CHAPTER 6

IMPACT OF OIL SHOCKS ON INDIAN ECONOMY

The chapter is aimed to make an attempt to forecast the likely impact of oil market shocks on different sectors (agriculture, industrial, construction, services) of the economy and on important macro economic indicators in a general equilibrium framework. The chapter also aims to focus on the impact of oil shocks on BOP of our country and the possibility of export led growth to solve the likely BOP problem.

6.1 Introduction

The hydrocarbon sector has been on the list of sectors where price deregulation has been considered. This sector is one of the key infrastructure industries as it fulfills a large part of the demand for commercial energy. The government administered prices in this sector and there was cross subsidization within the sector. The administered domestic prices were fixed by the government so that its revenue objectives as well as objectives relating to consumption of energy in different segments of the economy are met. The Indian oil industry has been deregulated, the oil prices decontrolled. The government pats it back for pushing through the reform agenda set out in 1997. With 80% import dependence, we cannot afford to divorce domestic retail prices from international oil prices. Buying crude at high prices and selling products processed from that very crude at artificially low retail prices is just not sustainable. Prices have to reflect costs. Second, price volatility in international oil markets is today a norm, rather than an exception. There are too many factors influencing oil prices- Organization of Petroleum Exporting Countries (OPEC) decisions; conflicts in the Middle East; US crude stock levels; the harshness of the European winters; and so on and so forth.
The erstwhile-administered pricing mechanism (APM) protected the Indian consumer from the ups and downs in the global markets through the oil pool. The pool absorbed the volatility and kept retail prices stagnant. In April 2002, however, the APM for the oil industry was dismantled. The oil pool is defunct. Distilling the facts, it follows, that eventually domestic retail pieces will start reflecting international oil prices. The best way to analyze it is to consider it in two distinct segments refining and marketing, even while considering prices offered by one single company. The refining division would procure crude from international markets; process it; and transfer products to the marketing division at the refinery gate. Margins in the refining industry are embedded in the inherent crude and product price differentials in international oil markets. The transfer price for products at the refinery gate thus reflects international product prices, what is typically referred to as the import parity price of that product. Deregulation to this effect, i.e., affecting refinery purchases and receivables at import parity prices actually took place way back in April 1998 itself.

This refinery gate price, essentially, becomes the base price for the final consumer. Added to this are distribution costs; excise duties; sales tax and other local levies; and finally the marketing margin. The only variable element in this entire list of mark ups is the marketing margin, and hence, it becomes one of the most crucial elements in price fixation in a deregulated environment. Under the APM, marketing margins were decided by the government in relation to the net worth of the companies, and reimbursed through the oil pool. It is this system, which changes with the announced full deregulation of the industry. In a deregulated environment, market prices would be driven by competition. Oil companies vie for market share through aggressive stands on marketing margins. The long and short of it- the Indian consumer should reconcile himself to frequent adjustments (either way, upwards and downwards). As international oil markets become tight, global prices would rise, and so would domestic retail prices. By October
2007 prices had reached $92/ barrel and reached a high of $99.29/barrel for December futures in New York on November 21, 2007 (://en.wikipedia.org/wiki/oil/oil_price_increases_of_2004-2006). Our study is gaining significance and importance as it becomes all the more important to see that consequent of global price hike, how do changes in domestic prices of petroleum products influence the overall price level and hence the whole range of economic performance? The present study have examined the impact of oil shocks on five important macro variables viz. GDP, inflation as measured through WPI, employment, wages and BOP using distributed lag model which produces excellent inference about the values of $\alpha$ and $\beta$ (t statistics in parentheses).

6.2 Oil Importing Countries

High oil prices affect all oil-importing countries but they can hurt developing countries more than others. Developing countries suffer more from an oil price hike, as they are more reliant on their energy-intensive manufacturing sectors to spur economic growth. There are often no alternatives to oil. In developing countries an increase in the oil import bill, as a result of a price hike, can lead to a stabilizing deterioration in the trade balance and feed inflation. Oil consumption in the developing countries has increased rapidly over the last three decades, as a result of robust GDP growth, urbanization and a substantial increase in motor vehicle ownership. The replacement of non-commercial energy sources by modern fuels, such as substitution of LPG for fuelwood in cooking, has also contributed to the rapid rise in oil demand in the developing world. On average, oil-importing developing countries use more than twice as much oil to produce one unit of economic output, as do OECD countries (IEA, 2000). Developing countries may also be disadvantaged by deterioration in their terms of trade. Higher oil prices directly increase the foreign exchange cost of imported oil. The domestic price of oil products also rises, which increase
the production costs for all industries. This price increase can be, and often are, magnified by adverse currency adjustments, which lead to a drop in international competitiveness and so in exports. Price subsidies, a common policy in developing countries to protect the poor, can obscure but do not neutralize the effect of oil price increases. These subsidies become more costly as oil prices go up, thus weakening the government budget. The Indian oil pool account, which managed the balance between domestic and international oil prices, has been drained by the huge cost of oil imports.

The OPA (oil pool account) was managed by OCC (Oil Coordination Committee, Ministry of Petroleum & Natural Gas, Government of India) and was maintained to provide uniform and stable prices by balancing high and low input costs. The private sector and foreign investors were entitled to the global price of crude oil. The two national oil companies, the ONGC (Oil and Natural Gas Corporation) and the OIL (Oil India Limited) were entitled to 77.5% of the FOB (free-on-board) price prevailing in the world market. Petroleum refineries, however, pay the landed cost of crude with duties added on. The oil pool account got 22.5% of the landed cost of crude oil (The Financial Express, 13 March 2000).

The pool account was meant to be self-providing over a period of time. The system helped the government to administer the prices of petroleum products according to socio-economic requirements. Hardening of international crude oil prices, an explosive growth in the consumption of subsidized petroleum products and the APM (administered price mechanism) were the main contributors to any deficit in the OPA. The APM was based on the retention concept under which refineries, marketing companies, and pipelines were compensated operating costs and allowed a return of 12% post-tax net worth.

The efficiency of the APM depended entirely on the ability of the system to keep the OPA in balance. Until the late eighties, the account was in surplus. However, the nineties saw a bludgeoning deficit, and by 1997,
the oil pool account recorded a deficit of $5 billion, thereby leaving no other option for the Government of India but to issue oil pool bonds. But, with international crude prices falling as low as $11 per barrel in early 1999, the OPA showed a minor surplus and this resulted in the oil pool bonds being redeemed. However, the situation was reversed in recent times with the crude prices touching a high and the oil pool once again showing a deficit (The Financial Express, 13 March, 2000). The oil pool account was partially abolished in 1998 and oil companies were allowed to fix their own prices for the following products:

1. Naphtha
2. Furnace Oil
3. Low Sulphur High Stock Fuel
4. Bitumen
5. Raw Petroleum Coke
6. Calcified Petroleum Coke

However, the prices for the following petroleum products were still kept under the purview of APM i.e. Administrative Price Mechanism, which was also dismantled w.e.f. April 2002:

1. Petrol
2. Diesel
3. SKO (Superior Kerosene Oil)
4. LPG

India’s oil pool account was Rs 126 Billion in 2001. The government tried bonds aggregating Rs 9000 crore in 2002 to state owned oil companies to liquidate a substantial part of their dues in the oil pool account and cover the oil pool account deficit. (The Hindu, April 02, 2002).
The estimated net deficit of India's oil pool account was around Rs. 14,500 crores at the end of 2002. There has been a huge oil pool deficit of over Rs 75,000 crores reported in 2006. Oil prices have shot up from slightly over $33 a barrel (brent crude) in April 2004 to $73.66 in Sept 2006. With prices of crude oil spiraling beyond $70 a barrel, India's tangled policy of taxes and subsidies is weaving a complex web around the petroleum sector. The government in the mid 2006 increased the prices of diesel and petrol without touching LPG and kerosene so as to avoid impact on the population below the poverty line. This has only partially offset the losses to the oil companies. The result is whopping strain on government finances. The government of India has worked out a convoluted and patently untenable system for offsetting the losses being incurred by the public sector oil marketing companies (OMC's). Part of the seepage is to be absorbed by issuing oil bonds worth Rs 28,300 crore, some by the upstream companies- Oil and Natural Gas corporation (ONGC), Gas Authority of India (GAIL) and Oil India- which are being forced to shell out Rs 24,000 crore as subsidy to OMC's since they stand to benefit from the higher oil prices (Jishnu Latha, 2006).

