the Nepalese price decreases or Indian price increases, Nepalese exports to India increases. Similarly, as the NDA increases, production and exportation of Nepalese goods increases due to more productive activities in the country. However, the negative relation between Nepalese exports to India and Nepalese GDP possibly due to the increase in Nepalese consumption of domestically produced goods with the rise in their income. The value of $R^2$ and $F$ show that the estimate is highly significant. Similarly, the value of DW signifies there is no positive autocorrelation in the error term.

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ii) The results further show that import from India at time period “t” is directly related to NFA$, NFAI, NDA and Nepalese price and inversely related to the Indian price and the Nepalese GDP of the same time period. This signifies that with the increase in NFA$, NFAI, and NDA, Nepalese imports from India increases. This may be due to the fact that with the increase in these variables, the domestic money supply increases and hence the domestic demand increases leading to increase in imports. Similarly, as increase in price encourages imports, increase in Nepalese price leads to increase in imports from India. The inverse relationship between Nepalese imports and its GDP signifies that with the increase in Nepalese GDP Nepalese imports from India decreases. This is possibly due to substitution of imports from India. Similarly the negative relation between Indian price and Nepalese imports signifies that decrease in Indian price encourages imports from India. However, these estimates show that decrease in Nepalese GDP and increase in its NDA encourages both exports to and imports from India at the same time. The value of $R^2$, F and DW are appreciable. However, as the price of India, NFA$, and also NFAI are exogenously determined, the only option left for Nepal, to improve its trade with India, is to improve its price competitiveness.
2) Taking Lagged Variables

Table 7.2

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>( Y_{t-1} )</th>
<th>NFA(<em>S</em>{t-1} )</th>
<th>NFA(<em>I</em>{t-1} )</th>
<th>NDA(_{t-1} )</th>
<th>( P_{t-1} )</th>
<th>( P^*_{t-1} )</th>
<th>( R^2 )</th>
<th>F</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>( XL_t ) t-value</td>
<td>14856.62</td>
<td>-2.225</td>
<td></td>
<td></td>
<td>.163</td>
<td>4.922</td>
<td>-352.455</td>
<td>104.08</td>
<td>.983</td>
<td>345.754</td>
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<tr>
<td>P</td>
<td>3.747</td>
<td>-4.928</td>
<td></td>
<td></td>
<td>4.922</td>
<td>0.000</td>
<td>-2.227</td>
<td>4.162</td>
<td>.036</td>
<td>4.162</td>
</tr>
<tr>
<td>( ML_t ) t-value</td>
<td>11681.16</td>
<td>-0.966</td>
<td>.136</td>
<td>.135</td>
<td>.673</td>
<td>5.804</td>
<td>432.232</td>
<td>-418.47</td>
<td>.992</td>
<td>459.503</td>
</tr>
<tr>
<td>P</td>
<td>1.418</td>
<td>-0.985</td>
<td>862</td>
<td>649</td>
<td>5.804</td>
<td>0.000</td>
<td>1.313</td>
<td>-1.232</td>
<td>.231</td>
<td>1.232</td>
</tr>
<tr>
<td></td>
<td>.170</td>
<td>.335</td>
<td>398</td>
<td>523</td>
<td>0.000</td>
<td>.203</td>
<td>.992</td>
<td>459.503</td>
<td>1.270</td>
<td></td>
</tr>
</tbody>
</table>

Note: the “t” in the subscripts denotes time and p denotes the level of significance.

i) The table (Table 7.2) shows the result of the regression of Nepalese exports to and imports from India using lag variables. The high value of \( R^2 \) and F for both the models of exports and imports show that the model is highly good fit. Compared to the result of Table 7.1 and Table 7.2, it is visible that for exports the lag of Nepalese GDP, Nepalese price, and Indian price are more significant than their unlagged value. However, for Nepalese imports from India, the lag of NFA\(_S\), Nepalese price and Indian price are more significant compared to their unlagged values.

Using the above results, it can be concluded that, all the other variables of GDP and NDA, which are used in the analysis encourage both the imports from and exports to India at the same time. However, the price variables exhibit inverse relationship. The gist is that, Nepalese trade deficit improves with the fall in Nepalese price or increase in Indian price. However, Nepal cannot influence Indian price, the only option left to it is to reduce the price of Nepalese exportables. This can only be done by
enhancing the efficiency of production, controlling the inflation to a desired level and creating a favourable environment for new investments.

