CHAPTER V

ENERGY CRISIS AND ITS IMPACT ON THE BALANCE OF PAYMENTS AND THE ECONOMY OF INDIA - AN EMPIRICAL ANALYSIS

This chapter deals with the empirical analysis of the impact of 'Energy Crisis' on the economy of India and its balance of payments, discussed theoretically in the preceding chapter, caused by the increasing consumption of Energy-Commercial (coal, oil, electricity) and Non-Commercial, and the international oil price hike of the mid-seventies and the early eighties.

The Ordinary Least Square (OLS) estimation technique has been used. Orthogonal regression was also conducted and the results obtained thereof were more or less the same as by OLS. Time series data comprising of twenty-five years (1960-85) has been divided into the Pre-(1960-73) and the Post-(1973-85) Energy crisis periods.

Impact of Energy Consumption on the Indian Economy

In order to empirically analyse the impact of energy consumption in totality and component-wise, various equations are regressed taking GNP/GDP at current and constant prices (1970-1971) and Per Capita Net National Product as the explained variables. The explanatory variables are Energy consumption (commercial and non-commercial), together with Gross Domestic Capital Formation, the ratio of Gross Domestic Savings and Gross Domestic Capital Formation to GNP/GDP, and Per Capita Commercial Energy Consumption. Since exports and imports have a bearing on Trade Balance, and hence Current Account deficit of the Balance of Payments, it was imperative to include these variables in the regression equations. The variables GDCF and the ratio of GDS and GDCF to GNP/GDP are taken along with Energy, as these are found to be highly and significantly correlated to GNP/GDP both, at current and constant prices (Table 5.1). The following equations
TABLE 5.1  
CORRELATION MATRIX

<table>
<thead>
<tr>
<th></th>
<th>GDCF</th>
<th>GDCF</th>
<th>GDCF/GNP</th>
<th>GDCF/GNP</th>
<th>GDS/GNP</th>
<th>GDS/GNP</th>
<th>X</th>
<th>M</th>
<th>(X-M)</th>
<th>X</th>
<th>M</th>
<th>(X-M)</th>
<th>Current Account Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td></td>
</tr>
<tr>
<td>GNP/GDP</td>
<td>0.9822</td>
<td>0.9661</td>
<td>0.7218</td>
<td>0.8959</td>
<td>0.7123</td>
<td>0.9136</td>
<td>0.9670</td>
<td>0.8920</td>
<td>0.1067</td>
<td>0.9740</td>
<td>0.9394</td>
<td>-0.8021</td>
<td>-0.5350</td>
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<tr>
<td></td>
<td>0.0285</td>
<td>0.0540</td>
<td>0.3877</td>
<td>0.1597</td>
<td>0.3987</td>
<td>0.1388</td>
<td>0.0525</td>
<td>0.1635</td>
<td>0.8002</td>
<td>0.0415</td>
<td>0.0951</td>
<td>0.2867</td>
<td>0.5777</td>
</tr>
<tr>
<td>GNP/GDP</td>
<td>0.9394</td>
<td>0.9770</td>
<td>0.6589</td>
<td>0.8605</td>
<td>0.7250</td>
<td>0.8368</td>
<td>0.9421</td>
<td>0.9495</td>
<td>-0.0556</td>
<td>0.9823</td>
<td>0.9835</td>
<td>-0.8821</td>
<td>-0.6709</td>
</tr>
<tr>
<td></td>
<td>0.0780</td>
<td>0.0049</td>
<td>0.4581</td>
<td>0.2100</td>
<td>0.3840</td>
<td>0.2427</td>
<td>0.0910</td>
<td>0.0797</td>
<td>0.8069</td>
<td>0.0123</td>
<td>0.0255</td>
<td>0.1796</td>
<td>0.4431</td>
</tr>
<tr>
<td>PW</td>
<td>0.9627</td>
<td>0.9829</td>
<td>0.6819</td>
<td>0.8732</td>
<td>0.7222</td>
<td>0.9586</td>
<td>0.9530</td>
<td>0.9379</td>
<td>-0.0115</td>
<td>0.9920</td>
<td>0.9778</td>
<td>-0.8685</td>
<td>-0.6420</td>
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<tr>
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<td>0.0593</td>
<td>0.0114</td>
<td>0.4331</td>
<td>0.1923</td>
<td>0.3873</td>
<td>0.2124</td>
<td>0.0743</td>
<td>0.0974</td>
<td>0.8093</td>
<td>0.0130</td>
<td>0.0356</td>
<td>0.1988</td>
<td>0.4758</td>
</tr>
</tbody>
</table>

NOTE : Columns (1) to (13) have been computed.
Figures in brackets indicate '6(Probable Error)', an estimate used to ascertain the significance of the correlation coefficients.
Bar denotes at constant prices (1970-71)
are estimated:

\[ Y_t = a_0 + a_1 X_{1t} + a_2 X_{2t} + a_3 X_{3t} + a_4 T E_t \] (1a)

\[ Y_t = a^1_o + a^1_1 X_{1t} + a^1_2 X_{2t} + a^1_3 X_{3t} + a^1_4 T E_t \] (1b)

\[ \bar{Y}_t = a_0 + a_1 \bar{X}_{1t} + a_2 \bar{X}_{2t} + a_3 \bar{X}_{3t} + a_4 T E_t \] (2a)

\[ Y_t = a^1_o + a^1_1 X_{2t} + a^1_2 X_{3t} + a^1_3 T E_t \] (2b)

\[ \bar{Y}_t = a_o + a_1 \bar{X}_{2t} + a_2 \bar{X}_{3t} + a_3 T E_t \] (3a)

\[ Y_t = a^1_o + a^1_1 x_t + a^1_2 x_{3t} + a^1_3 T E_t \] (3b)

\[ \bar{y}_t = a_o + a_1 \bar{x}_{1t} + a_2 \bar{x}_{2t} + a_3 \bar{x}_{3t} + a_4 C_t \]
\[ + a_5 O_t + a_6 E_t + a_7 N_t \] (4a)

\[ y_t = a^1_o + a^1_1 x_{1t} + a^1_2 x_{2t} + a^1_3 x_{3t} + a^1_4 C_t \]
\[ + a^1_5 O_t + a^1_6 E_t + a^1_7 N_t \] (4b)

\[ \bar{y}_t = a_o + a_1 \bar{x}_{2t} + a_2 \bar{x}_{3t} + a_3 C_t + a_4 O_t \]
\[ + a_5 E_t + a_6 N_t \] (5a)

\[ y_t = a^1_o + a^1_1 x_{2t} + a^1_2 x_{3t} + a^1_3 C_t + a^1_4 O_t \]
\[ + a^1_5 E_t + a^1_6 N_t \] (5b)

\[ \bar{y}_t = a_o + a_1 \bar{x}_{3t} + a_2 \bar{x}_{3t} + a_3 C_t + a_4 O_t \]
\[ + a_5 E_t + a_6 N_t \] (6a)

\[ y_t = a^1_o + a^1_1 x_t + a^1_2 x_{3t} + a^1_3 C_t + a^1_4 O_t \]
\[ + a^1_5 E_t + a^1_6 N_t \] (6b)
\begin{align*}
  y_t &= a_0 + a_1 x_{1t} + a_2 x_{2t} + a_3 x_{3t} + a_4 C_t \\
  &\quad + a_5 O_t + a_6 E_t + a_7 N_t \\
  PNY &= a_0 + a_1 PCM_c \\
  \text{where, } \overline{Y}, Y_t &= \text{GNP at constant and current prices;} \\
  \overline{Y}_t, Y_t &= \text{GDP at constant and current prices;} \\
  PNY &= \text{Per Capita National Income;} \\
  \overline{x}_{1t}, x_{1t} &= \text{GDS/GNP at constant and current prices;} \\
  \overline{x}_{2t}, x_{2t} &= \text{GDCF/GNP at constant and current prices;} \\
  \overline{x}_{3t}, x_{3t} &= \text{Trade Balance at constant and current prices;} \\
  \overline{x}_{1t}, x_{1t} &= \text{GDS/GDP at constant and current prices;} \\
  \overline{x}_{2t}, x_{2t} &= \text{GDCF/GDP at constant and current prices;} \\
  x_{3t} &= \text{Balance of Payments-Current Account Deficit;} \\
  C_t, O_t &= \text{Coal and Oil consumption;} \\
  E_t, N_t &= \text{Electricity and Non-Commercial Energy consumption;} \\
  TE_t &= \text{Total Energy consumption;} \\
  PCM_c &= \text{Per Capita Commercial Energy Consumption,} \\
  \text{and } t\text{'denotes time period, and } a, s, \text{'s are constants.}
\end{align*}

**EMPIRICAL RESULTS**

The results of estimation of equations 1(a&b) in which total Energy consumption, Trade Balance, and the ratio of GDS and GDCF to GNP are taken as the explanatory variables are presented as follows:

**Pre and Post-Energy Crisis**

\begin{align*}
  \overline{Y}_t &= 3801.13 + 21186.97 \overline{x}_{1t} + 34482.56 \overline{x}_{2t} - 1.40^{**} \overline{x}_{3t} + 81.61^{*} TE_t \\
  &\quad (0.60) \quad (1.17) \quad (-1.52) \quad (11.26) \\
  R^2 &= 0.97, \quad F = 332.99, \quad DW = 1.94.
\end{align*}
\[ Y_t = 62355.38 + 160598.31 X_{1t} + 40726.31 X_{2t} - 7.21^{* * } X_{3t} + 294.57 \times TE_t, \]

\[ (0.47) \quad (0.11) \quad (-2.30) \quad (4.84) \]

\[ \bar{R}^2 = 0.96, \quad F = 193.60, \quad DW = 1.83. \]

**Pre-Energy Crisis**

\[ \bar{y}_t = 26124.90 + 70980.24^{**} X_{1t} + 50984.26^{**} X_{2t} - 4.90 \times X_{3t} + 32.38 \times TE_t, \]

\[ (2.82) \quad (1.97) \quad (1.50) \quad (1.40) \quad (3.22) \]

\[ \bar{R}^2 = 0.96, \quad F = 107.4, \quad DW = 1.95. \]

\[ y_t = -26923.08 + 177681.09^{***} X_{1t} + 139369.10^{**} X_{2t} - 4.14^{***} X_{3t} + 163.89 \times TE_t, \]

\[ (1.35) \quad (1.35) \quad (1.40) \quad (1.59) \]

\[ \bar{R}^2 = 0.97, \quad F = 193.60, \quad DW = 1.99. \]

**Post-Energy Crisis**

\[ \bar{y}_t = -1187.37 + 47967.54 X_{1t} + 12812.14 X_{2t} - 1.21 X_{3t} + 90.59 \times TE_t, \]

\[ (0.34) \quad (0.16) \quad (-0.37) \quad (4.16) \]

\[ \bar{R}^2 = 0.95, \quad F = 52.95, \quad DW = 1.93. \]

\[ y_t = -159915.82 + 342176.17 X_{1t} + 11826.92 X_{2t} - 10.69 X_{3t} + 586.81 \times TE_t, \]

\[ (1.35) \quad (0.04) \quad (-0.46) \quad (11.57) \]

\[ \bar{R}^2 = 0.97, \quad F = 182.67, \quad DW = 2.11. \]

---

**NOTE :** Figures in parentheses denote the t-values.

*Statistically significant regression coefficients at 1 percent level; ** at 5% level, and *** at 10 percent level.

\[ \bar{R}^2 \] is the adjusted \( R^2 \) for degrees of freedom associated with the sum of squares entering into it.

\( F \) is a test for the overall significance of the estimated regression line for degrees of freedom in the numerator and in the denominator.