The situation however is getting messy. For one, the first tranche of oil bonds has not been issued though parliament had approved bonds worth Rs 14,150 crore in the supplementary demand for grants. Special bonds worth Rs 11,500 crore issued by the government earlier have found no takers in the secondary market. Financial institutions and banks are not keen on them because oil bonds cannot be considered part of their statutory liquidity ratio (SLR). Nor do they qualify for refinance from the RBI (Jishnu Latha, 2006). Thus increase in oil price since 2006 will impact the growth in the GDP and have a cascading effect on the prices of all commodities

Therefore the adverse effects on oil-importing developing countries are particularly pronounced. If the oil price level as of today were sustained
for longer period, several oil-importing developing countries would register significant deficits in their trade balances. India suffered badly during global oil shocks and during the gulf war its oil import bill shot up by 50 percent. Present geopolitical uncertainties both in our immediate neighborhood and in the Middle East have been creating oil price fluctuations.

**Experience of the 70's**

The increase in the world price of oil during the 1970's consisted of two shocks when prices went up threefold between 1973 and 1974 and when prices nearly doubled between 1978 and 1980. The oil importing developing countries had to increase their external borrowing to adjust to the price increases. The additional borrowing increased from 2.3% of GNP to as much as 3.4% of GNP for these countries between 1978 and 1980 (*World Bank, 1980*). Much of the borrowing in such cases is on short-term basis.

The increase in short-term borrowing was a source of concern as this implied higher debt service ratios (*World Bank, 1981.b*). A study by the World Bank (*World Bank, 1981.c*) analyzed the adjustment to external shocks by 28 developing countries and the newly industrialized countries (NICs). The findings of the study implied that the quadrupling of oil prices in 1974 caused terms of trade for the non-OPEC developing countries to deteriorate. These countries adopted deflationary policies to safeguard their balance of payment (BOP), which might have ultimately contributed to the 1974-75-world recession. Pricing of petroleum products, thus, becomes a very important issue in the face of external shocks especially for developing countries like India.

**6.3 Trends in Global Oil Prices**

International crude oil prices experienced a sharp increase in the recent period. From a 25-year low of US$ 11 per barrel in February 1999, the reference price of crude oil used by the International Monetary Fund
(IMF) increased to a peak of almost US$ 35 per barrel in the first week of September 2000. All oil importing countries faced the specter of this “oil shock” and India, being a net oil importer, was no exception. Although the burden of the price increase at the international market was not fully passed on to domestic consumers in India, the combined oil pool deficit exerted pressure on government finances, affecting the macroeconomic outlook and inflation in the ensuing year.

The world economy has witnessed four bouts of oil price shocks in the past thirty years, viz, 1973-74, 1979-80, 1990 and the recent one in 1999 (Bhattacharya and Bhattacharya, 2001,pp.4735-4741). Oil prices have been steadily rising from mid 2001. The spiraling of global prices of crude oil from-$30/bbl in January, 2004 to a peak of $39/bbl in June 2004 (Brent Crude)- is being attributed to a number of factors that include growth of the global economy, high demand from countries like the US, China and India, supply side worries due to instability in West Asia and the terrorist attacks in Saudi Arabia (which resulted in $4-8/bbl ‘terror premium’ in crude prices). These factors and OPEC’s low supply flexibility from current levels of production could result in high crude prices in the short to medium term. As of October 2004, the West Texas Intermediate was trading at $53.13 per barrel, up by 75% from a year ago (FICCI, 2004). By August11, 2005, the price of standard crude oil had been above $60/barrel for over a week and a half. A record price of $75.35 was reached, due in part to Iran’s nuclear crisis, on April 21, 2006. While oil prices were considerably higher than a year ago, they were still roughly $ 14 from exceeding the inflation-adjusted “peak of the 1980, when prices were over $90 a barrel in today’s prices”. Therefore there was an uncontrolled change in the price of oil in most times since 2005 to 2006 with some high and downs but settled at around $50-$60/ barrel in the early 2007. But this was not enough so it raised more above the price of $92/ barrel in late 2007 and ended up at about $99.29 in NYMEX futures in November end of 2007.

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This clearly shows that oil prices has been increasing passing years and the price tag of $100/barrel is clear to cross in the year 2008. Perhaps the price may increase above that if there are political conflicts in Middle East or any more of OPEC’s production cuts (OILSIM, 2007).

Figure 6.1

The above discussion is on the question of adjustment of an economy to external shocks.

In this chapter we provide an assessment of the implications of a rise in domestic petroleum product prices on the macro economic scenario for India.
6.4 Impact of Oil Prices on Macro Economic Variables

Table 6.1: Selected Regression Results for GDP from 1970-71 to 2004-05

<table>
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<th>Independent variables</th>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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<td>( Y_{t-1} )</td>
<td>0.393</td>
<td>0.372</td>
<td>0.604</td>
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<td>( Y_{t-3} )</td>
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<td>(4.876)</td>
<td>(1.476)</td>
<td>(1.570)</td>
<td>(3.492)</td>
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Figures in parentheses are t values

a) Impact of Oil Prices on GDP

Instead of simulated data and taking actual numbers, the results are calculated by regressing each year’s growth rate in GDP i.e. \( (y_t) \) on four lags of growth rate of GDP and four lags of the percentage change in the average weighted price of mineral oil \( (O_{t,j}) \). When this regression is estimated for time-series data from 1970-71 to 2004-05 it becomes very valuable to examine table 6.1, which summarizes five of the regression results of GDP. The variables used in the estimation process are as follows:

\[
\begin{align*}
Y_t &= \text{Growth rate of GDP (dependent variable)} \\
Y_{t-1}, \ldots, Y_{t-n} &= \text{lags in growth rate of GDP} \\
O_t &= \text{percentage change in mineral oil price index} \\
O_{t-1}, \ldots, O_{t-n} &= \text{lags in percentage change in oil prices}
\end{align*}
\]

Equation 1) \( y_t = f (y_{t-1}, o_{t-1}) \)

From equation 1), it is seen that there is a strong adverse impact of oil prices on our country’s current GDP. The previous year’s GDP has a positive impact on our current GDP. In other words holding the oil prices constant, a 1% increase in GDP will lead to one-year lag impact of .39% increase on the current GDP with a high degree of statistical significance at 5% level. Similarly holding one year lag in GDP as constant, a 1% increase in oil prices will lead to one-year lag adverse impact of -.102% on \( y_t \). Here one-year lag in oil prices do have a strong and statistically significant effect
on the economy, with a t-statistic of −2.14. The value of R Square is .234, which shows 23% of the variation in our current GDP rate of growth is due to these two variables. The value of adjusted R² is .178.

Equation 2) \( y_t = f(y_{t-1}, y_{t-2}) + (O_{t-1}, O_{t-2}) \)

In the second regression equation, the effect of one year GDP lag is positive on \( y_t \) and also statistically significant but becomes negative after two years with coefficient of -0.230, which is strong but not statistically significant. The coefficient \( O_{t-1} \) has a t-statistic of −1.27. The estimated coefficients of oil prices imply that the increase in oil prices negatively impact the level of GDP in the later two years. The value of coefficients \( O_{t-1} \) is statistically significant at 10% but \( O_{t-2} \) is not statistically significant. The value of R Square and adjusted R Square is .368 and .248.