It is to be noted that, the major weakness of all the models of the type above is that they study only the trade account of the balance of payments but not the overall international balance of the economy. Despite known as the approaches to adjust balance of payments, the major weakness associated with the elasticity approach and the absorption approach is that these models study only the trade account but not the whole balance of payments. Though based on many unrealistic assumptions, the monetary approach to the balance of payments studies the overall international balance of an economy. In view of the above, an attempt is made here to study the monetary interpretation of the balance of payments in the following sections.

7.2 Monetary Interpretation to balance of payments

In formulating the monetary interpretation of the balance of payments, some ideas have been drawn from two research works— work done by D. Sykes Wilford and Walton T. Wilford1, and the report submitted by the Institute for Sustainable Development to NRB. The model is formulated in the growth form including both the Indian and Nepalese economic variables. The model is based on the following propositions—

(i) As the ratio of Indian price to Nepalese price increases, the demand for Indian currency for transaction increases. Given the fixed money demand in the short run, with the increase in demand for Indian currency, the demand for domestic currency decreases tending to depreciate the domestic currency and appreciate the

Indian currency. However, given the fixed exchange rate regime with the Indian currency, Nepalese authority sells the Indian currency to purchase the domestic currency holdings of the people and thereby increases the supply of the inconvertible currency in the economy resulting a decline in the reserve of inconvertible currency of the monetary authority of Nepal. In this way, by the process of adjustment and readjustment in the money supply and demand, the exchange rate is kept unaltered.

(ii) As the Nepalese GDP (Y) increases, the demand for domestic currency increases and thereby the domestic currency tends to appreciate. Given the fixed exchange rate regime, the monetary authority will supply its domestic currency by purchasing the Indian currencies held in the commercial banks. This act will contribute to increase in the reserves of inconvertible currency of the monetary authority of Nepal.

(iii) The effect of increase in the ratio of value of US$ in India and value of US$ in Nepal (Re) on the net foreign reserves of Indian currency is expected to be positive. As the ratio increases, the direct inflow of dollar will divert to India first and be converted into Indian currency and then flow into Nepal in the form of Indian currency. This act, on the one hand, will increase the supply of Indian currency in Nepal tending to depreciate it, and on the other, tends to appreciate Nepalese currency due to increase in demand associated with the inflow of Indian currency. However, in order to keep the exchange rate fixed, the monetary authority of Nepal will buy Indian currency and sell Nepalese currency to people and
commercial banks. This will cause to an increase in the Indian currency reserves of Nepalese authority.

(iv) The effect of the increase in ratio of Indian interest rate to Nepalese interest rate on the level of reserves of Indian currency is assumed to be negative. As the ratio of interest rate (i*/i) increases, people are assumed to demand more Indian currencies for the purpose of depositing it in the Indian banks in order to accrue more benefits arising from the differential nature of the interest rate. As the demand for Indian currency increases, Indian currency tends to appreciate. However, in order to keep the exchange rate fixed, the Nepalese authority sells the Indian currency and buys the Nepalese currency so that the effect on the exchange rate is annulled. This act exerts a downward pressure in the level of reserves of Indian currency. Thus, increase in the ratio of interest rate ultimately causes to decrease in the level of reserves of inconvertible currency of the country.

(v) The effects of increase in the net domestic assets (NDA) of the country is assumed be negative in the reserves of Indian currency holdings of Nepalese monetary authority. As the net domestic assets increase, the domestic money supply increases. As the domestic money supply increases the domestic currency will tend to depreciate. However, in order to maintain the fixed exchange rate system, Nepalese monetary authority will buy the domestic money by selling the Indian currency. This act is supposed to exert a downward pressure on the Indian currency holdings of Nepalese monetary authority.
(vi) The increase in the net foreign assets of the convertible currency (NFA$) in the country is assumed to exert a downward pressure on the level of the Indian currency holdings of Nepalese monetary authority. As the NFA$ increases, the domestic money supply increases leading to its depreciation on the one hand, and the demand for Indian currency increases for more imports from India leading to appreciation of the IC, on the other. However, in order to keep the exchange rate fixed, the monetary authority will buy its domestic currency by selling Indian currencies. This will exert a negative effect on the reserves of Indian currencies of Nepalese monetary authority.

(vii) Capital movements are speculative in nature, so no restriction is imposed to the speculative capital flows.