\( DW \) is the Durbin-Watson statistic (statistically significant at 5 percent level). In the case of Pre and Post-Energy Crisis periods, the values of the standard tables have been extrapolated as the number of observations during the said periods are less than fifteen (Ref. Durbin, J., and Watson, G.S., "Testing for Serial Correlation in Least Squares Regression", Biometrika, Vol.38, pp.159-77, 1951).
It is apparent from the results that during the period Pre-Post Energy Crisis, the regression coefficients of the variables $X_{3t}$ and $E_t$, both at constant and current prices, are statistically significant as shown by the high $t$-ratio in the parantheses. Also, $E_t$ exhibits a larger slope coefficient than $X_{3t}$. The variables have the expected signs. $R^2$ accounts for 96 to 97 percent variation in the real and nominal GNP.

In the Pre-Energy Crisis period, the regression coefficients of all the variables viz., $X_{1t}$, $X_{2t}$, $X_{3t}$, and $E_t$ in eqns. (a&b) are statistically significant. $R^2$ explains 96 to 97 percent variation in the dependent variable.

In the Post-Energy Crisis period, on the other hand, only the regression coefficient of the variable $E_t$ emerges as statistically significant at 1 percent level. Moreover, $E_t$ shows a larger slope coefficient in this period as compared to the period 1960-73. $R^2$ varying between 95 to 97 percent in eqns. (a&b) is high.

To summarise, Energy consumption is responsible in a major way for causing variations in the real and nominal GNP during the Pre and well as in the Post-Energy Crisis periods; the impact being more prominent in the latter period. Trade Balance, sharing an inverse relationship with GNP is significant during the overall twenty-five year period and the Pre-Energy Crisis period. The ratio of GDS and GDCF to GNP are significant only in the period prior to the Oil price hike of 1973-74. This being so as $GDS/GNP$ varying between 15 to 22 percent during 1960-85, has remained more or less constant, exhibiting a declining trend in both, the Pre and Post-Energy Crisis periods. $GDCF/GNP$ ranging between 15 to 22 percent during the years 1960-79, and thereby declining to 22 percent in 1984-85 showed a rising trend only in the period 1960-73, and a falling one during 1973-85. This explains why $X_{1t}$ and $X_{2t}$ are prominent only in the Pre-Energy Crisis period. Also, in the aforesaid equations autocorrelation
and high degree multicollinearity are not found and all the estimated equations \( 1(a \& b) \) are found to be statistically significant.

- The results of equations \( 2(a\&b) \) are given in the following text. The variable GDS/GNP, at current and constant prices, has not been included as it has remained more or less constant in the period under study. To observe, if there are any deviations from the results obtained in eqns. \( 1(a\&b) \), the following equations have been estimated.

**Pre and Post-Energy Crisis**

\[
\bar{Y}_t = 6979.08 + 20915.64 \bar{X}_t - 1.06*** \bar{X}^{3t} + 77.69* \bar{TE}_t
\]
\[
(1.12) \quad (-1.49) \quad (25.26)
\]
\[
R^2 = 0.97, \quad F = 457.82, \quad DW = 2.07.
\]

\[
Y_t = -52106.03 + 11521.17 X_t - 8.49* X^{3t} + 271.04* \bar{TE}_t
\]
\[
(0.89) \quad (-5.36) \quad (7.79)
\]
\[
R^2 = 0.96, \quad F = 204.53, \quad DW = 1.85.
\]

**Pre-Energy Crisis**

\[
\bar{Y}_t = 13793.17 + 10310.14 \bar{X}_t - 2.42*** \bar{X}^{3t} + 57.23* \bar{TE}_t
\]
\[
(0.55) \quad (-1.43) \quad (8.84)
\]
\[
R^2 = 0.95, \quad F = 80.00, \quad DW = 2.04.
\]

\[
Y_t = -24633.06 + 3194.64 X_t - 1.01 X^{3t} + 146.00* \bar{TE}_t
\]
\[
(0.11) \quad (-0.62) \quad (19.18)
\]
\[
R^2 = 0.97, \quad F = 226.25, \quad DW = 2.20.
\]

**Post-Energy Crisis**

\[
\bar{Y}_t = -3347.99 + 10223.69 \bar{X}_t - 0.21 \bar{X}^{3t} + 83.69* \bar{TE}_t
\]
\[
(0.28) \quad (-0.15) \quad (10.35)
\]
\[
R^2 = 0.96, \quad F = 79.30, \quad DW = 1.93.
\]

\[
Y_t = -146013.29 + 320964.53** X_t - 1.43 X^{3t} + 550.57* \bar{TE}_t
\]
\[
(2.83) \quad (-0.99) \quad (12.19)
\]
\[
R^2 = 0.97, \quad F = 220.38, \quad DW = 2.16.
\]

**NOTE:** *Statistically significant regression coefficients at 1 percent level; ** at 5% level, and *** at 10 percent level.
The behaviour of the variables $T_E$ and $X_{3t}$ is the same as observed in eqns. 1(a&b). The only difference now is that, the regression coefficient of the variable GDCF/GNP statistically significant at 5 percent level. It has been seen earlier in Chapter IV that this ratio of GDCF to GNP exhibited a positive trend during the years 1973-85. Hence, together with Energy consumption this variable has a significant impact on the real and nominal GNP of the country during the Post-Energy Crisis period. $R^2$ in the equations varies between 95 to 97 percent. Autocorrelation and high degree multicollinearity are not found in the regression equations $2(a ~ s' & b ~ s')$, which are also statistically significant.

The results of the estimated equations 3(a&b) in which GDCF at current and constant prices has been included as the explanatory variable found to be highly and significantly correlated to the real and nominal GNP are:

**Pre and Post-Energy Crisis**

\[
\begin{align*}
\bar{Y}_t &= 5189.83 + 0.94* \bar{x}_t - 0.85 \bar{X}_{3t} + 55.63* T_t \\
(2.12) & (-1.27) & (5.94) & T_t \\
R^2 &= 0.97, \ F = 525.74, \ DW = 2.13.
\end{align*}
\]  
\[3a\]

\[
\begin{align*}
Y_t &= -3843.41 + 3.29* x_t - 1.05 X_{3t} + 39.37* T_t \\
(13.02) & (-1.20) & (2.21)
\end{align*}
\]  
\[3b\]

**Pre-Energy Crisis**

\[
\begin{align*}
\bar{Y}_t &= 13067.15 + 0.42 \bar{x}_t - 3.25** \bar{X}_{3t} + 47.80* T_t \\
(0.66) & (-2.16) & (4.06)
\end{align*}
\]  
\[3a\]

\[
\begin{align*}
Y_t &= -16878.53 + 1.44*** x_t - 1.13 X_{3t} + 102.64* T_t \\
(1.85) & (-0.85) & (4.28)
\end{align*}
\]  
\[3b\]

\[
\begin{align*}
R^2 &= 0.97, \ F = 312.63, \ DW = 2.19.
\end{align*}
\]
Post-Energy Crisis.

\[
Y_t = -214.05 + 1.04*** x_t - 0.002 \bar{X}_t + 63.08* TE_t
\]

\[(3a)
\]

\[
R^2 = 0.96, F = 111.34, DW = 1.98.
\]

\[
Y_t = 18653.84 + 3.73* x_t - 1.25 X_t - 17.92 TE_t
\]

\[(3b)
\]

\[
R^2 = 0.97, F = 277.99, DW = 2.19.
\]

In eqns. 3(a&b) during the period Pre-Post Energy Crisis, it is observed that the regression coefficients of the variables \(TE_t\) and \(x_t\), at current and constant prices, are statistically significant at 1 percent level. \(R^2\) in both the cases is 97 percent.

During the Pre-Energy Crisis period the variables \(TE_t\) and \(X_t\) at constant prices, have statistically significant regression coefficients at 1 and 5 percent levels respectively. But, at current prices, it is GDCF which has a significant regression coefficient at 10 percent level along with \(TE_t\). \(R^2\) ranging between 95 to 97 percent is high.

In the Post-Energy Crisis period, it is the regression coefficients of \(TE_t\) and GDCF which are significant.

To sum up, total Energy consumption and Gross Domestic capital Formation have a significant impact on the GNP in the Pre, Post, and Pre-Post Energy Crisis periods respectively; the impact being more prominent in the Post than in the Pre-Energy Crisis period. These variables depicted a conspicuous rising trend in the reference period as discussed in the preceding chapter. Also the regression eqns. 3(a&b) in the different time period do not have autocorrelation or high degree multicollinearity, and the estimated equations 3(a' & b'& s') are found to be significant.

In the following section, a few equations have been computed by taking the various components of Energy-Commercial (coal, oil & electricity) and Non-Commercial separately.

NOTE: *Statistically significant regression coefficients 1 percent level; ** at 5 percent level, and *** at 10 percent level.
along with other explanatory variables inorder to assess their impact on the real and nominal GDP of the country. High degree multicollinearity is not found in these equations. The results of equations 4(a&b) are as follows:

**Pre and Post-Energy Crisis**

\[ \bar{y} = 26765.77 + 44611.19 \times x_{1t} + 27047.25 \times x_{2t} - 0.38 \times \bar{x}_{3t} + 23.29 \times C_t \]

\[ (1.49) \quad (0.99) \quad (0.34) \quad (0.51) \]

\[ + 46.43 \times O_t + 296.19 \times E_t + 6.34 \times N_t \]

\[ (1.71) \quad (4.84) \quad (1.00) \]

\[ \bar{R}^2 = 0.97, \quad F = 381.80. \]

\[ \bar{y}_t = 111788.23 + 165067.65 \times x_{1t} + 77198.32 \times x_{2t} - 1.49 \times x_{3t} + 606.56 \times C_t \]

\[ (0.85) \quad (0.41) \quad (-0.88) \quad (2.60) \]

\[ + 229.01 \times O_t + 1050.24 \times E_t + 1012.10 \times N_t \]

\[ (1.09) \quad (3.19) \quad (3.47) \]

\[ \bar{R}^2 = 0.97, \quad F = 391.15. \]

**Pre-Energy Crisis**

\[ \bar{y}_t = 132827.45 + 81533.85 \times x_{1t} + 80418.55 \times x_{2t} - 0.48 \times \bar{x}_{3t} \]

\[ (3.86) \quad (4.18) \quad (-0.20) \]

\[ + 60.91 \times C_t + 122.79 \times O_t + 1040.20 \times E_t + 760.11 \times N_t \]

\[ (1.89) \quad (1.19) \quad (2.61) \quad (3.29) \]

\[ \bar{R}^2 = 0.97, \quad F = 204.64. \]

**Post-Energy Crisis**

\[ \bar{y}_t = -25867.60 + 264324.36 \times x_{1t} + 196617.63 \times x_{2t} - 4.47 \times x_{3t} \]

\[ (3.07) \quad (2.61) \quad (-2.45) \]

\[ + 44.75 \times C_t + 14.04 \times O_t + 549.60 \times E_t + 262.11 \times N_t \]

\[ (0.85) \quad (0.12) \quad (1.17) \quad (0.80) \]

\[ \bar{R}^2 = 0.97, \quad F = 343.67. \]
It is seen from eqns. 4(a&b) that during the period Pre-Post Energy Crisis, the regression coefficients of the variables Coal, Oil, Electricity, and Non-Commercial Energy along with GDS/GNP are statistically significant with the expected signs. $\bar{R}^2$ explains 97 percent variation in the real and nominal GDP.

In the Pre-Energy Crisis period, the variables GDS/GDP and GDCF/GDP both at current and constant prices, together with Coal, Electricity, Non-Commercial Energy, and Trade Balance have statistically significant regression coefficients. The regression equations are also statistically significant, and $\bar{R}^2$ accounts for 97 percent of the variation in the GDP.

In the Post-Energy Crisis period, it is the variables GDCF/GDP at constant prices, Oil, and Electricity which are characterised by significant coefficients, with a high $\bar{R}^2$.