Equation 3) \( y_t = f(y_{t-1}, y_{t-2}, y_{t-3}) + (O_{t-1}, O_{t-2}, O_{t-3}) \)

Here \( y_t \) and \( y_{t-1} \) are moving in the same direction but the impact of \( y_{t-2} \) is negative and quite strong but not statistically significant. The negative impact gets neutralized and becomes positive again in the third year. There is a lag impact of oil prices, which is negative for 2 years, and the adverse impact gets neutralized in the third year. The negative impact of oil price lags is not so strong and not statistically significant. The value of R2 is .553, which is higher than Equation 2 because the addition of more independent variables to the regression equation can never lower R Square and is likely to raise it. This means that 55% of the variation in \( y_t \) is due to these independent variables where the positive impact of one year lag in GDP is more profound than the negative impact of oil prices. The value of adjusted R2 is .374.

Equation 4) \( y_t = f(y_{t-1}, y_{t-2}, y_{t-3}, y_{t-4}) + (O_{t-1}, O_{t-2}, O_{t-3}, O_{t-4}) \)

This Equation includes eight explanatory variables. The lag impact of GDP have a strong positive effect and statistically significant (at the 10%
level) on current growth rate of GDP in the first year but this lag impact becomes negative in the fourth year, but not statistically significant. It is expected that, other things being equal, increases in the percentage of average oil price index will lower the growth rate in GDP through its lag impact. The results are consistent with this notion, since the regression coefficient of $O_{t-1}$ is negative and significant. Thus, it is inferred that oil prices have a strong and statistically significant effect on the economy, with a t-statistic of $-2.10$. Finally, more lag variables of oil prices are entered to account for the effect of the rate of oil price changes. This negative lag impact of oil prices is there till four years but is less strong and less statistically significant because the impact is getting less as it spreads over the years. The value of $O_{t-3}$ is positive which shows that the negative impact is getting neutralized but it again regains its negative lag impact in the fourth year. While the results are generally good with of R Square is .654 but the value of adjusted R2 has decreased to .347. Clearly the value of corrected R2 gives a more accurate picture of this particular equation, which shows that the addition of new variables does not fit well in the model.

Equation 5) $y_t = f (O_t, y_{t-1})$

The impact of current oil prices i.e. $O_t$ is positive but negligible on $y_t$ and also statistically insignificant so we should not bother about its coefficient's sign. This means that the effect of one-year lag in GDP is more as usual, as the coefficient of $y_{t-1}$ is positive, strong and statistically significant. This shows that the lag impact of oil price is more profound rather than the current impact.

As figure 6.2 shows the increase in oil price in 1973-74 leads to decrease in GDP in 1975–76 from 22 percent to 17.71 percent and when oil prices came down in 1975-76, our GDP started increasing in 1976-77. Similarly increase in prices in 1990-91 reduced the GDP growth rate in
oil prices came down in 1975-76, our GDP started increasing in 1976-77. Similarly increase in prices in 1990-91 reduced the GDP growth rate in 1991-92 and 1992-93. In 1996-97 and 2000-01 the increase in oil prices again lowered the GDP rate till 2 years. Thus the figure shows that the increase in oil prices has a negative lag impact on the growth rate of GDP.

Figure 6.2

As figure 6.2 shows the increase in oil prices or oil shocks have an effect on GDP growth rate which normally takes an effect after an incubation period varying between six to nine months but than has an effect on GDP growth rate lasting for almost two years. This can be seen from the oil shock, which took place in 1974-75 and had an effect on GDP growth rate. It caused the GDP growth rate to plummet in the next two years. Again during the oil shocks between 1979-80 and 1980-81, the growth rate of GDP showed a decline during the corresponding two years that followed the oil shock. We see a similar pattern during the oil price hike in 1990-91, which caused a noticeable dip in the growth rate of GDP. Again there is a similar effect of oil shocks, which occurred during 2000-01. The Indian economy, which displays a very robust character, has recovered from oil shock of 2000-01 and is showing up trend in the growth rate of GDP from
B) Impact of Oil Prices on Employment

Now we will be considering the results of employment by regressing each year employment on GDP value and one lag of the percent change in the mineral price of oil. The model is estimated using time-series data from 1970-71 to 2002-03. The variables used in the estimation process are as follows:

- $E_t$: employment of public and private sector (dependent variable)
- $Y_t$: GDP at factor cost
- $O_{t-1}$: one year lag in percentage change in oil prices

The symbol $\Delta$ is used to denote the process of differencing, i.e.,

$$\Delta y_t = y_t - y_{t-1}$$

Equation 6) \( E_t = f(Y_t, \Delta y_t, O_{t-1}) \)

Table 6.2: Selected Regression Results for Employment from 1970-71 to 2002-03

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Constant</th>
<th>$Y_t$</th>
<th>$\Delta y_t$</th>
<th>$O_{t-1}$</th>
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<tr>
<td>Employment</td>
<td>21.579</td>
<td>3.249E-06</td>
<td>.121</td>
<td>-3.06E-02</td>
</tr>
<tr>
<td>( T )</td>
<td>(12.503)*</td>
<td>(5.583)*</td>
<td>(1.158)</td>
<td>(-1.136)</td>
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</tbody>
</table>

* sig at 1% level
** sig at 5% level
*** sig at 10% level
The equation includes two explanatory variables. GDP is expected to have a strong positive effect on employment, since increase in gross domestic product imply increase in investment and thereby employment. As expected, the $y_t$ coefficient is positive and statistically significant at 1 percent level. But the effect of $y_t$ is not much or negligible. The change in GDP is added in an attempt to include (in a detailed manner) the time process involved as employment adjusts to growth in the economy. As expected the coefficient is positive but not statistically significant. The third variable included in the model is the lag in percentage change in oil prices i.e. $o_{t-1}$. Considering the earlier discussion, increase in oil prices leads to decrease in income and decrease in income lowers the employment rate. Therefore it is expected that, other things being equal, increases in oil prices will lead to lower the employment rate. The results are consistent with this notion, since the regression coefficient is negative but statistically insignificant, so no serious attempt should be made to evaluate the sign of its coefficient. The value or $R^2$ is .582. The value of adjusted $R^2$ is .530.

The employment growth rate up to 1978-79 was between 3.48 to 4.44 percent. During the oil shocks of 1979-80, which lasted up to 1981-82,
in 1979 the growth rate dropped from previous year 4.44 to negative growth of -1.97 percent during a period when their was 14.46% hike in oil prices in oil prices. In 1980-81, there was very severe oil shock and oil prices rose by 33.97 percent but there was a positive employment growth rate of 2.23 percent. Similarly in 1981-82 with oil price increase of 21 percent, the employment growth rate jumped to 4 percent. Thereafter, there has been a slide in the employment growth rate. This shows that the oil shocks have some effects but takes place after lapse of one to two years. We again see that during the oil shock of 1990-91 to 1991-92 the growth rate was 1.48 percent and 1.20 percent respectively. However a year after that, employment growth rate declined to less than unity as the investment in oil intensive industry declined. After the increase of almost 30 percent in between 1996-1998, the employment growth rate started declining and has remained negative till 2002-03. This is in spite of the fact that the GDP has looked up. This indicates that the industry primarily in service sector such as IT etc may have become more globally competitive. From the data it is apparent that oil shocks have effect on employment with lag effect of one to two years. But according to our regression results the impact of oil prices has been insignificant on employment rate. So we can also interpret the negative growth in employment as a result of recession in 1979-80 and 1998-99 or due to many other factors.