The model is based on the following assumptions—

i) Both the Indian and Nepalese economies are fully liberalized and market oriented so that no restriction is imposed on the free flow of money and capital between the countries, on their convertibility and on Peoples' desire to deposit in either country's bank.

ii) People can correctly speculate on the changes in the ratio of interest rate and exchange rate change. Peoples’ demand for Indian currency depends upon the expected change in the ratio of interest rates (i*/i) and expected change in the ratio of exchange rate (e*/e). It is further assumed that their expectation is exactly represented by the ratio of interest rate and the exchange rate of the coming year.

iii) All the information are assumed to be available at free of cost and there is no costs for the movement of capital.
iv) There are no other assets to substitute for money. Therefore, people substitute only between Indian currency and Nepalese currency.

v) People are assumed to be rational so that they quickly respond on any change in money supply and demand.

vi) No sterilization of excess money supply and demand by the central bank through the process of open market operation etc.

vii) Indian currency circulation in Nepal is fully canalized through the banking system so that any response of the currency substitution is promptly reflected in the reserves of Indian currency.

viii) Money multiplier is equal to unity.

ix) The general price levels of both the countries are best reflected by their respective CPIs.

x) The figures obtained from various sources are correct and do not show any inconsistency.

**The Model**

\[ MS_t = MD_t \]

But,

\[ MS_t = m \cdot H_t \]

Where,

\[ MS_t = \text{money supply at time period } t, \]
\[ MD_t = \text{money demand at the same time period } t, \]
\[ m = \text{money multiplier and is equal to unity by assumption,} \]
\[ H_t = \text{hard powered or base money which equals the international reserves (R) of the monetary authority at the time period } t. \]
But,

\[ H_t = TNFA_t + NDA_t \]

Where,

TNFA\(_t\) = Total net foreign assets at time period \(t\), and
NDA\(_t\) = Net domestic assets at time period \(t\) and it is equal to the net credit flow in the economy.

But,

\[ TNFA_t = NFAI_t + NFA$_t \]

Where,

NFAI\(_t\) = net international reserve of the Indian currency (inconvertible currencies) held in the monetary authority of Nepal, and
NFA$\(_t\) = net international reserves of convertible currencies in the monetary authority of Nepal.

Substituting equations 3 and 4 in 2 and assuming the money multiplier to unity, we get the money supply equation as–

\[ MS_t = NFAI_t + NFA$_t + NDA_t \]

The money demand is assumed to be determined by both the Nepalese variables and Indian variables, like Nepalese national income (\(Y\)) proxied by its GDP; Nepalese general price level (\(P\)) proxied by its consumer price index; Indian general price level (\(P^*\)) proxied by its consumer price index; Nepalese structure of interest rate (\(i\)); and Indian structure of interest rate (\(i^*\)). The money demand function is assumed to be–

\[ MD_t = \frac{Y_t}{R_{t+1}^{b1} R_{t+2}^{b2} R_{t+3}^{b3} R_{t+4}^{b4}} \]

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Where,
\( Y = \text{Nepalese GDP and} \)
\( \text{Re} = \text{ratio of value of US$ in India to value of US$ in Nepal} = (e^*/c) \)
\( \text{Ri} = \text{ratio of Indian interest rate structure to Nepalese interest rate structure} = (i^*/i) \)
\( \text{RP} = \text{ratio of Indian consumers price index to Nepalese consumers price index} = P^*/P \)
\( e^U = \text{the error term} \)

Substituting equations 5 and 6 in equation 1 we get–
\[
\text{NFAI}_t + \text{NFA}$t + \text{NDA}_t = \frac{Y_{i+1}^b . \text{Re}_{i+1}^b . e^U}{R_{i+1}^{b_3} . \text{RP}_t^{b_4}} \] .................9

Taking growth both sides
\[
g(\text{NFAI}_t + \text{NFA}$t + \text{NDA}_t) = g\left(\frac{Y_{i+1}^b . \text{Re}_{i+1}^b . e^U}{R_{i+1}^{b_3} . \text{RP}_t^{b_4}}\right) .......10
\]

Where,
g represents the growth of the corresponding variables and the growth rate of a variable “z” with respect to time “t” is defined as–
\[
g(z) = \frac{d}{dt} \ln z = \frac{1}{y} \frac{dy}{dt} \]

\[
\frac{\text{NFAI}_t}{\text{NFAI}_t + \text{NFA}$t + \text{NDA}_t} \cdot g(\text{NFAI}_t) + \frac{\text{NFA}$t}{\text{NFAI}_t + \text{NFA}$t + \text{NDA}_t} \cdot g(\text{NFA}$t)
+ \frac{\text{NDA}_t}{\text{NFAI}_t + \text{NFA}$t + \text{NDA}_t} \cdot g(\text{NDA}_t)=
\]
\[
g(Y_{i+1}^b . \text{Re}_{i+1}^b . e^U) - g(R_{i+1}^{b_3} . \text{RP}_t^{b_4}) .................11
\]
\[
\frac{NFAI_t}{MS_t} \cdot g(NFAI_t) + \frac{NFA_t}{MS_t} \cdot g(NFA_t) + \frac{NDA_t}{MS_t} \cdot g(NDA_t) = b_1 g Y_t + b_2 g R_{t+1} - b_3 g R_{i+1} - b_4 g R_{P_t} + U
\]