Thus, we find that when the different Energy components are taken with the other explanatory variables, then Coal, Oil, Electricity, and Non-Commercial Energy along with GDS/GDP and GDCF/GDP have a significant impact on the GDP.

In the period 1960-73, it is Trade Balance Coal, Electricity, Non-Commercial Energy and the ratios of GDS and GDCF to GDP which have an impact on the GDP, while in the period 1973-85, only GDCF/GDP, Oil, and Electricity emerge as significant variables as to cause variations in the dependent variable.

As has been observed earlier in Chapters I and II, Oil and Electricity assume greater significance in the context of the Indian economy, particularly in the Post-Energy Crisis period, as these are found to be replacing the less

NOTE: *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level, and *** at 10 percent level.
competent energy forms viz., Coal and Non-Commercial Energy. In the case of GDCF/GDP, it indicates a positive trend in the aforesaid period, while GDS/GNP has remained more or less constant.

- The results obtained by regressing equations 5(a&b) in which the variable GDS/GDP has not been included to see if there are any departures from the results obtained in eqns. 4(a&b) are as follows:

Pre and Post-Energy Crisis

\[
\bar{y}_t = -15464.96 + 7222.78 \overline{x}_{2t} -0.72 \overline{x}_{3t} + 19.90 C_t + 33.41 O_t
\]
\[
+ 291.03* E_t + 46.24 N_t
\]
\[
R^2 = 0.97, F = 416.71.
\]

\[
y_t = 133465.17 + 73155.91 x_{2t} -2.50** x_{3t} + 561.91** C_t
\]
\[
+ 295.14*** O_t + 940.42* E_t + 1138.61* N_t
\]
\[
R^2 = 0.97, F = 463.16.
\]

Pre-Energy Crisis

\[
\bar{y}_t = 162262.18 + 16841.63 \overline{x}_{2t} -6.75** \overline{x}_{3t} + 12.17 C_t
\]
\[
+ 372.93** O_t + 1904.20* E_t + 1052.19** N_t
\]
\[
R^2 = 0.96, F = 71.5.
\]

\[
y_t = -93876.74 + 27496.66 x_{2t} -3.08 x_{3t} +36.77 C_t
\]
\[
+ 148.85 O_t + 319.09 E_t + 763.29*** N_t
\]
\[
R^2 = 0.97, F = 166.26.
\]
Post-Energy Crisis

\[
\bar{y}_t = 19734.73 + 78601.60 \bar{x}_{2t} -2.13^{***} \bar{x}_{3t} + 209.49 C_t \\
(1.46) \quad (1.84) \\
+ 95.65^{***} O_t + 276.56^* E_t + 85.86 N_t \\
(1.82) \quad (3.44) \quad (0.35) \\
+ 95.65^{***} O_t + 276.56^* E_t + 85.86 N_t \\
(1.82) \quad (3.44) \quad (0.35) \\
\]

\[
R^2 = 0.97, F = 87.70.
\]

\[
y_t = 400890.15 + 209767.88 x_{2t} -3.31^{**} x_{3t} + 539.73 C_t \\
(1.09) \quad (2.35) \\
+ 308.86 O_t + 1096.25^{**} E_t + 2408.08^{***} N_t \\
(1.44) \quad (2.63) \quad (1.60) \\
\]

\[
R^2 = 0.97, F = 203.29.
\]

In the Pre and Post-Energy Crisis period, the variable \(E_t\) in Eq. (5a), and the variables \(X_{3t}, C_t, Q_t\) and \(N_t\) have statistically significant regression coefficients. \(R^2\) and \(F\) are both high. In the period 1960-73, the regression coefficients of \(x_{3t}, O_t, E_t,\) and \(N_t\) are statistically significant, while \(R^2\) varies between 96 to 97 percent. The signs are as expected.

In the Post-Energy Crisis period, the variables \(X_{3t}, O_t,\) and \(E_t\) in eqn. (5a), and the variables \(X_{3t}, E_t,\) and \(N_t\) in eqn. (5b), emerge with statistically significant regression coefficients as to cause variations to the extent of 97 percent in the real and nominal GDP. However, the slope coefficient of \(X_{3t}, O_t\) and \(E_t\) are larger in the Pre than in the Post-Energy Crisis period.

It thus follows that during the overall period, all Energy components together with Trade Balance at current prices are found to be responsible for causing variations in the GDP. In the period 1960-73, it is again Trade Balance, Oil, Electricity and Non-Commercial Energy which are significant, whereas during the period 1973-85 it is Trade Balance, Oil, Electricity, and Non-Commercial Energy which account for effecting changes in the explained variable. The results

NOTE: *Statistically significant regression coefficients at 1 percent level; at ** at 5% level, and *** at 10 percent level.
so obtained all statistically significant are more or less the same as in eqns. 4(a&b).

In equations 6(a&b), the variable GDCF, at current and constant prices, has been regressed alongwith Trade Balance and the various Energy forms as the explanatory variables. GDCF is taken as its observed to be highly correlated to GDP. The results are presented below:

**Pre and Post-Energy Crisis**

### Pre-Energy Crisis

\[
\bar{y}_t = 156443.67 + 0.84*** \bar{x}_t - 6.26** \bar{x}_t + 8.65 C_t \\
(1.83)\quad (-2.36)\quad (0.19)
\]

\[
+ 150.83** O_t + 1777.58* E_t + 1010.98* N_t \\
(3.03)\quad (3.97)\quad (3.49)
\]

\[R^2 = 0.97, F = 97.29.\]

### Post-Energy Crisis

\[
\bar{y}_t = 15831.29 + 0.51*** \bar{x}_t - 0.46 \bar{x}_t + 29.63 C_t + 28.85 O_t \\
(1.42)\quad (-0.57)\quad (0.66)\quad (0.72)
\]

\[
+ 249.66* E_t + 21.85 N_t \\
(3.77)\quad (0.39)
\]

\[R^2 = 0.97, F = 457.46.\]

### Pre and Post-Energy Crisis Period

\[
\bar{y}_t = 36357.16 + 1.63** \bar{x}_t - 1.33*** \bar{x}_t + 190.13** C_t \\
(3.25)\quad (-1.60)\quad (2.53)
\]

\[
+ 67.02*** O_t + 165.59** E_t + 132.26 N_t \\
(2.40)\quad (2.53)\quad (0.80)
\]

\[R^2 = 0.97, F = 192.15.\]
\[ y_t = 361827.84 + 2.95 * x_t - 0.06 X_{3t} + 896.47 * C_t + 116.90 O_t \\
(3.44) \quad (-0.05) \quad (4.65) \quad (0.81) \\
+ 97.78 E_t + 2161.27** N_t \quad (0.29) \quad (3.09) \quad (6b) \]

\[ R^2 \quad 0.97, \quad F = 553.79. \]

During the Pre-Post Energy Crisis period, the regression coefficients of the variables \( x_t \), and \( E_t \) in eqn.(6a), and the regression coefficients of \( x_t \), \( X_{3t} \), \( C_t \) and \( O_t \) in eqn. (6b), are statistically significant. \( R^2 \) accounts for 97 percent of the total variation in the real and nominal GDP.

The variables in the Pre—Energy Crisis period having statistically significant regression coefficients are GDCF and Trade Balance at constant prices, together with Oil, Electricity, and Non-Commercial Energy. \( R^2 \) explains 97 percent of the total variation in the dependent variable and both the equations are also statistically significant. In the Post—Energy Crisis period too, it is the variables \( x_t \) and \( X_{3t} \), at current and constant prices, along with Coal, Oil, Electricity, and Non-Commercial Energy that have significant regression coefficients, with \( R^2 \) explaining 97 percent of the variation in the GDP.

Thus we find that, in the twenty-five year period GDCF, Oil, Coal, Electricity, and Trade Balance have an impact on the GDP. In the sub-period 1960-73, with the exception of Coal, all the variables are significant, while during the years 1973-85, it is GDCF, Trade Balance, and the various Energy forms that dominate the scene.

- Next, in order to determine the impact of the Balance of Payments—Current Account deficit on the GDP, another equation is regressed taking it as the explanatory variable in place of Balance of Trade. The results of estimation of equation (7) are:

**NOTE:** *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level, and *** at 10 percent level.*
Pre and Post-Energy Crisis

\[ y_t = 110957.42 + 244969.26 x_1 t + 164323.96 x_2 t - 0.49 x_3 t \]

\[ + 683.80* C_t + 244.57 O_t + 1075.49* E_t + 1063.25* N_t \]

\[ R^2 = 0.97, F = 375.36. \]  

Pre-Energy Crisis

\[ y_t = 9161.29 + 319864.36*** x_1 t + 259.52*** x_2 t - 3.84 x_3 t \]

\[ + 36.63 C_t + 100.02 O_t + 1022.71*** E_t + 26.11 N_t \]

\[ R^2 = 0.97, F = 183.22. \]  

Post-Energy Crisis

\[ y_t = 407355.37 + 152831.20 x_1 t + 490583.67 x_2 t - 5.53** x_3 t \]

\[ + 291.06 C_t + 280.50*** O_t + 1472.36* E_t \]

\[ + 2310.51*** N_t \]

\[ R^2 = 0.97, F = 363.25. \]

It is observed from the results that during the Pre-Post Energy Crisis period, only the Energy components—Coal, Electricity, and Non-Commercial Energy have statistically significant regression coefficients with the expected sign. \( R^2 \) accounts for 97 percent of the total variation in the nominal GDP. However, in the Pre-Energy Crisis period, the ratios of GDS and GDCF to GDP alongwith Electricity have statistically significant regression coefficients, with \( R^2 \) and \( F \) also having high values. But in the Post-Energy Crisis period, it is the Current Account Deficit with Oil, Electricity, and Non-Commercial Energy having significant regression coefficients. The equations are also significant statistically.

NOTE: *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level, and *** at 10 percent level.
Another equation taking only two variables, Per Capita National Income (PNY) as the explained variable, and Per Capita Commercial Energy Consumption (PCM_c) as the explanatory variable, has been estimated to find out empirically the impact of Commercial Energy on the National Income. While computed equations 8(a,b,c), autocorrelation and multicollinearity were not found. The results of estimation are given below:

Pre and Post-Energy Crisis

\[
PNY = -732.28 + 358.98 \times PCM_c \\
(8.52)
\]

\[\bar{R}^2 = 0.75, F = 72.51, DW = 2.18.\]

Pre-Energy Crisis

\[
PNY = -224.73 + 189.72 \times PCM_c \\
(17.96)
\]

\[\bar{R}^2 = 0.96, F = 322.63, DW = 2.48\]

Post-Energy Crisis

\[
PNY = 3.66 + 254.50 \times PCM_c \\
(3.34)
\]

\[\bar{R}^2 = 0.48, F = 11.18, DW = 1.59.\]

The empirical results of equations 8(a,b,c) reveal that in all the three periods viz., Pre-Post, Pre and Post-Energy Crisis, the regression coefficients of Per Capita Commercial Energy Consumption are statistically significant at 1 percent level. \( \bar{R}^2 \) explains 75 percent variation in PNY during 1960-85, 96 percent during the sub-period 1960-73, and 48 percent in the sub-period 1973-85. The variations thus caused Per Capita National Income due to a change in Per Capita Commercial Energy Consumption is more in the Pre than in the Post-Energy Crisis period; which is in line with the observation that a compound growth rate of PCM_c at 4.92 percent in the period prior to 1973-74, excelled 1.74 percent that of 1973-85.