C) Impact of Oil Shocks on Inflation

In order to see the impact of oil shocks on inflation we have used time series data for the period 1970-71 to 2003-04. The explanatory variables are:

- \( P_t \): percentage Change in inflation rate as measured by WPI (wholesale price index of all commodities) (dependent variable)
- \( Y_t \): GDP at factor cost
- \( \Delta y_t \): Growth rate of GDP at factor cost

\vspace{1cm}

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In the first equation, GDP has a negligible effect on percentage change in WPI. But the growth rate in GDP has a strong and positive impact on WPI. Keeping other things being equal, increases in GDP rate leads to increase in inflation rate. The coefficient of GDP rate is statistically significant (at the 1 percent and 5 percent levels). As expected, the impact
of oil prices ($O_t$) is also positive, strong and statistically significant. The change and increase in oil prices tends to increase the WPI of all other commodities. Keeping other things being equal, a 1 percent increase in price of oil leads to .22 percent increase in WPI. The impact of $O_{t-1}$ is negative but very less i.e. -.070 and is also statistically insignificant. The results are generally good with $R$ Square of .774 and adjusted $R^2$ of .730.

The second equation (column 2) includes five explanatory variables. We have skipped the variable $O_t$ and $\Delta y_t$ here and added certain variables. The impact of $y_t$ is negligible and statistically insignificant. The impact of one-year lag in oil prices i.e. $O_{t-1}$ is negative but very less. It is -.076 and also statistically insignificant. The impact of index of agricultural production and industrial production is statistically insignificant. The only variable with statistically significant coefficient is food grains which has come out to be negative i.e. holding other things being equal, the increase in production of food grains lowers the inflation rate as expected. The value of $R$ Square is .328 and adjusted $R^2$ is .181, which is low, and the results of most of the coefficients have come out to be statistically insignificant.

In the third equation (column 3), one more variable along with all other variables as in equation 2 is present i.e. the change in GDP, in an attempt to include the time process involved as inflation rates adjust to change in GDP or growth rate of GDP. Only $O_t$ is skipped. As it is suspected that change in GDP affects inflation, the coefficient comes out to be positive and statistically significant. The coefficient of lag in oil prices has come out to be statistically insignificant. The results suggest that some improvement has taken place. $R$ Square has increased (as well as adjusted $R$ Square), as has the $F$ statistic. The impact of food grains as expected is negative and statistically significant at 5% level.

In the fourth equation if we take all the seven variables, the results have come out to be the best with highest $R$ Square of .857 and highest adjusted $R^2$ of .801. As the overall result depicts the growth rate in GDP,
and the change in oil prices have a profound positive and statistically significant effect on WPI. The impact of food grains is also significant but negative being consistent with the notion that increases in production of food grains will lower the inflation rate. The coefficients of all other variables like in other regression equations of WPI have come out to be insignificant. The value of R Square has considerably increased with the addition of $O_t$ that depicts the importance of $O_t$ in the equation of oil price impact on WPI. The standard error of regression has diminished to 2.69. At the same time each of the t statistics has increased somewhat in magnitude (in absolute value). For these reason the final specification is the best.

Figure 6.4

Impact of Oil Prices on Inflation

As can be seen from figure 6.4 the impact of oil prices on inflation is almost simultaneous. In the year 1973-74 there was a hike in oil prices and oil prices rose by 26.74 percent and the inflation rate rose by 20.34 percent. In the following year the increase in oil prices was the highest ever and peaked to almost 69 percent and the inflation rate rose by over 25 percent. Again in the year 1979-80 when oil prices increased by 14.6 percent the inflation rate touched 17 percent and in the following year when there was a
further increase in oil prices of almost 34 percent, there was a corresponding increase in inflation of 18.22 percent. We again see a similar effect in the oil price hikes between 1990 and 1993 when the inflation also increased in double digits. In the year 2000-01, when there was a steep increase in oil price of over 41.25 percent, the inflation jumped from 3 percent in the previous year to 6.25 percent in the year 2000-01. Therefore, the increase in oil prices has a direct impact on inflation with hardly any lag effect.

D) Impact of Oil Price Shocks on Wages

As wages respond to prices, in order to see the impact of oil price changes on wages the time series data from 1973-74 to 1997-98 has been collected. The variables used in the estimation process are as follows:

\[ W_t = f(P_t, O_t, O_{t-1}) \]

Where \( W_t \) = wages rate or percentage change in wages
\( P_t \) = percentage change WPI of all commodities
\( O_t \) = percentage change in mineral oil price index
\( O_{t-1} \) = one year lag impact of \( O_t \).

Table 6.4: Selected Regression Results for Wages from 1973-74 to 1997-98

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>( P_t )</th>
<th>( O_t )</th>
<th>( O_{t-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages</td>
<td>6.102</td>
<td>1.202</td>
<td>-0.562</td>
<td>0.237</td>
</tr>
<tr>
<td>( T )</td>
<td>(2.412)*</td>
<td>(3.807)*</td>
<td>(-3.341)*</td>
<td>(3.289)*</td>
</tr>
</tbody>
</table>

*  sig at 1% level
** sig at 5% level
*** sig at 10 % level

As the regression results show, other things being equal or constant, increases in the inflation variable or WPI of all commodities by 1 percent will
lead to increase in wages by 1.2 percent. According to the results, the coefficient of WPI of all commodities have a very strong and positive coefficient and statistically significant at 1% level. The impact of oil prices is negative and strong on wages, which depicts as oil price increase our wage rate decreases. The coefficient of oil prices is statistically significant at 1 percent and 5 percent levels. The one-year lag impact of oil prices as expected has a positive effect on wages and the coefficient of $O_{t-1}$ is also statistically significant. Overall the result is very good (the coefficient of all the variables have significant t values and an R Square of .563. The value of adjusted $R^2$ is .462, which is little less than R Square value.

As figure 6.5 depicts, when there was a peak in oil price, there was a corresponding dip in the wages. In the year 1974-75, when there was a very steep increase in oil prices, oil prices had a delayed effect on wages after approximately two years. The global hike in oil prices had a gradual effect on our economy and wages. In the year 1979-80, when the oil prices started peaking there was a immediate drop in wages from 19.94 percent in the previous year to 15.13 percent followed with a further dip during the next year to 12.37 percent in 1980-81 because of a corresponding peak in oil prices of almost 34 percent. There is a similar dip in wages in the year 1990-91, when the oil prices increased by 19.2 percent and the percentage wage increase slid from 14.57 percent to 11.87 percent in 1990-91, in the following year when the oil prices came to almost 16 percent, there was increase in wage rate to 15.72 percent. In the year 1992-93, the percentage increase in oil prices again came to 13.33 percent and the percentage increase in wages went up to 21.77 percent. This indicates that there has been an adverse impact of oil price shocks on the percentage increase in wages in the Indian economy.
E) Impact of oil price shocks on BOP

CRUDE OIL AND NATURAL GAS POSITION

India’s crude oil and natural gas production has been stagnating in recent years as figure 6.6 depicts. Demand, however, has been growing by more than 6 per cent annually, resulting in rapid growth in oil imports. Therefore oil is always trouble for India given that it imports over 70 per cent of its requirements. The Indian crude oil import was around 1.98 million barrels per day in 2004, according to the Petroleum Intelligence Weekly. This would translate to around 98 MMTPA (Million tons per year).
Source: Energy statistics, 2002-03

India is poised to become the world's third largest economy by 2020. In any case it will be on the threshold of overtaking European economies. A combination of sustained economic growth, expanding military capabilities and large population will be at the root of the expected rapid rise in economic and political power.

India's GDP in 2004 was at 500 billion US dollars. It is set to grow at 2 trillion US dollars by the year 2020 FICCI (2004). It is interesting to note that the market capitalization on Exxon mobile today is valued at 298 billion US dollars and that of Shell at 130 billion US dollars. It is therefore evident that oil will play a major role in our aspirations to be the third largest economy by 2020.