\[
\frac{NFAI_t}{MS_t} \cdot \frac{1}{NFAI_t} \frac{dNFAI_t}{dt} + \frac{NFA_t}{MS_t} \cdot \frac{1}{NFA_t} \frac{dNFA_t}{dt} + \frac{NDA_t}{MS_t} \cdot \frac{1}{NDA_t} \frac{dNDA_t}{dt} = b_1 g Y_t + b_2 g R_{t+1} - b_3 g R_{i+1} - b_4 g R_{P_t} + U
\]

\[
\frac{1}{MS_t} \frac{dNFAI_t}{dt} + \frac{1}{MS_t} \frac{dNFA_t}{dt} + \frac{dNDA_t}{dt} = b_1 g Y_t + b_2 g R_{t+1} - b_3 g R_{i+1} - b_4 g R_{P_t} + U
\]

\[
\frac{1}{MS_t} \frac{dNFAI_t}{dt} = b_1 g Y_t + b_2 g R_{t+1} - b_3 g R_{i+1} + b_4 g R_{P_t} - \frac{1}{MS_t} \frac{dNFA_t}{dt} + U
\]

Equation 15 shows that the growth of NFAI (that is Nepalese balance of payments with India) at any time period is positively related to the growth rate of Nepalese GDP of the same time period and to the expected growth rate of the ratio of value of US$ in India to value of US$ in Nepal, while it is inversely related to the growth rate of ratio of Indian prices to Nepalese prices of the same period, expected growth rate of ratio of Indian interest rates to Nepalese interest rate, growth of NFA$ (that is Nepalese balance of payments with countries other than India) at the same time period and growth of NDA at the same time period. The signs of the coefficients show the relationship between the dependent and independent variables.
Taking discrete approximation and adding the constant term, the final equation of estimate will be:

\[
\frac{\Delta NFA_{t}}{MS_t} = b_{0} + b_{1}gY_{t} + b_{2}gR_{t+1} - b_{3}gR_{t+1} - b_{4}gRP_{t} - \frac{\Delta NFA_{t+1}}{MS_{t+1}} - \frac{\Delta ND_{t+1}}{MS_{t+1}} + U
\]

Sources of Data

The major problems of this study are the availability of the relevant data. Even if the data are available they are not adequate for the analytical purpose. Even if they are fairly adequate, there arises the question of their reliability. The data has been derived from four major sources, viz. Nepal Rastra Bank (NRB), Institute for Sustainable Development report, Reserve Bank of India (RBI), and International Monetary Fund (IMF).

i) Balance of payments figures

The foremost problem is that the data are not available easily from only one source. The NRB maintains bilateral data of balance of payments between India and Nepal. But due to its policy of non-dissemination, the NRB source did not become easy source for the bilateral balance of payments data. The other sources are IMF and the report by Institute for Sustainable Development. But the IMF has started to maintain such bilateral balance of payments data only after 1994/95 and the Institute for Sustainable Development has supplied the figures of bilateral balance of payments only from 1975/76 to 1990/91. Even if both the sources are used to construct a time series of balance of payments data, a gap is created from 1991/92 to 1993/94. This gap is fulfilled by the unpublished data provided by the NRB
in a special request made to some of its higher officials. This shows that the bilateral BOP data has been derived from three different sources, viz., Report of the Institute for Sustainable Development (from 1975/76 to 1990/91), IMF (from 1994/95 to 2003/2004) and Nepal Rastra Bank unpublished source (from 1991/92 to 1993/94). Moreover, the IMF has supplied the records of bilateral balance of payments in the US$ term which is converted into NC term multiplying by the corresponding exchange rates supplied by the International Financial Statistics (IFS). This shows the problem of collecting BOP data for the study. The heterogeneous sources of data may impose some constraints in the analysis. Given the heterogeneous sources of data, the error term is more likely to be high. This is the major limitation of the empirical study.

ii) Figures of interest rate and the exchange rates

The structure of Indian Interest rates are obtained from the “Hand Book of Statistics on the Indian Economy” 2005-06, p. 129, and the structure of interest for Nepal is derived from different volumes of the Quarterly Economic Bulletin published by Nepal Rastra Bank. To make more comparable the interest rates, the annual interest rate of IC in India has been converted into the NC value by multiplying it by the corresponding NC– IC exchange rate published by Nepal Rastra Bank in its Quarterly Economic Bulletin. Furthermore, to eliminate the problem of comparison, only the year wise interest rates are taken as representative of all. In some cases, the average of lower and upper limit of interest rates were taken to avoid any mathematical difficulties.