NOTE: *Statistically significant regression coefficients at 1 percent level.
In the preceding sections, the empirical study of equations (1) through (8) reveal the following:

- Total Energy consumption has a significant impact on the real and nominal GNP during the Pre and Post-Energy Crisis period. Trade Balance and Gross Domestic Capital Formation, both at current and constant prices, are also statistically significant in explaining variations in the GNP, with the former being negatively correlated to the dependent variable. In the case of the ratios of Gross Domestic Savings and Gross Domestic Capital Formation to GNP, these are not statistically significant over the period. At constant prices GDS/GNP varied between 18 to 21 percent during 1960-77, thereby declining to 15 percent in 1984-85, whereas GDCF/GNP varying between 16 to 25 percent during 1960-81, fell to 22 percent in 1984-85. Thus, both the variables remained more or less constant in the period under study.

During the Pre-Energy Crisis period, it is Energy along with (i) the ratio of Gross Domestic Savings and Gross Domestic Capital Formation to GNP, Trade Balance and (ii) Gross Domestic Capital Formation both, at constant and current prices, which are largely responsible for causing variations in the GNP. All these variables, as observed in the preceding chapter, exhibited a positive trend in the said period. However, during the Post-Energy Crisis period only Energy consumption and Gross Domestic Capital Formation significantly influence the real and nominal GNP, with these variables showing a prominent trend in the period subsequent to 1973-74, whereas GDS/GNP and GDCF/GNP at constant prices, showing a declining trend did not emerge as significant variables.

- When the different Energy components are regressed with other explanatory variables we find that during the Pre and Post-Energy Crisis period, (i), Coal, Oil, Electricity, and Non-Commercial Energy, Trade Balance, and the ratios of GDS and GDCF to GDP; and (ii) Gross Domestic Capital Formation are significant, thus having an impact on the real and nominal GDP.
In the Pre-Energy Crisis period, the different forms of Energy along with (i) Trade Balance, the ratios of Gross Domestic Savings and Gross Domestic Capital Formation to GDP; and (ii) Gross Domestic Capital Formation, which led to significant variations in the Gross Domestic Product of the country.

In the Post-Energy Crisis period, it is observed that (i) Oil and Electricity together with (ii) Trade Balance and Gross Domestic Capital Formation both, at current and constant prices; (iii) Balance of Payments Current Account Deficit, and in certain formulations (iv) Coal and Non-Commercial Energy have a significant impact on the GDP.

Thus the empirical analysis of the impact of energy consumption on the economy of India reveals that Energy consumption viz., Electricity, Oil, Coal, and Non-Commercial in order of significance along with Current Account Deficit engendered variations in the Gross Domestic Product, particularly in the Post-Energy Crisis period as compared to the period prior to it. It has already been observed in the context of Coal and Non-Commercial Energy, that these are losing ground to the more competent energy forms - Oil and Electricity. Thus these latter variables predominantly effect the economy of the country. As far as Gross Domestic Capital Formation is concerned, it significantly influences the GDP of the country in the period 1960-85; while the ratios of Gross Domestic Savings and Gross Domestic Capital Formation to GDP are significant only in the Pre-Energy Crisis period, as these have remained more or less constant during 1960-85.

Per Capita Commercial Energy Consumption is found to cause more variations in the Per Capita National Income in the Pre than in the Post-Energy Crisis period. The impact is also very significant in the overall period.

To conclude, the relative importance of the Energy sector thus assumes greater significance by the high degree of correlation it shares with GNP/GDP, and the significant
impact it has on it with Oil and Electricity dominating the scene, particularly in all Post-Energy Crisis period whereas Coal and Non-Commercial Energy are more significant in the Pre-Energy Crisis period.

**Energy Crisis - Its Impact on the Terms of Trade, Current Account Deficit of the Balance of Payments, and Domestic Inflation**

An in-depth analysis of the impact of 'Energy Crisis' on the Net Barter and Income Terms of Trade (with and without petroleum products), the Current Account Deficit, and Domestic Inflation has been dealt with in the following text. The analysis empirically oriented, is confined to the Pre, Post, and Pre and Post-Energy Crisis periods respectively.

**Terms of Trade**

It has been observed in Chapter IV dealing with the theoretical analysis of the impact of 'Energy Crisis' on the economy of India that, the Import Unit Value Index played a significant role in the determination of the Net Barter Terms of Trade as compared to the Export Unit Value Index. The Income Terms of Trade were largely influenced by the Quantum Index of Exports and Net Barter Terms of Trade during the period 1960-84. The latter also contributed to the movements in the Income Terms of Trade particularly in the case when crude Oil and petroleum product imports were excluded. The variables Export Quantum Index, Import and Export Unit Value Indices, were found to be highly and significantly correlated to the Income Terms of Trade.

Over the Pre-Energy Crisis period, the rise in the Income Terms of Trade was greater than the improvements in the Barter Terms of Trade. However, during the Post-Energy Crisis period both, ITT and NBTT with petroleum products fell sharply and the decline in NBTT was greater than the decline in ITT. The rate of fall in ITT engendered by falling
NBTT was dampened by the rise in the quantum of exports over the years under study.

It was also observed that the Terms of Trade without petroleum products exhibited a slow rising trend. This makes it all the more obvious that crude Oil and petroleum product imports recording a compound growth rate of 21.10 percent during the period 1973-84, as compared to 7.69 percent during the period 1960-73, were responsible in a large way for the deterioration in the Terms of Trade in the second period.

Thus, inorder to empirically investigate the impact of the 'Energy Crisis' on the Terms of Trade during 1960-84, a few regression equations are computed. The Net Barter and Income Terms of Trade (with and without petroleum products) are taken as the explained variables. The explanatory variables are the Export Unit Value Index, Import Unit Value Index (with and without crude Oil and petroleum products), together with the Quantum Index of Exports. Further, to determine the impact of NBTT (with and without petroleum products) and the Export Quantum Index on the Income Terms of Trade, two more equations are estimated. The equations computed are:

\[
\begin{align*}
\text{NBTT} &= \beta_0 + \beta_1 \text{IUVI} \quad (1) \\
\text{NBTT} &= \beta_0 + \beta_1 \text{IUVI} + \beta_2 \text{EUVI} \quad (2) \\
\text{NBTT}' &= \beta_0 + \beta_1 \text{EUVI} \quad (3) \\
\text{NBTT}' &= \beta_0 + \beta_1 \text{EUVI} + \beta_2 \text{IUVI}' \quad (4) \\
\text{ITT} &= \beta_0 + \beta_1 \text{EQUI} \quad (5) \\
\text{ITT} &= \beta_0 + \beta_1 \text{EQUI} + \beta_2 \text{NBTT} \quad (6) \\
\text{ITT}' &= \beta_0 + \beta_1 \text{EQUI} \quad (7) \\
\text{ITT}' &= \beta_0 + \beta_1 \text{EQUI} + \beta_2 \text{NBTT}' \quad (8)
\end{align*}
\]

Empirical Results

The results of estimation during the Pre, Post, and Pre-Post Energy Crisis periods are discussed in the following text. In all the equations (1 thro' 8), autocorrelation

NOTE: NBTT,NBTT', ITT, ITT', IUVI, IUVI', EUVI and EQUI - terms already explained in Chapter IV, whereas $\beta$s' are the constants.
and high degree multicollinearity are not detected.

**Pre and Post-Energy Crisis**

\[
\text{NBTT} = 103.20 - 0.0944 \ast \text{IUVI} \\
\quad \text{R}^2 = 0.57, \ F = 31.62, \ DW = 1.63.
\]

(1)

\[
\text{NBTT} = 96.42 - 0.2486 \ast \text{IUVI} + 0.2370 \ast \text{EUVI} \\
\quad \text{R}^2 = 0.79, \ F = 43.39, \ DW = 1.96.
\]

(2)

\[
\text{NBTT}' = 97.10 + 0.0575\ast \text{EUVI} \\
\quad \text{R}^2 = 0.11, \ F = 3.81, \ DW = 1.49.
\]

(3)

\[
\text{NBTT}' = 104.97 + 0.5272 \ast \text{EUVI} - 0.5609 \ast \text{IUVI}' \\
\quad \text{R}^2 = 0.74, \ F = 33.51, \ DW = 1.86.
\]

(4)

\[
\text{ITT} = 29.37 + 0.6070 \ast \text{EQI} \\
\quad \text{R}^2 = 0.71, \ F = 57.45, \ DW = 1.79.
\]

(5)

\[
\text{ITT} = -144.92 + 0.8849 \ast \text{EQI} + 1.61 \ast \text{NBTT} \\
\quad \text{R}^2 = 0.92, \ F = 126.06, \ DW = 2.36.
\]

(6)

\[
\text{ITT'} = -7.33 + 1.13 \ast \text{EQI} \\
\quad \text{R}^2 = 0.93, \ F = 289.11, \ DW = 2.39.
\]

(7)

\[
\text{ITT'} = -141.15 + 1.04 \ast \text{EQI} + 1.38 \ast \text{NBTT}' \\
\quad \text{R}^2 = 0.96, \ F = 1175.64, \ DW = 2.18.
\]

(8)

It is apparent from the results that over the period 1960-84, the variable IUVI with the inclusion of crude Oil

**NOTE:** *Statistically significant regression coefficients at 1 percent level, and ** at 5 percent level.*

Figures in the parantheses denote the t-ratio.
and petroleum products, has a statistically significant regression coefficient at 1 percent level with a negative sign. $R^2$ explains 57 percent of the total variation in the regressand. We thus find that with NBTT exhibiting a declining trend during the twenty-four year period as observed earlier, it is IUVI which is responsible for it in a major way.

When the variable Export Unit Value Index is added to the equation as in (2), $R^2$ accounts for 79 percent of the variation in NBTT. Both the regression coefficients of the variables export and import prices are statistically significant as seen from the high t-ratios. Also, the signs are as expected. But the impact of IUVI on NBTT is more as compared to EUVI.

In the case of NBTT without petroleum products, Export Unit Value Index accounts for only 11 percent of the total variation in the Terms of Trade. The regression coefficient has the positive sign and is significant at 5 percent level.

In eqn. (4) it is seen that with the inclusion of the explanatory variable IUVI without petroleum products, $R^2(0.74)$ is high. IUVI is inversely correlated to the Net Barter Terms of Trade, and again IUVI renders a greater influence on the Barter Terms of Trade in comparison to EUVI. The regression coefficients in both the cases are statistically significant at 1 percent level.

It is hence quite evident from eqns. (1) to (4), that it is the variable Import Unit Value Index (with and without petroleum products) that is contributing more to the variations in the Net Barter Terms of Trade over the period under reference.

In the case of Income Terms of Trade (estimated with the inclusion of petroleum products) as the dependent variable and taking Export Quantum Index as the independent variable, we find that the variations caused in ITT as indicated by $R^2$ are to the extent of 71 percent, EQI has a
statistically significant regression coefficient at 1 percent level.

When the variable Net Barter Terms of Trade with petroleum products is also included in eqn. (6), it is seen that $R^2$ accounts for 92 percent of the total variation in ITT. The regression coefficients of both the variables are statistically significant as indicated by the high t-ratios. Also NBTT has a larger slope coefficient than the Export Quantum Index. This being so as in the years 1980-84, the Unit Value Index of Exports went up from 195.28 to 333.33 over the period, and this was followed by a simultaneous decline in the Import Unit Value Index from 385.00 to 327.08 during 1982-84. The Net Barter Terms of Trade in the process went up from 55.16 to 80.61 in the year 1983-84. On the other hand, the Export Quantum Index showed a decline from 385.00 to 327.00 during 1982-84.

Thus, the upward movement in the Income Terms of Trade in the period as a whole developed from the fact that both, the quantity of exports and the Net Barter Terms of Trade moved together and in the upward direction, with the exception of a few dips in NBTT in certain specific years (that is, 1961-62, 1968-69, 1973-76 and 1978-81, the latter two periods being characterised by the world oil price hike).

Now coming to the Income Terms of Trade without petroleum products, it is observed that with EQI as the explanatory variable, $R^2$ explains 93 percent of the variation in the former. The regression coefficient of EQI is statistically significant at 1 percent level.