To bring an eightfold increase in energy sector in India will demand an investment of at least 500 billion US dollars up to the year 2020.

In the past decade, India imported large quantity of refined products due to lack of the refining capacity to keep up with the growing demand. In March 1998 the total annual refining capacity of 14 refineries in the country was 61.55 mt (1231 b/d). At the end of 1999, refining capacity reached 1.86
mb/d adding 720 kb/d in a year, in some ways far more important than growth in crude oil production. (See figure 6.7).

Figure 6.7

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic Production (000 tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993-94</td>
<td>267</td>
</tr>
<tr>
<td>1995-96</td>
<td></td>
</tr>
<tr>
<td>1997-98</td>
<td></td>
</tr>
<tr>
<td>1999-00</td>
<td></td>
</tr>
<tr>
<td>2001-02</td>
<td></td>
</tr>
</tbody>
</table>

Source: Energy Statistics, 2002-03.

The graphical trend shows that the production of petroleum products is still increasing & is better than the domestic production of crude.

Regulated Oil Prices and Problem of Oil Import Bill

National oil companies operate in a regulated environment. Most of these companies are integrated through exploration, development, refining, marketing and imports of crude and products. Where national oil companies, as in India, supply the domestic produce at regulated prices that do not cover the total costs, the potential for self-financing is limited. Production costs are usually covered in India, but the import costs are not covered automatically. The pricing of crude oil and oil products in India was based on the concept of “import parity” till the first oil crisis in 1973. Before this year, the domestic producers were allowed to charge a price in line with prices prevailing in the international market. However, after the 1973 price increase in international market, the indigenous producers were not allowed
to charge the higher international price. This led to the beginning of crude oil price concept, i.e., pooling the costs of imported and indigenous crude as discussed earlier in this chapter. The pricing regime has continued with minor variations till date. For political reasons the government was not able to pass on the effect of the recent hike in oil prices to the people. As a result the oil companies were suffering huge losses, as they were not able to recover their cost. During the past few years, international prices of crude petroleum have increased very sharply, with the price rising from 11 dollars per barrel in February 1999 to 35 dollars per barrel in September 2000 and to 52 dollars per barrel in October 2004 and Dollars 92 per barrel in late 2007. In India, petrol and diesel prices may go up in response. Domestic petrol prices are short by Rs 1.88 a litre of the international prices and diesel by Rs 3.30 per litre. There is yet another problem, which needs to be tackled, and that is the complex mechanism of subsiding kerosene and domestic cooking gas. Therefore besides petrol and diesel, the nationalised oil companies are losing heavily on LPG and kerosene, with losses being put at Rs 13,250 crore for 2004-05 fiscal. LPG is being priced Rs 158 per cylinder below the import price and kerosene by Rs 11 a litre, sources said.

The loss is compensated by the Oil Pool Account or now called Petroleum Planning and Analyses Cell, which is performing all functions of OCC after the dismantling of APM and which keep the price within India the same irrespective of vicissitudes of the international price.

Thus although India’s petroleum sector was deregulated in April 2002 and state-run oil companies were allowed to adjust domestic oil prices in line with global levels every two weeks, the government has been intervening to keep prices down in the face of record high crude prices. Indian basket of crude oil, which had averaged 27.98 dollars per barrel in 2003-04, increased to 34.17 dollars a barrel in April-June and 38.66 dollars a barrel in July-September in 2004 Basu Deepak (2005).
The recent trend of rising world oil prices have been posing a serious challenge to both corporates as well as policy makers in India, right from the beginning of the new millennium. Even with a dearer rupee, India's oil import bill jumped to $26.65 billion in April-February 2004-2005 from $18.45 billion and $15.94 billion for the same months in the two preceding years. For the whole of 2004-05, the value of oil imports can be easily $29 billion.

As oil imports constituted 38.18 per cent of a distinctly higher level of export earnings in 2004-2005 against 33.58 per cent in the same period in 2003-04 and non-oil imports also were much higher, the trade deficit touched a new peak of $23.83 billion against $13.73 billion, in spite of record imports of $93.63 billion and an increase in export earnings by $14.85 billion to $69.80 billion. The trade gap for the year 2004-2005 may well be $25 billion against only $9.17 billion for the whole of 1998-99. The huge trade gap has however not affected the external value of the Indian currency, as invisible receipts have been steadily increasing. Foreign Exchange reserves too have been on the uptrend with record FII inflows and slightly higher level of foreign direct investments (FDI).

**Figure 6.8**

![Diagram](source)
If this trend continues in future as well, it will give rise to severe BOP problems since all the products except motor spirit (MS) in addition to crude oil are imported at the margin. India will need to reduce the growth of its dependence on crude oil imports by expanding domestic exploration and production. Even if domestic production picks up, India will continue to remain and become increasingly dependent on imports of both oil and natural gas for the foreseeable future.

**Figure 6.9**

![India - External oil dependency outlook](image)

The increasing dependence of oil imports along with serious repercussions on BOP is also likely to have acute political strings attached to it, which can have far reaching effects and will therefore need careful considerations.

In general the effect of oil price shocks on the economy of the oil importing countries can be interpreted as the adverse impact of it on the terms of trade, which in turn leads to alarming BOP deficit. Such deficits depreciate the oil importing country’s currency. Keeping in view the
expected dependence of our country or oil imports in the years to come, it
would be important to study the effect if oil imports on BOP of our country.

Table 6.5 provides a comparison of the oil import bill with the export
earnings of the country during the last few years.

It relates oil imports in this period to export earnings. Although there
is no secular trend in Table 6.5, there is a clear pattern in which oil imports
were linked to the growth in consumption of petroleum products and the
trends in the domestic production of crude oil. The higher international oil
price in 1980-81 boosted India's oil import bill. In response, India
accelerated the exploitation of the offshore Bombay High Reserves. Thus,
production of Indian crude tripled to 28.9 million tons in 1984-85.

Table 6.5: INDIA'S OIL IMPORT BILL AS % OF EXPORT EARNINGS

<table>
<thead>
<tr>
<th>Years</th>
<th>Oil Imports (net) Rs. billion</th>
<th>Oil imports as % of export earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>1.32</td>
<td>08.6</td>
</tr>
<tr>
<td>75-76</td>
<td>12.4</td>
<td>30.9</td>
</tr>
<tr>
<td>80-81</td>
<td>52.58</td>
<td>78.3</td>
</tr>
<tr>
<td>85-86</td>
<td>43.16</td>
<td>39.6</td>
</tr>
<tr>
<td>90-91</td>
<td>97.74</td>
<td>30.0</td>
</tr>
<tr>
<td>94-95</td>
<td>162.50</td>
<td>19.7</td>
</tr>
<tr>
<td>95-96</td>
<td>222.63</td>
<td>21.9</td>
</tr>
<tr>
<td>96-97</td>
<td>320.92</td>
<td>27.0</td>
</tr>
<tr>
<td>97-98</td>
<td>289.15</td>
<td>22.2</td>
</tr>
<tr>
<td>98-99</td>
<td>268.87</td>
<td>19.2</td>
</tr>
<tr>
<td>99-00</td>
<td>535.16</td>
<td>33.5</td>
</tr>
<tr>
<td>00-01</td>
<td>703.53</td>
<td>34.6</td>
</tr>
<tr>
<td>01-02</td>
<td>594.27</td>
<td>28.4</td>
</tr>
<tr>
<td>02-03</td>
<td>735.33</td>
<td>28.8</td>
</tr>
<tr>
<td>03-04</td>
<td>764.24</td>
<td>26.9</td>
</tr>
<tr>
<td>04-05</td>
<td>1034.00</td>
<td>29.0</td>
</tr>
</tbody>
</table>

Source: Planning commission
The economic situations have changed not only for India, but also, for all developing countries which are economies dependent on large quantities of imported oil. Thus our foreign exchange bill for the import of oil over the years has been rising. Given the inelasticity of oil consumption as has been analyzed in the previous chapter of the determinants of oil demand, that total oil demand responded to price increases in oil but the response was very meager, and the regression results which shows that the price elasticity of total oil product demand is very less and is ranging between (-.01 to -.05), high crude prices also imply a high import bill. The increase in oil prices in 1999-2000 and 2000-2001 as Table 6.6 depicts, have already led to a situation where India's oil import bill is 2.5 times the level in 1998-1999. Moreover India's pattern of commercial energy consumption is characterized by high degree of oil dependency as discussed in Chapter 4. The consumption rate accelerated in the second half of the 1980s. Consumption increased at an annual average rate of 5.5 per cent during the Sixth Plan (1980-85), but it increased at 6.8 per cent per year during the Seventh Five-Year Plan. As Bombay High was exploited fully in the mid 1980s and no new discoveries on the same scale as in the mid-1970s were made, oil imports rose inexorably (Jayant Sathaye and Amulya Reddy, 1993).