Similarly, the figures of exchange rates of the currencies of both the countries are derived from the International Financial Statistics (IFS). The
exchange rate in the whole thesis means the price of one unit of US$ expressed in terms of domestic currency. The period average of market exchange rate has been taken for the purpose of analysis.

iii) NFAI, NFA$, and NDA

Nepal Rastra Bank supplies the data of total net foreign assets (TNFA) which incorporates the net reserves of both convertible and inconvertible currencies including the reserves of gold, SDR and IMF reserve tranche position. It also provides the time series of money supply. The broad money supply (M2) is taken as the representative of the money supply. It is expected to be preferable to take M2 than M1 as the money supply as the former equals the total aggregate of TNFA and NDA. The Bank also publishes the time series of NDA.

The challenge is to find the time series of both NFA$ and NFAI. It is to be noted that, all the reserves of gold, SDR and IMF reserve tranches are near convertible currencies. Therefore they are to be included in the NFA$. Thus the NFA$ consists of the net change in the reserves of convertible currencies, and net changes in the reserves of gold, SDR and IMF reserve tranche positions. The remaining part of TNFA$ after deducting the NFA$ is the NFAI.

The series of NFAI and NFA$ has been constructed with the help of both the “Foreign Assets and Liabilities of the Banking System” published in Quarterly Economic Bulletin and “balance of payments statistics” derived from aforementioned sources. In deriving the series, it is assumed that, the gross stock of NFA$ for the initial year (1975) represents its net. The annual series of NFA$ is derived by adding the surplus or deficit figure for the corresponding year as represented by the change in net reserves in the
balance of payments summary. For example, the net reserves of convertible currency for the year 1976 is derived by summing up the NFA$ for 1975 and the changes in reserves for the year 1975/76 as depicted by Nepalese balance of payments with countries other than India. Once the series of NFA$ is calculated, the series of NFAI for each year is derived by subtracting the NFA$ from the TNFA of the same year.

Analysis of Data

The available data is analyzed with the help of Excel and EViews computer programmes. Simple OLS formula, derived (above) from the monetary approach to balance of payments, is used to analyse the effects of the key variables to the reserves of the India currency in the country.

The Result

Table 7.3

Results of Monetary Interpretation of Balance of Payments

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLE</th>
<th>constant</th>
<th>gYt</th>
<th>gRe_{t-1}</th>
<th>gRe_{t-1}</th>
<th>gRPt</th>
<th>ΔNFA$/MS</th>
<th>ΔNDA$/MS</th>
<th>R²</th>
<th>F</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔNFAI/MS</td>
<td>0.125</td>
<td>0.294</td>
<td>4.339</td>
<td>-0.004</td>
<td>-0.412</td>
<td>-0.822</td>
<td>-0.912</td>
<td>0.938</td>
<td>25.557</td>
<td>1.911</td>
</tr>
<tr>
<td>t-value</td>
<td>6.759</td>
<td>0.739</td>
<td>1.298</td>
<td>-0.064</td>
<td>-1.69</td>
<td>-9.086</td>
<td>-7.035</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>p</td>
<td>0.000</td>
<td>0.468</td>
<td>0.208</td>
<td>0.950</td>
<td>-0.106</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The empirical result shows that, all the coefficients are consistent to the theory. Moreover the value of $R^2$ is as high as above 93 percent and $F$ is highly significant. The value of $R^2$ shows that 93.8 percent changes in the dependent variables can be explained by the changes in the independent variables. The value of $F$ shows that the overall estimation is very significant. The value of DW is still enough to show that there is no autocorrelation in the error term.

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The result suggests that the reserves of Indian currency of the monetary authority of Nepal can be influenced by some important economic variables like Nepalese real GDP, interest rate, cross exchange rates, price indexes, reserves of the convertible currencies, and net domestic assets. For the improvement of Nepalese balance of payments with India, the result draws the following conclusions—

1) The ratio of expected interest rates (i* / i) is to be decreased, which can be done either decreasing the value of numerator keeping denominator constant or increasing the value of denominator keeping numerator constant. However, as the interest rate in India (i*) is exogenously determined and Nepal cannot make any decision on it, the only option left is to increase in the domestic interest rate (i). In increasing the domestic interest rate, the inflow of Indian currencies increases to enjoy the benefit accruing from the interest rate differential.