Comparing equations (5) and (7) we find that, EQI explains more variations occurring in ITT without petroleum products than with petroleum products.

Finally, in equation (8) both the variables, Export Quantum Index and NBTT without petroleum products explain 97 percent of the total variation in the Income Terms of
Trade, as their regression coefficients are statistically significant at 1 percent level. Again it is NBTT\(^1\) which is more dominating than EQI. NBTT when estimated without petroleum products, exhibited a discernible rising trend along with EQI over the reference period. Hence both, NBTT\(^1\) and EQI moved together in the upward direction accounting for movements in ITT\(^1\) in the same direction in a significant way:

While comparing equations (5) to (8) it is observed that it is the Net Barter Terms of Trade which has a larger impact on ITT than EQI. Also NBTT with petroleum products has a greater slope coefficient than NBTT without petroleum products. All the estimated equations (1 thro' 8) pertaining to the period 1960-84, are found statistically significant.

**Pre-Energy Crisis**

\[
\text{NBTT} = 65.53 + 0.3598 \times \text{EUVI} \\
R^2 = 0.67, F = 25.23, DW = 1.91. \tag{1}
\]

\[
\text{NBTT} = 88.78 + 0.9928 \times \text{EUVI} - 0.8821 \times \text{IUVI} \\
R^2 = 0.97, F = 490.08, DW = 1.97. \tag{2}
\]

\[
\text{NBTT} = 66.39 + 0.4521 \times \text{EUVI} \\
R^2 = 0.58, F = 17.33, DW = 1.78. \tag{3}
\]

\[
\text{NBTT} = 97.11 + 1.18 \times \text{EUVI} - 1.12 \times \text{IUVI} \\
R^2 = 0.97, F = 2295.76, DW = 2.38. \tag{4}
\]

\[
\text{ITT} = -35.11 + 1.39 \times \text{EQI} \\
R^2 = 0.95, F = 216.43, DW = 2.44. \tag{5}
\]

\[
\text{ITT} = -98.40 + 0.9771 \times \text{EQI} + 1.03 \times \text{NBTT} \\
R^2 = 0.97, F = 1256.18, DW = 2.24. \tag{6}
\]

\[
\text{ITT} = -45.52 + 1.60 \times \text{EQI} \\
R^2 = 0.96, F = 174.64, DW = 2.18. \tag{7}
\]
\[ \text{ITT'} = -105.74 + 1.03* EQI + 1.04* NBTT' \]
\[(20.47) \quad (13.82) \quad (8)\]

\[ R^2 = 0.97, \ F = 1690.94, \ DW = 2.31. \]

From the results it is observed that the variable Export Unit Value Index, the regression coefficient of which is statistically significant at 1 percent level, is responsible for 67 percent of the total variation in the Net Barter Terms of Trade (with petroleum products) in the Pre-Energy Crisis period. The sign is as expected.

In equation (2), we find that both the regression coefficients of the variables EUVI and IUVI are statistically significant as apparent from the high t-ratios in the parentheses. However, the impact of EUVI is comparatively more than IUVI; the latter is also inversely correlated to NBTT. \( R^2 \) accounts for 97 percent of the total variation in the terms of trade.

Thus, during the period 1960-73 when petroleum products are included in estimating the variables, it is the Export Unit Value Index which is largely responsible for changes in the Net Barter Terms of Trade followed by the Import Unit Value Index.

In equation (3), when NBTT with the exclusion of petroleum products is taken as the regressand and EUVI as the regressor, \( R^2 \) explains 58 percent variation in the former. EUVI has the positive sign with a statistically significant regression coefficient at 1 percent level.

With the inclusion of IUVI' along with EUVI as the explanatory variables given in eqn. (4), it is seen that \( R^2 \) explains 78% of the total variation in NBTT'. Both the variables have statistically significant regression coefficients at 1 percent level, although EUVI exerts a greater

NOTE : *Statistically significant regression coefficients at 1 percent level.

Figures in the parantheses denote the t-ratio.
influence on NBTT' than IUVI. The signs are as expected.

It has been earlier observed in Chapter IV that the Net Barter Terms of Trade (with and without petroleum products) depicted a positive trend in the Pre-Energy Crisis period. This upward rising trend was due to a greater rise in the Export Unit Value Index than the Import Unit Value Index. This is supported by the empirical results as in eqns. (1 thro' 4) in which it is the variable EUVI which is exercising a greater influence on the Net Barter Terms of Trade than the Import Unit Value Index (with or without petroleum products).

In the context of the Income Terms of Trade as the dependent and the Export Quantum Index as the independent variables, the latter is found to be positively correlated to the former and $\bar{R}^2$ accounts for 95 percent of the total variation in it.

In equation (6), both EQI and NBTT have significant regression coefficients at 1 percent level with the expected signs. However, NBTT has a larger slope coefficient than EQI. $\bar{R}^2$ explains 97 percent of the total variation in ITT.

In equation (7) when ITT without petroleum products is taken as the dependent variable and EQI as the independent variable, then the latter accounts for 96 percent variation in ITT.

A comparison of equations (5) and (7) reveals that, EQI has a greater impact on ITT with petroleum products than with petroleum products.

Finally in equation (8) we find that both, EQI and NBTT' have significant regression coefficients at 1 percent level with the expected signs, positively contributing to the rise in ITT'. $\bar{R}^2$ explains 97 percent of the total variation in the dependent variable.

From the foregoing analysis regarding the Income Terms of Trade it is found that NBTT (with or without petroleum products) engendered movements in ITT followed by the Export Quantum Index.
As far as the Net Barter Terms of Trade are concerned, it is the factor Export Unit Value Index which is found to be largely responsible for changes in NBTT or NBTT' than the Import Unit Value Index. Both EUVI and IUVI moved in the upward direction during the Pre-Energy Crisis period, the rise in EUVI being more than IUVI and the former thus contributing to the rise in the Net Barter Terms of Trade in a more significant way. The equations (1 thro' 8) pertaining to the sub-period 1960-73 as estimated in the foregoing paras are significant.

**Post-Energy Crisis**

\[
\begin{align*}
\text{NBTT} &= 110.83 - 0.1200* \text{IUVI} \\
&= 108.57 - 0.2152* \text{IUVI} + 0.1811* \text{EUVI} \\
&= 86.71 + 0.0950 \text{EUVI} \\
&= 123.52 + 0.4504* \text{EUVI} - 0.5645* \text{IUVI}' \\
\text{ITT} &= 54.07 + 0.4629** \text{EQI} \\
&= -177.86 + 0.8839* \text{EQI} - 2.07* \text{NBTT} \\
&= -1.09 + 1.09* \text{EQI}
\end{align*}
\]

\(\bar{R}^2 = 0.44, F = 8.92, DW = 1.79.\)  
\(\bar{R}^2 = 0.78, F = 18.62, DW = 1.76.\)  
\(\bar{R}^2 = 0.77, F = 1.84, DW = 1.48.\)  
\(\bar{R}^2 = 0.95, F = 1.95, DW = 1.99.\)  
\(\bar{R}^2 = 0.19, F = 3.32, DW = 1.60.\)  
\(\bar{R}^2 = 0.72, F = 13.79, DW = 1.73.\)  
\(\bar{R}^2 = 0.70, F = 23.97, DW = 2.39.\)
\[
\text{ITT}' = -181.19 + 1.06* EQI + 1.72* NBTT' \\
(16.04) \quad (9.69) \\
\tilde{R}^2 = 0.96, \quad F = 182.77, \quad DW = 2.13.
\]

During the Post-Energy Crisis period, the empirical results reveal that the variable Import Unit Value Index in eqn. (1) has a statistically significant regression coefficient with a negative sign. \(\tilde{R}^2\) explains 44 percent of the total variation in NBTT.

In equation (2) with the inclusion of EUVI along-with IUVI, \(\tilde{R}^2\) increases to 78 percent. The regression coefficients of both the variables are statistically significant at 1 percent level. IUVI retains the negative sign and exerts a greater influence on NBTT as compared to EUVI.

In the case of NBTT without petroleum products, the Export Unit Value Index does not have a statistically significant regression coefficient (eqn.3). However, in eqn.(4) both the variables EUVI and IUVI have statistically significant regression coefficients at 1 percent level. The sign are as expected and \(\tilde{R}^2\) explains 95 percent of the variation in the Terms of Trade. Again, IUVI has a larger slope coefficient than EUVI.

Thus, in the Post-Energy Crisis period both IUVI and EUVI played a significant role in the determination of the Net Barter Terms of Trade; the contribution to the deterioration in the terms of trade by import prices being far greater than the positive impact of export prices, thereby resulting in declining Net Barter Terms of Trade with petroleum products.

With regard to ITT without petroleum products, the variable EQI in eqn. (5) has a statistically significant regression coefficient at 10 percent level with a positive

\[\text{NOTE :} \quad *\text{Statistically significant regression coefficients at 1 percent level, and} \quad **\text{ at 10 percent level.}\]

\[\text{Figures in parantheses indicate the t-ratio.}\]
sign. $R^2$ accounts for only 19 percent of the total variation in ITT. But in eqn. (6), $R^2$ increases to 72 percent when the variable NBTT with petroleum products along with EQI are taken as the explanatory variables. The regression coefficients in both the cases are statistically significant with the expected signs. Again NBTT has the larger slope coefficient than EQI, thus implying a decline in ITT due to declining NBTT as observed earlier and obviously swamping the positive impact of EQI.

In eqn. (7) when ITT without petroleum products is taken as the regresand and EQI as the regressor, $R^2$ accounts for 70 percent of the total variation in the Income Terms of Trade. The regression coefficient of EQI is statistically significant as observed from the high $t$-value.

When the variable NBTT without petroleum products is also taken up together with EQI as in eqn. (8), $R^2$ accounts for 96 percent of the variation in ITT'. The $t$-values show the statistical significance of both the regression coefficients having positive signs as expected, with NBTT exercising a greater influence on ITT' than EQI. All the equations pertaining to the sub-period 1973-84, are found to be statistically significant.

Now the Income and Net Barter Terms of Trade with the exclusion of petroleum products, exhibited a rising trend in the period following the Oil price hike of 1973-74. The contribution of the factor NBTT to the upward rise in ITT was more than that of the Export Quantum Index. And in the case of Income Terms of Trade with petroleum products, it is again NBTT' which emerges as a significant variable having a larger slope coefficient than the Export Quantum Index, and thus significantly affecting the Income Terms of Trade in the downward direction.

From the foregoing analysis regarding the impact of the 'Energy Crisis' on the Terms of Trade, it follows that:
In the determination of the Net Barter Terms of Trade (with or without petroleum products) during the period 1960-84, the factor Import Unit Value Index estimated (with or without petroleum products), is predominantly significant as compared to the Export Unit Value Index. In both the cases, import prices have the negative sign implying their adverse impact on the Net Barter Terms of Trade.

- In the Pre-Energy Crisis period, the upward rise in the Net Barter Terms of Trade with and without petroleum products is largely due to the dominating influence of the Export Unit Value Index than the Import Unit Value Index.

In the Post-Energy Crisis period, on the contrary, the decline in the Net Barter Terms of Trade with petroleum products is accounted for by the factor Import Unit Value Index which has a negative sign as expected. With regard to the Net Barter Terms of Trade without petroleum products, the favourable terms of trade are explained by the simultaneous rise in export prices, although import prices also have a significant effect on NBTT.

- In the determination of the Income Terms of Trade with petroleum products, the impact of the Net Barter Terms of Trade is more as compared to the Export Quantum Index during the period 1960-84. This being so as NBTT in the years 1981-84 experienced a sudden increase. The factors responsible for it were a rise in export prices for four consecutive years 1980-84, together with a decline in import prices in 1983-84. In the process, the Net Barter Terms of Trade increased from 55.16 to 80.61 during the period 1980-84. On the other hand, the quantity of exports showed a decline from 385.00 to 327.00 during the year 1982-84. Thus, the upward movement in the Income Terms of Trade was accounted for by a rise in the Net Barter Terms of Trade in the same direction and the quantity of exports during the period as a whole.