Table 6.6: INDIA’S OIL IMPORTS AND AVERAGE SPOT YEARLY PRICE OF BRENT CRUDE OIL

<table>
<thead>
<tr>
<th>Years</th>
<th>Average spot price (US$ per barrel)</th>
<th>Oil imports (Rs billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>23.89</td>
<td>97.74</td>
</tr>
<tr>
<td>1991-92</td>
<td>19.30</td>
<td>118.24</td>
</tr>
<tr>
<td>1992-93</td>
<td>19.37</td>
<td>154.39</td>
</tr>
<tr>
<td>1993-94</td>
<td>15.94</td>
<td>162.21</td>
</tr>
<tr>
<td>1994-95</td>
<td>16.54</td>
<td>162.50</td>
</tr>
<tr>
<td>1995-96</td>
<td>17.47</td>
<td>222.63</td>
</tr>
<tr>
<td>1996-97</td>
<td>21.28</td>
<td>320.92</td>
</tr>
</tbody>
</table>
In most of the empirical studies conducted so far, the impact of oil prices hike on the economies of different countries has been evaluated taking oil as the major commercial energy source. Various studies have also been done in the field of BOP crisis due to oil imports, not specifically in this field but part of their study deals with the BOP front of our country. (Srinivasan Kanan, 1997) studied that India’s demand for petroleum products is rising sharply, even if the domestic production is declining. India’s oil exports, which have lagged behind imports to produce a trade deficit of $4.54 billion in 1995-96, cannot pay for these imports. According to him this could precipitate the next BOP crisis or a sharp decline in the rate of growth of our economy. Majumder S. also in (2001) concluded that petroleum products emerged as a major export item accounting 4% of total exports in 2000-2001 against 1% in the corresponding previous period. But this was hardly enough to cover the oil import bill, which zooms with the sudden spiral in crude prices. (Ahya Chetan, 2002) explained that any increase in crude price has an immediate impact on exchange rate and BOP position. He estimated that a US $ 2 increase in crude oil prices adds around US $1.1 billion to India’s oil import bill on an annualized basis. Hence, any such increase would push the current account deficit up by 0.2% of GDP.

<table>
<thead>
<tr>
<th>Year</th>
<th>Import (US$)</th>
<th>Value (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>17.33</td>
<td>289.15</td>
</tr>
<tr>
<td>1998-99</td>
<td>12.05</td>
<td>268.87</td>
</tr>
<tr>
<td>1999-00</td>
<td>21.77</td>
<td>535.16</td>
</tr>
<tr>
<td>00-01</td>
<td>28.13</td>
<td>703.53</td>
</tr>
<tr>
<td>01-02</td>
<td>23.29</td>
<td>594.27</td>
</tr>
<tr>
<td>02-03</td>
<td>25.57</td>
<td>735.33</td>
</tr>
<tr>
<td>03-04</td>
<td>28.95</td>
<td>764.24</td>
</tr>
<tr>
<td>04-05</td>
<td>42.10</td>
<td>1034.00</td>
</tr>
</tbody>
</table>

Source: Public Sector Undertaking/ DGCI &S, Kolkata, Ministry of Finance
According to our results when we regressed India's net oil imports with brent crude oil price we came to the conclusion that a US$ 2 increase in crude oil prices adds around US$ 1.3 billion to our oil import bill. This can throw the country’s import scene in a tizzy and the current account deficit in turmoil. Oil and oil products alone raised its volatility ratio in the total imports from 21% in 1999-2000 to 33% in 2000-2001. Our results are very close to the results obtained by Ahya Chetan (2002). We also estimated that a 2% increase in crude oil prices would lead to .75% increase in oil imports as percentage of total export earnings. According to Reserve Bank of India estimates, for every 1-dollar increase in international oil prices, India's oil import bill swells around 600 million dollars.

The total imports and exports discussion in this study does not reveal the compound annual growth rate of BOP deficit, which is an important parameter to see the effect of increasing consumption and imports of oil on our country's BOP and foreign exchange position. Therefore in order to check the intensity of problem, the growth rates of imports of crude and petroleum products for the period 1970-71 to 2005-06 have been estimated. The growth rates of import of crude oil for the period before liberalization i.e. 1970-71 to 1990-91 and after liberalization i.e. 1991-92 to 2005-06 has also been estimated. For achieving a sustainable economic growth and development in any society, it is necessary to design a master plan for oil production and utilization. To design such an appropriate plan, requires adequate data. The study has estimated the growth rate of domestic production of crude oil and petroleum products during the entire period from 1970-71 to 2005-06 and for the period before and after liberalization i.e. from (1970 -71 to 1990-91 and 1991-92 to 2005-06. The time period considered here, i.e. 1970 to 2005, is because our oil consumption has been increasing at a very rapid rate since seventies and also the price of oil have been quite volatile during this period, which led to the two oil price
crises. The import demand of crude and petroleum products and also their domestic production is forecasted for the year 2020.

The question, which looms large today, is whether the emerging consumption pattern of oil in India is sustainable in foreseeable future. Keeping in view the estimated reserves of 2 billion barrels of oil (out of which about 27% has been discovered) the balance can only last for the next 20 years. From the foregoing discussion it follows that, given the present development pattern indications are emerging that consumption of oil is likely to rise further and invite problems of BOP.
RESULTS

1. The log linear equation for calculation of the growth rate of import demand of crude oil for the period 1970-71 to 2005-06 has come out to be:

\[ \log y = \log a + t \log b \]

\[ \log y = 9.016 + 5.916 \times 10^{-2} \]

CAGR = (antilog of 5.916 \times 10^{-2} - 1) \times 100 = (1.0609 - 1) \times 100 = 6.09%

The log linear equation for calculation of the growth rate of import demand of crude oil for the period 1970-71 to 1990-91 has come out to be:

\[ \log y = \log a + t \log b \]

\[ \log y = 9.405 + 2.036 \times 10^{-2} \]

CAGR = (antilog of 2.036 \times 10^{-2} - 1) \times 100 = (1.0205 - 1) \times 100 = 2.06%

The log linear equation for calculation of the growth rate of import demand of crude oil for the period 1991-92 to 2005-06 has come out to be:

\[ \log y = \log a + t \log b \]

\[ \log y = 7.460 + 1.115 \]

CAGR = (antilog of 1.115 - 1) \times 100 = (1.12146 - 1) \times 100 = 12.15%

The compound annual rate of growth (CAGR) of imports of crude oil increased from 2.06% before liberalization to 12.15% after liberalization.