2) The ratio of expected cross rate (e* / e) is to be increased. As the value of US$ in India increases relatively to the value of US$ in Nepal, Nepalese balance of payments with India improves through the changes in the pattern of money transfer. As the ratio increases, many currency speculators, business sectors, and the underworld players find beneficial to transfer dollar directly to India. The US$ which would enter directly into Nepal now diverts first to India, gets converted into Indian currency, and then enters into Nepal in the form of Indian currency. This act will positively affect Nepalese balance of payments with India so that Nepalese balance of payments with India is improved. However, e* cannot be changed by the Nepalese decision, the only option left for the Nepalese monetary authority is to
decrease the value of US$ in Nepal, that is to appreciate its currency vis-à-vis US$.

3) The current ratio of price indexes (P*/P) is to be decreased. As the ratio declines, the transaction demand for Indian currency declines and hence the reserve of Indian currency is improved. However, Nepal cannot make any change on P*, the only option left is to increase the ‘P’, the price level of Nepal. This will increase the demand of Nepalese currency which is fulfilled by the purchase of Indian currency holdings of the people and commercial banks at the cost of domestic currency. This will ultimately increase the supply of domestic currency and thereby the reserves of Indian currency. But this option may discourage the export trade and encourage the import trade with India. However, this seems to be plausible in the scenario where Nepalese trade with India is not much price elastic.

4) The result also shows that the growth rate of the reserves of inconvertible currency is adversely affected by the growth in the reserves of convertible currencies of the monetary authority of Nepal. As the reserves of the convertible currency of the monetary authority of Nepal increases, the reserves of the inconvertible currencies decline. This is because, as the growth of the convertible currencies increases, the domestic money supply increases leading to a depreciation of the domestic currency vis-à-vis the Indian currency. The monetary authority, in order to keep the exchange rate unchanged, will sell the Indian currency and buy the domestic currency. This act ultimately depletes the reserves of Indian currencies of the monetary authority of Nepal. The result shows that one percent increase in the growth rate of the reserves of convertible currency
leads to 0.822 percent reduction in the growth rate of the inconvertible currency. In this backdrop, it is advisable that Nepalese authority, in consultation with Indian Government, enter into an agreement to make payments for the purchase of goods from India in convertible currencies. Nepal needs to further diversify its trade with overseas countries and earn more convertible currencies.

5) The result shows that the growth rate of the NFAI, is adversely affected by the current growth rate of the NDA. As the NDA increases, the supply of domestic money increases and it will act in the same manner as the increase in the growth rate of the inconvertible currencies. The result suggests that one percent increase in the growth rate of NDA leads to approximately one percent decrease in the growth rate of the inconvertible currencies. The growth rate of NDA can be decreased, without hampering the developmental activities, by imposing controls over the credit flow in the unproductive sectors of the economy. However, this should not pose a problem provided again Nepal reaches an understanding with India on the acceptability of the later agreeing to payment in convertible currencies.

Testing the Validity of the Result

i) Testing the Multicollinearity

However, the OLS assume that there is no collinearity between any two independent variables. If they are inter-correlated, the result given by the estimation equation might be misleading. Therefore, it is advisable to carry out the multicollinearity tests among the independent variables. However, for many scholars multicollinearity is not any big problem as it exists, naturally, either positively or negatively, between any set of
variables. Nevertheless, if the pair-wise or zero-order correlation coefficient between two regressors is high, in excess of 0.8, then multicollinearity is a serious problem (Gujarati, 2006).

A first indication for multicollinearity would be high pair-wise correlation between independent variables. The rule of thumb for this criterion is that if the value of correlation coefficients for any pair of variables is higher than 0.8, the multicollinearity is confirmed. However, this test has been subjected to severe criticism. Therefore, among the other, estimating linear auxiliary regression line, that is, regression line for each independent variable with rest of the other independent variables and calculating $R^2$, tolerance (TOL = 1-$R^2$) and variable inflation factor (VIF = 1/TOL) for each auxiliary regression lines are some of the popular and simplest tests. The $R^2$ criterion suggests that, the higher the value of $R^2$ the higher the multicollinearity. The TOL ranges from zero to unity and this criterion suggests that the closer the TOL to zero the greater the degree of intercorrelation among the independent variables. When TOL is zero there is perfect collinearity among the explanatory variables and on the other hand, when TOL is equal to unity, there is no intercorrelation among the independent variables. As all the $R^2$, TOL and the VIF can be explained in terms of each other, the general rule of thumb is that “if the value of $R^2$ for each auxiliary regression is very high up above 0.9 or the TOL less than 0.1 or the VIF more than 10, multicollinearity is confirmed.” As the correlation coefficient criterion for detecting multicollinearity is subjected to severe criticism, testing $R^2$, TOL and VIF for each auxiliary regression has been considered as more sophisticated tool for detecting the multicollinearity in this analysis (For detail see Gujarati 2004).
However, the tests that have been carried out during the estimation did not show any significant inter-correlation among the independent variables. The tables below show the bivariate correlation coefficients among the independent variables and the auxiliary regression estimation of each independent variable vis-à-vis rest of the other. The table shows that the values of correlation coefficients among the explanatory variables are very insignificant. This table further shows that the values of $R^2$ are very insignificant, the values of TOL are near to unity and the values of VIF are less than 10. All these analysis confirm that the equation of estimated does not suffer from the multicollinearity problem.