During the Pre-Energy Crisis period, both the Export
Quantum Index and the Net Barter Terms of Trade (with or without petroleum products) emerged as statistically significant variables as to cause variations in the Income Terms of Trade; the impact of the Net Barter Terms of Trade being more than the Export Quantum Index on the Income Terms of Trade (with and without petroleum products). Both, the quantity of exports and the Barter Terms of Trade (with and without petroleum products) moved upwards in the same direction, thus contributing to the rise in the Income Terms of Trade.

In the Post-Energy Crisis period, however, the impact of the Export Quantum Index was dampened by the deteriorating Net Barter Terms of Trade with petroleum products, hence accounting for the decline in the Income Terms of Trade in the said period. With the exclusion of crude Oil and petroleum imports, however, the Net Barter Terms of Trade and the Export Quantum Index, both having a positive trend as observed earlier, have a favourable and significant impact on the Income Terms of Trade.

Balance of Payments - Current Account Deficit

To investigate the impact of the 'Energy Crisis' on the Current Account Deficit of the Balance of Payments, the following equations are estimated for the Pre, Post, and Pre and Post-Energy Crisis periods respectively.

\[
\begin{align*}
\text{DF} & = \alpha_0 + \alpha_1 \text{MI} + \alpha_2 \text{XI} & (1) \\
\text{DF} & = \alpha_0 + \alpha_1 \text{MI}' + \alpha_2 \text{XI} & (2) \\
\text{DF} & = \alpha_0 + \alpha_1 \text{PI} + \alpha_2 \text{MI}' + \alpha_3 \text{XI} & (3) \\
\text{CDF} & = \alpha_0 + \alpha_1 \text{PM} + \alpha_2 \text{X} + \alpha_3 \text{M} & (4) \\
\text{DF} & = \alpha_0 + \alpha_1 \text{NBTT} + \alpha_2 \text{ITT} & (5) \\
\text{DF} & = \alpha_0 + \alpha_1 \text{NBTT}' + \alpha_2 \text{ITT}' & (6)
\end{align*}
\]

where,

\[
\begin{align*}
\text{DF} & = \text{Current Account Deficit Index};
\end{align*}
\]
CDF = Current Account Deficit;
MI, XI = Import and Export Indices;
MI' = Import Index without petroleum products and crude Oil;
PI = Petroleum Import Index;
M,X = Value of Imports and Exports;
PM = Value of petroleum and crude Oil Imports;
NBTT, NBTT' = Net Barter Terms of Trade with and without petroleum products,
ITT, ITT' = Income Terms of Trade with and without petroleum products, and g's are the constants.

The empirical results of eqns. (1) to (6) are discussed in the following text. Multicollinearity of a high degree and autocorrelation are not detected in the regression equations.

**Pre and Post-Energy Crisis**

\[
\text{DF} = 51.73 + 1.02 \times MI - 0.6840** XI \\
\quad (3.89) \quad (-1.75)
\]
\[
R^2 = 0.82, \quad F = 54.90, \quad DW = 2.16.
\]

\[
\text{DF} = 2.74 + 1.68\times MI' - 0.8670** XI \\
\quad (3.40) \quad (-1.74)
\]
\[
R^2 = 0.80, \quad F = 48.56, \quad DW = 1.93.
\]

\[
\text{DF} = 40.79 + 0.0684** PI + 1.17** MI' - 0.8074*** XI \\
\quad (1.57) \quad (2.01) \quad (-1.67)
\]
\[
R^2 = 0.81, \quad F = 35.34, \quad DW = 1.70.
\]

\[
\text{CDF} = -24.14 + 0.3748** PM - 1.10* X + 1.13* M \\
\quad (2.14) \quad (-6.33) \quad (5.28)
\]
\[
R^2 = 0.83, \quad F = 38.83, \quad DW = 1.78.
\]

\[
\text{DF} = -58.25 + 0.6714.**** NBTT - 0.2412**** ITT \\
\quad (1.22) \quad (-1.20)
\]
\[
R^2 = 0.07, \quad F = 1.88, \quad DW = 2.23.
\]
$DF = -25.22 - 0.2706 \times ITT' - 0.3311 \times NBTT'$
\[ \begin{align*}
(6) \\
\bar{R}^2 = 0.08, F = 2.00, DW = 1.70.
\end{align*} \]

It is observed from the results that during the period 1960-85, the variables MI and XI both have statistically significant regression coefficients at 1 and 5 percent levels respectively, with MI having a greater slope coefficient than XI. The signs are as expected, and $\bar{R}^2$ accounts for 82 percent of the total variation in the Current Account Deficit.

In equation (2), when the Import Index without petroleum products is taken along with the Export Index as the explanatory variables, the regression coefficients of these variables are statistically significant with the expected signs. Again MI' exerts a greater influence on DF than XI. $\bar{R}^2$ explains 80 percent variation in the dependent variable.

In equation (3), the variables Petroleum Import Index, Import Index without petroleum products, and the Export Index all have statistically significant regression coefficients. PI and MI' have positive signs and XI a negative sign as expected. The contribution of MI' to the rising Current Account Deficit is more than XI. $\bar{R}^2$ explains 81 percent variation in DF.

Now in equation (4) with CDF as the explained variable, and petroleum and crude Oil imports along with Exports and Imports as the explanatory variables, we find that the regression coefficients in all the three cases are statistically significant, with PM and M having an adverse impact on CDF, while X has the favourable impact. $\bar{R}^2$ accounts for 83 percent of the total variation in CDF.

NOTE: *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level; *** at 10 percent level, and **** at 15 percent level.

Figures in the parentheses denote the t-ratio.
Next coming to the equations in which the terms of trade are taken as the explanatory variables, it is observed that the Net Barter and Income Terms of Trade with petroleum products have statistically significant regression coefficients at 15 percent level. NBTT with the positive sign implies the adverse impact on DF, as it was observed to be deteriorating in the Pre and Post-Energy Crisis period. The Income Terms of Trade, on the contrary, were favourable in the aforesaid period, and hence the negative sign indicates their favourable impact on DF. However, the influence of NBTT on DF is comparatively more than ITT. \( R^2 \) accounts for only 7 percent of the total variation in the explained variable.

In equation (6), when the terms of trade estimated without petroleum products are taken as the independent variables, then only the regression coefficient of ITT' emerges as statistically significant at 5% level. The signs are as expected, and again ITT' has a favourable impact on DF with \( R^2 \) explaining 8 percent variation in it.

The foregoing analysis reveals that all the equations (1 thro' 6) pertaining to the Pre and Post-Energy Crisis period are statistically significant and the variables viz., Import Index (with and without petroleum products); Net Barter Terms of Trade, and the Oil Import Bill exerted an adverse impact on the Current Account Deficit, while the variables Export Index and the Income Terms of Trade (with and without petroleum products) had a favourable impact. But the influence of the former on CDF was much more than the latter variables, thereby leading to a consequential rise in the Current Account Deficit of th Balance of Payments.

**Pre-Energy Crisis Period**

\[
DF = -38.78 + 3.04 \times MI - 1.81 \times XI \\
(7.19) (-5.52)
\]

\( R^2 = 0.91, F = 25.88, DW = 1.73. \)
\[ DF = -31.08 + 2.71 \times MI - 1.52 \times XI \]
\[ \bar{R}^2 = 0.80, F = 24.62, DW = 1.59. \]

\[ DF = 44.82 + 2.84 \times MI - 2.07 \times XI + 0.4818 \times PI \]
\[ \bar{R}^2 = 0.79, F = 15.77, DW = 1.86. \]

\[ CDF = 212.35 + 0.8987 \times M - 0.6398 \times X + 1.66 \times PI \]
\[ \bar{R}^2 = 0.79, F = 15.77, DW = 1.19. \]

\[ DF = -17.34 - 0.1012 \times ITT - 0.1203 \times NBTT \]
\[ \bar{R}^2 = 0.15, F = 0.20, DW = 2.50. \]

\[ DF = -35.03 - 0.1334 \times NBTT' - 0.0142 \times ITT' \]
\[ \bar{R}^2 = 0.14, F = 0.26, DW = 2.62. \]

During the Pre-Energy Crisis period in equation (1) we find that the regression coefficients of MI and XI are statistically significant at 5 percent level with the expected signs. MI has the greater slope coefficient than XI. \( \bar{R}^2 \) explains 81 percent of the total variation in DF.

From equation (2) it is apparent that, the Import Index without petroleum products together with the Export Index have statistically significant regression coefficients at 1 percent level and the signs are as expected.

In equation (3), it is the variables Import Index without petroleum products and Export Index that are responsible for variations to the extent of 79 percent in DF. The signs of all the three variations are as expected.

NOTE: *Statistically significant regression coefficients at 1 percent level, and ** at 5 percent level.

Figures in parenthesis denote the t-ratio.
Equation (4) reveals that the Current Account Deficit is significantly influenced by the factors M and X in the period 1960-73, as their regression coefficients are statistically significant at 1 and 5 percent levels respectively. The variable petroleum and crude Oil imports does not have a significant regression coefficient. $R^2$ explains 79 percent of the total variation in CDF.

Finally, equations (5) and (6) show that the variables Net Berter and Income Terms of Trade (with or without petroleum products) do not have statistically significant regression coefficients as to have an impact on the Current Account Deficit in the Pre-Energy Crisis period.

Hence, it follows from the foregoing analysis that in the period prior to the Oil price hike of 1973-74, the regression equations (1 thro' 6) are statistically significant and the variable adversely affecting the Current Account Deficit are Imports (with or without petroleum products), whereas the Export Index has a favourable impact on CDF. However, the Import variable is found to be more dominant than the Export variable.

**Post-Energy Crisis**

\[
\begin{align*}
\text{DF} & = -113.53 + 0.6931^{***} \text{MI} - 0.1037 \text{XI} \\
& \quad (1.82) \quad (-0.16) \quad (1) \\
R^2 & = 0.80, F = 23.29, DW = 2.13. \\
\text{DF} & = -152.61 + 0.8626 \text{MI} - 0.2810 \text{XI} \\
& \quad (1.03) \quad (0.29) \quad (2) \\
R^2 & = 0.76, F = 18.26, DW = 2.01. \\
\text{DF} & = -113.52 + 0.874^{***} \text{PI} - 0.4656 \text{XI} + 0.1171 \text{MI} \\
& \quad (1.49) \quad (-0.51) \quad (0.13) \quad (3) \\
R^2 & = 0.79, F = 14.56, DW = 1.89. \\
\text{CDF} & = 668.06 + 0.4088^{***} \text{PI} + 0.9829^{**} \text{M} - 0.8823^{**} \text{X} \\
& \quad (1.66) \quad (2.76) \quad (-2.60) \quad (4) \\
R^2 & = 0.84, F = 20.35, DW = 1.91.
\end{align*}
\]
DF = -61.35 + 1.00*** ITT + 2.20*** NBTT
(1.84) (1.66)  
$R^2 = 0.21$, $F = 2.36$, $DW = 2.39$.

DF = 50.52 - 0.9120** ITT' - 0.8711 NBTT'
(-2.15) ((-0.60)  
$R^2 = 0.23$, $F = 2.53$, $DW = 2.26$.

During the Post-Energy Crisis period, equation (1) shows that only the regression coefficient of the variable Import Index is statistically significant at 10 percent level. The signs of the coefficients are as expected, and $R^2$ explains 80 percent variation in DF.