The result of import figure of crude oil forecasted for the year 2020 is estimated as below:

\[ \log y = \log a + t \log b \]

\[ = 9.016 + 50 \times (5.916 \times 10^{-2}) \]

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\[ \begin{align*} 
&= 9.016 + 50(0.05916) \\
&= 9.016 + 2.95 \\
&= 11.97 \\
\text{Antilog of } 11.97 &= 157945 ('000 \text{ tonnes}).
\end{align*} \]

2. The growth rate of imports of petroleum products for the period 1970-71 to 2005-06 is:
\[ \log y = \log a + t \log b \]
\[ \log y = 7.693 + 5.739E-02 \]
\[ \text{CAGR} = (\text{antilog of } 5.739 \text{ E-02-1}) \times 100 \text{ or } (\text{antilog of } .05739-1) \times 100 \\
= (1.0590-1) \times 100 = 5.91\% \\
\]
The growth rate of imports of petroleum products for the period 1970-71 to 1990-91 is:
\[ \log y = \log a + t \log b \]
\[ \log y = 7.606 + 5.921E-02 \]
\[ \text{CAGR} = (\text{antilog of } 5.921 \text{ E-02-1}) \times 100 \text{ or } (\text{antilog of } .05921-1) \times 100 \\
= (1.0609-1) \times 100 = 6.10\% \\
\]
The growth rate of imports of petroleum products for the period 1991-92 to 2005-06 is:
\[ \log y = \log a + t \log b \]
\[ \log y = 10.570 + t \times -3.86E-02 \\
\text{CAGR} = (\text{antilog of } -3.86 \text{ E-02-1}) \times 100 \text{ or } (\text{antilog of } -.0386-1) \times 100 \\
= (.96213-1) \times 100 = -3.79\% \\
\]
The CAGR of imports of petroleum products was 6.10 % during 1970-71 to 1990-91 but declined to -3.79% during the later period after liberalization. This decline in CAGR is due to the decreasing trend in the absolute volume of imports after 1998-99 till 2002-03. After 2002-03 the imports of petroleum products again started increasing, showing an upward trend.
The result of import value of petroleum products forecasted for the year 2020 is estimated as below:

\[ 7.693 + 50 \times (5.739 \times 10^{-2}) = 10.56 \]

Antilog of 10.56 = 38658 (‘000 tonnes).

3. The growth rate of Crude Oil Domestic production for the period 1970-71 to 2005-06 is:

\[ \log y = \log a + t \log b \]
\[ \log y = 9.007 + t5.023 \times 10^{-2} \]

CAGR = (antilog of 5.023 \times 10^{-2} - 1) \times 100 = 5.15%

The growth rate of Crude Oil Domestic production for the period 1970-71 to 1990-91 is:

\[ \log y = \log a + t \log b \]
\[ \log y = 8.553 + t9.746 \times 10^{-2} \]

CAGR = (antilog of 9.746 \times 10^{-2} - 1) \times 100 = 10.24%

The growth rate of Crude Oil Domestic production for the period 1991-92 to 2005-06 is:

\[ \log y = \log a + t \log b \]
\[ \log y = 10.103 + t9.250 \times 10^{-3} \]

CAGR = (antilog of 9.250 \times 10^{-3} - 1)*100 = (1.00929 - 1) * 100 = .93%

The growth rate of domestic production of crude oil was 10.24% before liberalization while it steeply declined to .93% after liberalization.

The result of crude oil domestic production figure forecasted for the year 2020 is estimated as below:

\[ 9.007 + 50 \times (5.023 \times 10^{-2}) = 11.52 \]

Antilog of 11.52 = 130710 (‘000 tonnes).
4. The growth rate of domestic production of petroleum products has been estimated for the year 1970-71 to 2005-06, is shown as below:

\[ \log y = 9.608 + 5.729 \times 10^{-2} \]

\[ = 9.608 + t \times 0.05729 \]

CAGR = \((\text{antilog of } 5.729 \times 10^{-2} - 1) \times 100\) or \((\text{antilog of } 0.05729 - 1) \times 100\)

\[ = (1.0589 - 1) \times 100 = 5.90\% \]

The growth rate of domestic production of petroleum products has been estimated for the year 1970-71 to 1990-91, is shown as below:

\[ \log y = 9.611 + 5.823 \times 10^{-2} \]

\[ = 9.611 + t \times 0.05823 \]

CAGR = \((\text{antilog of } 5.823 \times 10^{-2} - 1) \times 100\) or \((\text{antilog of } 0.05823 - 1) \times 100\)

\[ = (1.0599 - 1) \times 100 = 6.00\% \]

The growth rate of domestic production of petroleum products has been estimated for the year 1991-92 to 2005-06, is shown as below:

\[ \log y = 9.140 + 7.278 \times 10^{-2} \]

\[ = 9.140 + t \times 0.07278 \]

CAGR = \((\text{antilog of } 7.278 \times 10^{-2} - 1) \times 100\) or \((\text{antilog of } 0.07278 - 1) \times 100\)

\[ = (1.0754 - 1) \times 100 = 7.55\% \]

The growth rate of domestic production of petroleum products has increased from 6.00% before liberalization to 7.55% after liberalization.

The result of domestic production of petroleum products forecasted for the year 2020 is estimated as below:

\[ \log y = 9.608 + 50(5.729 \times 10^{-2}) \]

\[ = 9.608 + 50 \times (0.05729) \]

\[ = 12.47 \]

Antilog of 12.47 = 260406 ('000 tonnes).
Thus India is an energy importing country, primarily of oil and soon of gas. Its imports are growing while its domestic production lags behind the fast pace of demand growth. The Indian government is conscious of the need to diversify its sources of supply and also to boost domestic supply of primary energy as well as final products. (LPG, Kerosene, Natural gas, Lubes, etc.) On the exploration and production front, developments are slow. They reflect in part the state of India- its oil and gas reserves, mature fields, limited reserves or costly new developments. There has over the years been stagnation in oil production at around 32-33 million tones. But there has been no curbing the demand for petroleum products. Consequently, the import dependence or crude has zoomed. The only bright side of the Indian petroleum scene is the increase in the refining capacity, which can play as major export item. But they are hardly enough to cover the oil import bill, which zooms with sudden spiral in crude prices.

India has no other choice but to import oil, as the chances of major discovery is bleak. Neither it is possible to curb oil consumption, as it is crucial to sustain, and improve growth. India’s one hope is that the economic slowdown in the US and Japan will affect consumption in these two countries such that it would deter the OPEC from cutting production to raise prices. Our foreign exchange reserves are also around 130 US$ billion, which will help us, cover our oil import bill. India’s crude import demand growth for the period 1970-71 to 2005-06 has been estimated as 6.09% and the result of import figure forecasted for the year 2020 is 157945 (’000 tonnes). This is based on the assumption that there will be no change in the current refining capacity and that the indigenous crude production is stagnant at around 33 million tones. Further, if we assume that OPEC does affect another output cut, prices may stabilize at $23-25 per barrel. India’s oil import bill may then be around $13.8-15 billion. Thus the economic slowdown in the US and Japan whatever the other consequences, offer India the hope of saving $3-4 billion in the oil import bill.
The domestic production of crude is stagnant and not going to increase in the near future as there is very little hope of finding new oil fields to keep pace with the increasing demand. The value of import figure of crude forecasted for the year 2020 is estimated according to the price level existing today. But it is expected that the price of oil will most likely more than double than the price today, therefore our BOP would be adversely affected. As we known our current consumption is around 315 million tones of oil equivalent and this is expected to rise to 2400 mtoe by the year 2020, this will translate into an alarming BOP deficit (FICCI, 2004). Therefore by the year 2020, our increasing dependence oil would accentuate our BOP problem.