The OLS further assume that any time series under consideration is stationary. If the time series under consideration is non-stationary, the result might be misleading. Thus, in order to check whether the time series is non-stationary, there is need to apply unit root test.

Table 7.4

**Bivariate (Pair-wise) Pearson Correlation Coefficients among the Explanatory Variables**

<table>
<thead>
<tr>
<th></th>
<th>$gR_{t+1}$</th>
<th>$gR_{t-1}$</th>
<th>$gR_{P}$</th>
<th>$gR_{Y}$</th>
<th>$\frac{\Delta NFA_{S_{t}}}{MS_{t}}$</th>
<th>$\frac{\Delta NDA_{t}}{MS_{t}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$gR_{t+1}$</td>
<td>1.00</td>
<td>.204</td>
<td>-.126</td>
<td>-.055</td>
<td>.026</td>
<td>.091</td>
</tr>
<tr>
<td>$gR_{t-1}$</td>
<td>.204</td>
<td>1.00</td>
<td>-.186</td>
<td>-.279</td>
<td>.179</td>
<td>.405</td>
</tr>
<tr>
<td>$gR_{P}$</td>
<td>-.26</td>
<td>-.186</td>
<td>1.00</td>
<td>.251</td>
<td>-.081</td>
<td>-.067</td>
</tr>
<tr>
<td>$gR_{Y}$</td>
<td>-.055</td>
<td>-.279</td>
<td>.251</td>
<td>1.00</td>
<td>-.001</td>
<td>-.217</td>
</tr>
<tr>
<td>$\frac{\Delta NFA_{S_{t}}}{MS_{t}}$</td>
<td>.026</td>
<td>.179</td>
<td>-.081</td>
<td>-.001</td>
<td>1.00</td>
<td>.023</td>
</tr>
<tr>
<td>$\frac{\Delta NDA_{t}}{MS_{t}}$</td>
<td>.091</td>
<td>.405</td>
<td>-.067</td>
<td>-.217</td>
<td>.023</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: the “t” in the subscripts denotes time.
Table 7.5

Auxiliary Regressions among the independent variables

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Constant</th>
<th>gRt+1</th>
<th>gRt-1</th>
<th>gRPt</th>
<th>gY</th>
<th>( \Delta Y_{FAS} )</th>
<th>( \Delta Y_{ANDA} )</th>
<th>R²</th>
<th>TOL = 1/R²</th>
<th>VIF = 1/TOL</th>
<th>F</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>gRt+1</td>
<td>.033</td>
<td>.158</td>
<td>- .380</td>
<td>.089</td>
<td>.024</td>
<td>.025</td>
<td>.030</td>
<td>.095</td>
<td>1.052</td>
<td>234</td>
<td>1965</td>
<td></td>
</tr>
<tr>
<td>gRt-1</td>
<td>-.0107</td>
<td>.024</td>
<td>-.057</td>
<td>-.023</td>
<td>.018</td>
<td>.090</td>
<td>.091</td>
<td>.109</td>
<td>.437</td>
<td>.836</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gRPt</td>
<td>-.014</td>
<td>-.024</td>
<td>-.170</td>
<td>.202</td>
<td>.023</td>
<td>.018</td>
<td>.090</td>
<td>.091</td>
<td>1.099</td>
<td>.437</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gY</td>
<td>.044</td>
<td>.0065</td>
<td>-.351</td>
<td>.234</td>
<td>.023</td>
<td>-.068</td>
<td>.135</td>
<td>.865</td>
<td>1.156</td>
<td>.689</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta Y_{FAS} )</td>
<td>.052</td>
<td>-.01</td>
<td>.850</td>
<td>-.165</td>
<td>.144</td>
<td>-.068</td>
<td>.202</td>
<td>.789</td>
<td>1.267</td>
<td>.186</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta Y_{ANDA} )</td>
<td>.109</td>
<td>.006</td>
<td>.185</td>
<td>.064</td>
<td>-.210</td>
<td>-.033</td>
<td>.179</td>
<td>.821</td>
<td>1.218</td>
<td>.960</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: the “t” in the subscripts denotes time.