When the variable Import Index without petroleum products is taken along with the Export Index as the explanatory variables, both do not have statistically significant regression coefficients. This is all the more apparent in eqn. (3), where PI alone has a statistically significant regression coefficient at 10 percent level with $R^2$ accounting for 79 percent of the total variation in DF. The signs of the coefficients are as expected.

In the case of deteriorating Net Barter and Income Terms of Trade (with petroleum products and crude Oil imports) as the independent variables, both have an adverse impact on the Current Account Deficit with $R^2$ explaining 21 percent variation in DF.

Finally, regarding the terms of trade estimated without petroleum products, it is only the regression coefficient of the Income Terms of Trade which emerges as statistically significant at 5% level. As has been observed earlier, ITT', indicates a positive trend in the period following the Oil price hike of 1973-74. ITT', therefore, has a favourable impact on the Current Account Deficit in the said period with $R^2$ explaining 23 percent variation in the dependent variable.

NOTE: *Statistically significant regression coefficients at 1 percent level;** at 5 percent level, and ***at 10 percent level. Figures in parantheses denote the t-ratio.
Thus it has been analysed that all the equations pertaining to the period 1973-85, are found to be statistically significant and the variables largely accounting for variations in the Current Account Deficit are Imports (with petroleum products and crude Oil); and Petroleum Imports as compared to Exports. In the context of the terms of trade, both Net Barter and Income Terms of Trade with petroleum products adversely affect the Current Account Deficit, while without petroleum products ITT exerts a favourable impact.

From the analysis in the preceding text it follows that:

- During the period 1960-85, the factors adversely affecting the Current Account Deficit are the Imports (with and without petroleum products). On the other hand, the favourable Income Terms of Trade (with and without petroleum products), and the Net Barter Terms of Trade (excluding petroleum products), together with Exports exert a favourable impact on the Current Account Deficit. But the impact of the adverse factors is found to be more than that of the latter variables.

- In the sub-period 1960-73, the Oil import bill individually does not emerge as a statistically significant variable. The factors predominantly effecting the Current Account Deficit are the Imports (with and without petroleum products) and Exports. However, the former two have a greater influence on the Current Account Deficit than the latter. The Terms of Trade do not exert any significant impact on the Current Account Deficit.

- But in the sub-period 1973-85, Imports (with petroleum products); the Oil and petroleum product import bill, together with the deteriorating Net Barter and Income Terms of Trade have an adverse impact on the Current Account Deficit, while Exports and the rising Income Terms of Trade (without petroleum products) favourably effect the Current Account Deficit.
Account Deficit. However, the impact of these latter two is dampened by the prominently rising Import prices with petroleum products and the deteriorating Terms of Trade.

Domestic Inflation

To determine empirically the impact of the 'Energy Crisis' on the general price level of the country in terms of the Wholesale Price Index, the discussion ensues in the following section. In the context of the operation of international transmission mechanism, spreading inflation making it a world phenomenon, a phenomenon which became very prominent in the mid-seventies when the first Oil price hike took place, it is imperative to analyse the effect of Energy, import, and export prices along with Balance of Payments—Current Account deficit on the domestic price level. The inflation therein was mainly of an import-cost push type, and was fuelled by excessive monetary expansions, economic stagnation, and inflationary expectations leading to a deterioration in the terms of trade and a growing Current Account deficit. Obviously India was no exception to the world phenomenon.

The following equations are regressed in the context of domestic inflation to assess the impact of rising energy prices coupled with export and import prices, current account deficit, money supply, and the real national income, etc., on the general price level of the country.

\[
WPI = a_0 + a_1 E_p; \\
WPI = a_0 + a_1 E_p + a_2 M_s; \\
WPI = a_0 + a_1 E_p + a_2 M_s + a_3 Y; \\
WPI = a_0 + a_1 O_M; \\
WPI = a_0 + a_1 IUVI + a_2 EUVI; \\
WPI = a_0 + a_1 IUVI + a_2 EUVI + a_3 M_s; \\
WPI = a_0 + a_1 IUVI + a_2 E_p + a_3 M_s + a_4 Y \\
WPI = a_0 + a_1 IUVI' + a_2 E_p + a_3 M_s + a_4 Y, \text{ and }
\]
WPI = α + α DF

Where,

WPI = Wholesale Price Index;
E = Energy Price Index;
M = Money Supply Index;
Y = NNP Index at constant prices;
OMB = Oil Import Bill Index;
IUVI, IUVI' = Import Unit Value Indices with and without petroleum products;
EUVE = Export Unit Value Index;
DF = Current Account Deficit Index, and
α, β, γ are the constants.

Empirical Results

The results of estimation of equations (1) to (9) in the Pre, Post, and Pre and Post-Energy Crisis periods are presented in the following paras. Autocorrelation and multicollinearity of a high degree are not detected in the estimated equations.

Pre and Post-Energy Crisis

\[
\begin{align*}
\text{WPI} & = 34.55 + 0.5755* E \\
& \quad (34.26) P \\
\bar{R}^2 & = 0.97, F = 1173.43, DW = 2.29.
\end{align*}
\]

\[
\begin{align*}
\text{WPI} & = 35.85 + 0.2662** E + 0.3624* M \\
& \quad (2.21) P (2.59) S \\
\bar{R}^2 & = 0.97, F = 736.02, DW = 2.36.
\end{align*}
\]

\[
\begin{align*}
\text{WPI} & = 32.99 + 0.3145** E + 0.1070 M - 0.3613* Y \\
& \quad (3.07) P (0.75) S (-3.16) \\
\bar{R}^2 & = 0.97, F = 694.79, DW = 2.23.
\end{align*}
\]

\[
\begin{align*}
\text{WPI} & = 89.50 + 0.0559* OMB \\
& \quad (13.11) \\
\bar{R}^2 & = 0.88, F = 171.95, DW = 1.98.
\end{align*}
\]

NOTE: The import and export unit value indices for one year (1984-85) have been extrapolated, since the data for the other variables used in the regression analysis were available up to 1985.
\[ \text{WPI} = 60.33 + 0.3846^{**} \text{IUVI} + 0.1908 \text{EUVI} \]
\[ (1.10) \quad (0.38) \]
\[ R^2 = 0.42, \quad F = 9.74, \quad DW = 2.18. \]  
\[ (5) \]

\[ \text{WPI} = 33.32 + 0.1433^{*} \text{IUVI} + 0.0903^{***} \text{EUVI} \]
\[ (3.00) \quad (1.34) \quad (34.49) \]
\[ R^2 = 0.97, \quad F = 753.74, \quad DW = 2.34. \]  
\[ (6) \]

\[ \text{WPI} = 9.04 + 0.0520^{**} \text{IUVI} + 0.1938^{**} \text{EUVI} + 0.2964^{**} \text{M} \]
\[ (2.07) \quad (1.73) \quad (1.84) \quad (-1.72) \]
\[ R^2 = 0.97, \quad F = 603.19, \quad DW = 2.22. \]  
\[ (7) \]

\[ \text{WPI} = -13.71 + 0.1193^{***} \text{IUVI} + 0.2405^{*} \text{EUVI} + 0.2157^{***} \text{M} + 0.2377^{***} \text{Y} \]
\[ (1.36) \quad (2.21) \quad (1.34) \quad (-1.36) \]
\[ R^2 = 0.97, \quad F = 442.84, \quad DW = 2.09. \]  
\[ (8) \]

\[ \text{WPI} = 71.39 + 0.3782 \text{DF} \]
\[ (7.42) \]
\[ R^2 = 0.69, \quad F = 55.19, \quad DW = 1.79. \]  
\[ (9) \]

Equation (1) explains variations in the general price level in terms of Energy Prices during the period 1960-85. The regression coefficient of \( E_p \) is statistically significant at 1 percent level with the expected sign. \( R^2 \) explains 97 percent of the total variation in WPI.

Equation (2) incorporates Money Supply along with Energy prices. Both have statistically significant regression coefficients with the expected signs. \( M_s \) has a larger slope coefficient than \( E_p \). \( R^2 \) accounts for 97 percent of the total variation in the dependent variable.

Equation (3) regresses \( E_p \) and \( M_s \) together with \( Y \) on WPI. Only the regression coefficients of \( E_p \) and \( Y \) are statistically significant at 1 percent level. \( E_p \) contributes to the rise in general prices, while NNP at constant prices has a deflationary impact.

**NOTE:** *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level, *** at 10 percent level, and **** at 15 percent level. Figures in parantheses denote the t-ratio.

Ranganadhachary, A.V., "Inflation in India: A Monetarist - Structuralist Approach", Forward by Brahmananda, P.R.
In equation (4) the Oil Import Bill Index has been taken as the explanatory variable. It has a statistically significant regression coefficient at 1 percent level with the expected sign. $R^2$ accounts for 88 percent of the variation in WPI.

Equation (5) shows the influence of import and export prices on the price level. $R^2$ explains 42 percent variation in the general price level. When the relative influence of import and export prices on the domestic price level is considered, as can be expected import prices exert a greater influence as only the regression coefficient of IUVI is found to be statistically significant.

When Money Supply is taken together with the two foreign trade price indices (eqn.6), then all the three variables have statistically significant regression coefficients, and $R^2$ explains 97 percent variation in WPI.

Equation (7) is regressed taking IUVI, $E_P$, $M_s$, and $Y$ as the explanatory variables. These have statistically significant regression coefficients at 5 percent level and they account for 97 percent variation in the price level and the signs of the coefficients are as expected.

Equation (8), on the other hand, is regressed by taking $E_P$, $M_s$ and $Y$ alongwith import prices (excluding petroleum products) as the explanatory variables. The coefficient of $E_P$ is found to be significant at 1 percent level, while those of IUVI, $M_s$ and $Y$ are significant at 10 percent level. $R^2$ explains 97 percent variation in the general price level.

Equation (9) is estimated by taking the Current Account Deficit Index as the regressor. The coefficient has the expected sign and is statistically significant at 1 percent level. The variable explains 69 percent variation in the price level. Further, the equations (1 thro' 9) are significant in the said period.
From the analysis in the foregoing paras it follows that:

- Energy prices have a significant impact on WPI during the period 1960-85. Energy Prices when taken together with Money Supply, both significantly affect the general price level. But with the inclusion of NNP at constant prices, it is only Energy prices and Net National product which emerge as significant variables, and thus are largely responsible for variations in the Wholesale Price Index.

- The Oil Import Bill is observed to be significantly influencing WPI in the period under study. As far as the influence of Import and Export prices on the domestic price level is concerned, Import prices performed better than the Export price variable. When Money Supply is taken together with the foreign trade price indices, it is Money Supply and Import prices including petroleum products which are more dominant than the Export prices. With the inclusion of the variable Energy Prices, it is Import prices, Energy prices along with Money Supply and the real NNP which predominantly effect the price level. In the case of Import prices without petroleum products along with Energy prices, Money Supply, and NNP, it is Energy prices and NNP which significantly effect the Wholesale Price Index as compared to Money Supply and Import prices without petroleum products.

- As can be expected, the Current Account deficit has a significant contribution to the rising Wholesale Price Index.