ii) Testing the Unit Root

The classical OLS assumes that the underlying time series is stationary that is its means and variances are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. In short, if a time series is stationary, its mean, variance, and autocovariance remain the same no matter at what point we measure them; that is, they are time invariant. That is,

Mean: \[ E(Y_t) = \mu \]

Variance: \[ \text{var} (Y_t) = E(Y_t - \mu)^2 = \sigma^2 \]

Autocovariance \[ \text{cov}(Y_t, Y_{t+k}) = E[(Y_t - \mu)(Y_{t+k} - \mu)] = \gamma_k \]

If any time series does not satisfy the aforementioned properties, it is called non-stationary time series. That is a non-stationary time series have time-varying mean or a time-varying variance or both (Gujarati, 2006; 797-798).
However, in practice most of the economic time series are nonstationary. If the time series under consideration suffers from nonstationarity problem, it will generate spurious results. Therefore, it has become necessary for all the researchers to test whether or not the time series under consideration is stationary. Among many others, “correlogram” of white noise error term and “unit root” tests are the most popular techniques to test the stationarity of a time series. However, in this analysis only the unit root test has been carried out.

Let us assume an autoregressive scheme as mentioned below–

\[ Y_t = \rho Y_{t-1} + u_t \] \hspace{1cm} 17

Where, \( Y \) is any variable under consideration, \( \rho \) is the autoregressive coefficient and \( u_t \) is a white noise error term. If the computed value of \( \rho \) equals unity, then \( Y_t \) is nonstationary. To test the unit root, the most popular tests are Dickey-Fuller (DF) and the augmented Dickey-Fuller (ADF) tests. The starting point for DF test is to subtract both sides the \( Y_{t-1} \) of the equation 17. That is,

\[ Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + u_t \] \hspace{1cm} 18

Or, \[ \Delta Y_t = (\rho - 1) Y_{t-1} + u_t \]

Or, \[ \Delta Y_t = \delta Y_{t-1} + u_t \] \hspace{1cm} 19

Where, \( \delta = (\rho - 1) \) and
\( \delta = 0 \) if \( \rho = 1 \), and
When \( \delta = 0 \),
\[ \Delta Y_t = u_t \] \hspace{1cm} 20
In practice, therefore, instead of estimating equation 1, we estimate equation 3 to test the unit root. If $\delta = 0$, $\rho = 1$, which implies we have unit root that is the time series under consideration is nonstationary. If the computed absolute value of the tau statistic ($|\tau|$) exceeds the absolute DF or MacKinnon critical tau values ($|\tau|$), we reject the hypothesis that $\delta = 0$, in which case the time series is stationary (Gujarati, 2006; 816). This implies that if the absolute $t$ value of coefficient is greater than the MacKinnon critical values, non-stationarity is confirmed that is there is no unit root at all.

**Table 7.6**

Unit Root Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Method</th>
<th>Computed $t$ value</th>
<th>MacKinnon Critical values</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>gRe</td>
<td>$C + \Delta_1$</td>
<td>-7.344227</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-8.5999</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gRi</td>
<td>$C + \Delta_1$</td>
<td>-5.097084</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-5.391125</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gRP</td>
<td>$C + \Delta_1$</td>
<td>-6.560190</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-7.681247</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gY</td>
<td>$C + \Delta_1$</td>
<td>-8.256841</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-7.928712</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gNDAl</td>
<td>$C + \Delta_1$</td>
<td>-8.153339</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-10.17902</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gNFAI</td>
<td>$C + \Delta_1$</td>
<td>-6.450458</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-7.729482</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
<tr>
<td>gNFAS</td>
<td>$C + \Delta_1$</td>
<td>-5.534443</td>
<td>-3.7076</td>
<td>-2.9798</td>
</tr>
<tr>
<td></td>
<td>$C + \Delta_2$</td>
<td>-6.791412</td>
<td>-4.3738</td>
<td>-3.6027</td>
</tr>
</tbody>
</table>

Note: $C =$ intercept, $\Delta_1$ and $\Delta_2$ are first and second differences, and tr = trend variable.

The stationarity of the time series has been tested with the use of EViews statistical software. In the calculation, intercept and first difference
has been taken for the first time and then trend and intercept and second difference for the second time. The results of testing unit root (Table 7.6) show that for all the variables, the computed t value is higher than the MacKinnon critical values for all the 1%, 5% and 10% levels of significance, revealing that there is no unit root and therefore, the time series under consideration is proved to be stationary. Therefore, the validity of results given by the model under consideration stand confirmed.