Thus, we find that Energy Prices, Export, and Import prices (with and without petroleum products), Current Account Deficit, together with Money Supply and real Income have a predominant impact on the general price level of the country during the period consisting of two and a half decades.
Pre-Energy Crisis

\[
\text{WPI} = -21.07 + 1.16 \times E
\]
\[(22.03) \quad \text{(1)}\]
\[R^2 = 0.97, \ F = 485.13, \ DW = 2.46.\]

\[
\text{WPI} = -20.13 + 1.14 \times E + 0.0152 \times M
\]
\[(3.24) \quad \text{P} \quad (0.07) \quad \text{s}\]
\[R^2 = 0.96, \ F = 220.62, \ DW = 2.12.\]

\[
\text{WPI} = -17.38 + 1.16 \times E + 0.0235 \times M - 0.0195 \times Y
\]
\[(3.01) \quad \text{P} \quad (0.10) \quad \text{s} \quad (-0.18)\]
\[R^2 = 0.96, \ F = 132.88, \ DW = 1.98.\]

\[
\text{WPI} = 22.79 + 0.6699 \times O_{MB}^I
\]
\[(7.76) \quad \text{(4)}\]
\[R^2 = 0.83, \ F = 60.23, \ DW = 1.91.\]

\[
\text{WPI} = 16.83 + 1.54 \times EUVI + 0.7242 \times IUVI
\]
\[(6.37) \quad (2.29) \quad \text{(5)}\]
\[R^2 = 0.93, \ F = 76.93, \ DW = 1.85.\]

\[
\text{WPI} = 9.32 + 0.2191 \times EUVI + 0.1840 \times IUVI + 0.5313 \times M
\]
\[(0.84) \quad (0.80) \quad (5.65) \quad \text{s} \quad (6)\]
\[R^2 = 0.97, \ F = 220.49, \ DW = 2.19.\]

\[
\text{WPI} = -7.87 + 0.2706 \times EUVI + 0.5077 \times M + 0.3188 \times M - 0.0087 \times Y
\]
\[(2.63) \quad (1.30) \quad \text{P} \quad (1.45) \quad \text{s} \quad (-0.07)\]
\[R^2 = 0.97, \ F = 166.95, \ DW = 2.04.\]

\[
\text{WPI} = -6.32 + 0.2796 \times EUVI + 0.4463 \times M + 0.3674 \times M - 0.001 \times Y
\]
\[(2.76) \quad (1.39) \quad \text{P} \quad (0.65) \quad \text{s} \quad (-0.04) \quad (8)\]
\[R^2 = 0.97, \ F = 174.73, \ DW = 1.96.\]

\[
\text{WPI} = 76.11 + 0.0460 \times DF
\]
\[(0.33) \quad \text{(9)}\]
\[R^2 = 0.08, \ F = 0.12, \ DW = 2.58.\]

\[\text{NOTE} : \ *\text{Statistically significant regression coefficients}\]
\[\text{at 1 percent level} \quad ** \text{at 5 percent level}; \ *** \text{at 10 percent level}, \text{and} \ **** \text{at 15 percent level.}\]

\[\text{Figures in parantheses denote the t-ratio.}\]
Equation (1) shows that in the Pre-Energy Crisis period, the variable Energy prices has a statistically significant regression coefficient at 1 percent level with the positive sign. $R^2$ explains 97 percent of the total variation in WPI.

In equation (2), with the inclusion of $M_s$ together with $E_p$ as the explanatory variables, only the regression coefficient of the variable $E_p$ is statistically significant, and $R^2$ explains 96 percent variation in the general price level.

Equation (3) again reveals that it is only the regression coefficient of $E_p$ which is statistically significant at 1 percent level. $M_s$ and $Y$ do not emerge as significant variables. $R^2$ accounts for 96 percent variation in the dependent variable.

In the context of the crude Oil and petroleum product import bill, which is largely responsible for the rise in Energy prices followed by a rise in the prices of administered energy commodities viz., Coal, Oil, and Electricity the impact is significant on WPI, as $O_{MB}$ has a statistically significant regression coefficient at 1 percent level. $R^2$ explains 83 percent of the total variation in WPI.

In terms of Export and Import prices, the impact on WPI is also significant as both the variables have statistically significant regression coefficients. EUVI has a larger slope coefficient than IUVI. $R^2$ accounts for 93 percent of the variation in WPI (eqn.5).

When $M_s$ is regressed along with EUVI and IUVI on WPI, it is observed that only the regression coefficient of $M_s$ is statistically significant at 1 percent level with $R$ explaining 97 percent variation in the general price level (eqn.6).

In equation (7), with IUVI, $E_p$, $M_s$, and $Y$ as the independent variables, the regression coefficients of the former three are significant with $E_p$ having the largest
slope coefficient and \( R^2 \) accounting for 97 percent of the variation in WPI.

In equation (8), IUVI without petroleum products is regressed along with \( E_p \), \( M_s \), and \( Y \). Again, only the regression coefficients of \( E_p \), \( M_s \), and IUVI are statistically significant with \( R^2 \) explaining 97 percent variation in the regressand. Also, \( E_p \) has the largest slope coefficient.

In equation (9), the Current Account Deficit Index has the expected sign, but its regression coefficient does not emerge as statistically significant. It may also be added that the equations discussed above are found significant.

It can thus be inferred from the foregoing analysis that:

- During the period 1960-73, Energy prices emerge as a very dominant variable engendering variations to a large extent in the general price level. The Oil and petroleum product import bill is also found to be positively influencing the price level.

- As far as Export and Import prices are concerned, the impact on WPI of the former is greater than that of the latter. When Energy prices, Money Supply, and NNP are taken up along with Import prices (with and without petroleum products), then Energy prices emerge as the most significant variable followed by Money Supply and Import prices (with and without petroleum products).

- The Balance of Payments Current Account Deficit is found positively correlated to WPI but is not significant as to influence the latter.

Hence, it is apparent from the preceding analysis that Energy prices, Import Unit Value Index (with and without petroleum products), and crude Oil and petroleum product imports together with Money Supply have a significant impact on the general prices level of the country in the reference period.
Post-Energy Crisis

WPI = 64.02 + 0.5001* E
     \( \text{R}_2^2 = 0.97, F = 625.41, DW = 2.49. \) \( (1) \)

WPI = 64.96 + 0.3325* E + 0.1964*** M
     \( \text{R}_2^2 = 0.97, F = 367.35, DW = 2.27. \) \( (2) \)

WPI = 95.56 + 0.3309* E + 0.2567*** M - 0.1226 Y
     \( \text{R}_2^2 = 0.97, F = 234.56, DW = 2.15 \) \( (3) \)

WPI = 139.65 + 0.0393* O
     \( \text{R}_2^2 = 0.92, F = 109.00, DW = 2.31. \) \( (4) \)

WPI = 226.43 + 0.0995 EUVI + 0.0515 IUVI
     \( \text{R}_2^2 = 0.22, F = 0.02, DW = 2.50. \) \( (5) \)

WPI = 60.06 + 0.1039**** EUVI + 0.1101** IUVI + 0.5795* M
     \( \text{R}_2^2 = 0.97, F = 150.78, DW = 1.99. \) \( (6) \)

WPI = 97.51 + 0.0182 IUVI + 0.2931* E + 0.3127*** M
     \( \text{R}_2^2 = 0.97, F = 164.37, DW = 1.90. \) \( (7) \)

WPI = 99.59 + 0.0481 IUVI + 0.3040** E + 0.1629 Y
     \( \text{R}_2^2 = 0.97, F = 98.93, DW = 2.01. \) \( (8) \)

WPI = 150.43 + 0.2507* DF
     \( \text{R}_2^2 = 0.85, F = 61.25, DW = 1.71. \) \( (9) \)

**NOTE:** *Statistically significant regression coefficients at 1 percent level; ** at 5 percent level; *** at 10 percent level, and **** at 15 percent level. Figures in parantheses denote the t-ratio.
During the Post-Energy Crisis period, the variable Energy prices has a statistically significant regression coefficient at 1 percent level with the expected sign, explaining 97 percent of the total variation in the Wholesale Price Index.

In equation (2), with the inclusion of the variable Money Supply along with Energy prices, $R^2$ accounts for 97 percent variation in the price level. Both the regression coefficients are statistically significant, but $E_p$ has a larger slope coefficient than $M_s$.

In equation (3), the real NNP variable has been taken up together with $M_s$ and $E_p$. Only the latter two variables have significant regression coefficients, again with $E_p$ having a larger slope coefficient than $M_s$. The signs of the coefficients are as expected and the equation is statistically significant. $R^2$ explains 97 percent variation in the dependent variable.

In equation (4), when $O_{MB}$ is regressed on WPI, $R^2$ accounts for 92 percent variation in the regressand. $O_{MB}$ has a statistically significant regression coefficient with the positive sign.

In the context of Import and Export prices, none have significant regression coefficients (eqn.5). But when $M_s$ is regressed along with EUVI and variable IUVI on WPI, then $R^2$ explains 97 percent variation in the latter. $M_s$ has a statistically significant regression coefficient at 1 percent level, while IUVI and EUVI also have statistically significant regression coefficients.

In equation (7), it is IUVI, $E_p$, $M_s$, and $Y$ that are taken as the explanatory variables. Only $E_p$ and $M_s$ have statistically significant regression coefficients, with positive signs at 1 and 10 percent levels respectively. $R^2$ explains 97 percent variation in WPI.

Equation (8), yields similar results when $E_p$, $M_s$, and $Y$ are regressed together with Import Unit Value Index.
Finally, in equation (9) with the Current Account deficit Index taken as the independent variable, $R^2$ explains 85 percent variation in WPI. DF has a statistically significant regression coefficient at 1 percent level with a positive sign. All the equations (1 through 9) as discussed above are statistically significant.

Thus the analysis in the preceding sections sums up as follows:

- Over the period 1960-85, Energy prices and Money Supply predominantly affect the Wholesale Price Index. But with the inclusion of real NNP, only Energy Prices and the latter are found to be having an impact on the price level. The crude oil and petroleum product Import Bill also emerges as a significant variable engendering adverse movement in the general price level to a considerable extent. Import prices included petroleum products along with Export prices and Money Supply are also found to be responsible for influencing the price level, with Import Prices exerting a greater influence than Export Prices. In the case of Import prices (without petroleum products) together with Energy Prices, Money Supply, and real Net National Product, their impact on WPI is significant. Also the Balance of Payments—Current Account Deficit has a preponderant role to play in adding to the inflationary rise in prices over the period.

- During the Pre-Energy Crisis period, Energy Prices have significant impact on WPI as compared to Money Supply and the real Net National Product. The Oil import bill is found to be positively and highly correlated to the Wholesale Price Index, having a significant impact on the latter in the reference period. With regard to Export and Import prices, it is the former which is more dominant than the latter. When Import prices (with and without petroleum products) are taken up along with Energy prices, Money Supply,
...,with the exception of NNP, all the variables are found to effect WPI in a significant way. With regard to the Balance of Payments Current Account Deficit, its impact on WPI is not significant.

In the Post-Energy Crisis period, Energy Prices predominantly affect the price level followed by Money Supply. The Oil import bill is also observed to have significant impact on the Wholesale Price Index. In the context of Import prices (with petroleum products), these significantly affect the general price level followed by Export Prices. Finally Current Account Deficit of the Balance of Payments is found to be having an adverse impact on the Wholesale Price Index in the period subsequent to the Oil Price hike of 1973-74.

Summing up the empirical study in this chapter, it is observed that energy consumption in totality and component-wise viz., electricity, oil, coal and non-commercial energy in order of significance, alongwith trade balance/balance of payments - current account deficit and gross domestic capital formation are found to have a predominant impact during 1973-85 on the Gross National Product of the country. Per capita commercial energy consumption influenced per capita national income more in the Pre than in the Post-Energy Crisis period, which is attributed to the low growth rate of energy consumption per capita during the latter period.

The favourable net barter and income terms of trade during 1960-73, are adversely affected by the import prices (with petroleum products) as the same emerged more significant than either the quantity or price of exports. The import prices with petroleum products; the oil and petroleum product import bill coupled with the deteriorating terms of trade are again found to have an adverse impact on the current account deficit, which is more pronounced during 1973-85 than during 1960-73.
The empirical study of the period 1960-85 that rising energy prices and monetary expansions followed by import prices with petroleum products, export prices, and current account deficit etc., have markedly added to the inflationary spiral in the domestic economy, thereby implying that the 'Energy Crisis' has aggravated the adverse impact on the balance of payments, and hence the economy of India as supported by theoretical and empirical analysis.