The government is trying laying a gas pipeline to import Natural Gas from Iran. It is also laying a gas pipeline from Burma across Bangladesh into India. These are the two proposals, which are likely to materialize. Gas will help reduce oil imports and oil import bill as there would be no shipping costs importing from the neighboring countries, the cost will also be cheaper. Reliance and Gail have also discovered gas fields in Godavari and Cambay Basin. But according to the existing scenario our stocks are fixed for the coming years and given the demand to supply factors, demand will increase and prices may not reduce. The given demand condition, consumption pattern and the political factors suggest that prices are bound to increase. Thus efforts like pipelines may reduce cost but will out way due to price increase and increased consumption of oil as the expectation of price increase is more at the time of exhaustion in the near future or around 2020.

F) Possibility of export led growth

A matrix of the Indian economy for 2002 shows its heavy dependence on imports of crude oil and gas and its buoyant exports for refined products.
Share of domestic production of crude oil was only 28.7 percent while 71.3 percent were imports. In contrast LPG production was 82 percent while imports share was 18 percent.

In the case of Naphtha the share of domestic production was as high as 97.7 percent. However, the share of exports was 20.9 percent and a part of it was met by imports whose share was 23.2 percent.

In the case of residual fuel oil the country was both an importer and exporter with the respective shares being 7.3 percent and 6.5 percent respectively.

### Table 6.7: The Oil Scenario in India in 2002: Production, Imports and Exports (% share)

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Imports</th>
<th>Exports</th>
<th>Domestic Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>28.7</td>
<td>71.3</td>
<td>0.0</td>
<td>100</td>
</tr>
<tr>
<td>Refinery Feedstock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naphtha</td>
<td>97.7</td>
<td>23.2</td>
<td>-20.9</td>
<td>100</td>
</tr>
<tr>
<td>Liquified petroleum gas</td>
<td>82.0</td>
<td>18.0</td>
<td>0.0</td>
<td>100</td>
</tr>
<tr>
<td>Motor gasoline</td>
<td>129.1</td>
<td>0.0</td>
<td>-29.1</td>
<td>100</td>
</tr>
<tr>
<td>Aviation gasoline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jet kerosene</td>
<td>129.5</td>
<td>0.1</td>
<td>-29.6</td>
<td>100</td>
</tr>
<tr>
<td>Kerosene</td>
<td>93.5</td>
<td>6.5</td>
<td>0.0</td>
<td>100</td>
</tr>
<tr>
<td>Diesel</td>
<td>107.9</td>
<td>0.3</td>
<td>-8.1</td>
<td>100</td>
</tr>
<tr>
<td>Residual fuel oil</td>
<td>99.6</td>
<td>7.3</td>
<td>-6.5</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: FICCI

However, in the case of other refined products like motor gasoline, jet kerosene and diesel the country was self-sufficient and even a net exporter. Export share of the domestic production of motor gasoline was high 29.1 percent while the share of jet kerosene exported was 29.6 percent. Even in the case of diesel the exports was a significant 8.1 percent of the production.

Inspite of the very healthy foreign exchange reserves and prospect of being a net exporter of refined products, in view of the spiraling oil prices, the country will not be able cover the BOP deficit because of the huge dependence on import of crude.
6.5 Impact of Oil Prices on Different sectors of the economy

Historically the Indian economy has been shielded against any sharp spike in oil prices. The Administered Price Mechanism in the oil sector ensured that the impact of any sharp increase in international oil prices were dissipated by spreading over the price increase through smaller incremental hikes spread over a period of time, The oil pool account even then ran substantial deficits, which was partially recharged when the international oil prices went through a trough phase.

Thus the Indian economy was generally protected against sharp spurt in oil prices. Though the Administered price mechanism has been dismantled in 2002 the retail prices of oil products continues to be regulated by the government.

Figure 6.10

Trends in Global and National Oil Prices (% change)
Table 6.8: Selected Regression Results for Key Sectors of the Indian Economy from 1970-71 to 2003-04

(t statistics in parentheses)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Growth of Agriculture Production</th>
<th>Growth of Industrial Production</th>
<th>Growth of Construction Sector</th>
<th>Growth of Services Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>$O_t$</td>
<td>-.150 (-1.703)</td>
<td>-9.05E-02 (-2.254)</td>
<td>-9.10E-02 (-1.905)</td>
<td>.115 (1.905)</td>
</tr>
<tr>
<td>$O_{t-1}$</td>
<td>.360 (3.734)</td>
<td>-3.50E-02 (-.874)</td>
<td>6.978E-02 (1.114)</td>
<td>-1.59E-02 (-.251)</td>
</tr>
<tr>
<td>$O_{t-2}$</td>
<td>-.206 (-2.313)</td>
<td>3.690E-02 (-.839)</td>
<td>6.978E-02 (1.114)</td>
<td>-4.19E-02 (-.717)</td>
</tr>
<tr>
<td>$O_{t-3}$</td>
<td>.515 (3.596)</td>
<td>-5.01E03 (-.953)</td>
<td>.690E02 (-.717)</td>
<td>-4.44E-02 (-.867)</td>
</tr>
<tr>
<td>Constant</td>
<td>-.204 (-1.932)</td>
<td>7.332 (5.561)</td>
<td>13.508 (5.561)</td>
<td>13.789 (5.610)</td>
</tr>
<tr>
<td>N</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.624</td>
<td>.225</td>
<td>.286</td>
<td>.346</td>
</tr>
<tr>
<td>Adj $R^2$</td>
<td>.508</td>
<td>.154</td>
<td>.066</td>
<td>.145</td>
</tr>
<tr>
<td>S</td>
<td>5.79</td>
<td>3.00</td>
<td>3.76</td>
<td>3.81</td>
</tr>
<tr>
<td>F</td>
<td>9.385</td>
<td>3.187</td>
<td>1.302</td>
<td>1.719</td>
</tr>
</tbody>
</table>

1. Impact of Oil Prices on Agriculture Sector Growth

Index$_{AP}$ = f ($O_t$, $O_{t-1}$, $O_{t-2}$, $O_{t-3}$)

Where $Index_{AP}$ = percentage change in index of agricultural production

$O_t$ = percentage change in the price of oil

$O_{t-1}$.....$O_{t-n}$=lag impact of oil prices

As the result shows, the lag impact of oil prices is felt after two years in the agricultural sector. The impact of $O_t$ has come out to be statistically insignificant. The coefficient of $O_{t-1}$ is positive and significant which shows no adverse impact of oil prices. The increase in oil prices lower the agricultural output after two years. The negative impact is strong and statistically significant at 5 percent level. This negative impact gets neutralized in the third year where $O_{t-3}$ has come out to be positive and statistically significant. This means that there is no adverse impact of oil prices after three years. If the agricultural sector production still falls that may be due to certain other factors and not oil prices. The results have
come out to be good with three statistically significant values of the coefficients and with R Square of .624.

Increase in oil prices impacts on agricultural sector mainly through transport costs and through impact on prices of inputs like fertilizers and irrigation

Figure 6.11 depicts the impact of the peaks in oil prices through a dip in the agriculture sector. However there is another factor, which has a more prominent effect on this sector namely rainfall. In the year 1974-75 when there was a highest peak in oil prices there was a corresponding negative growth in the agriculture sector. Again in the year 1979-80 when there was another hike in oil prices, there was a very steep negative growth in the agriculture sector. However, this was not entirely due to oil price hike but because of several other factors such as global recession and rainfall. In the year 1980-81, when there was a sharp increase in oil prices of almost 34 percent, there was a positive growth in the agriculture sector of 15.65 percent, which was possibly because of good crop or good rainfall. In the year 1982-83, when the oil price hikes had started to come down there was a negative growth in the agriculture sector which is not explainable by oil but was accounted by the monsoons. In the year 1990-91 and 1991-92, there is a dip in the agriculture sector with a corresponding increase in oil price. Again in the year 2000-01, when there was a steep increase in oil prices, there was a negative growth in the agriculture sector. But in the year 2002-03 when the oil prices have more or less stabilized there is a sharp negative growth in the agriculture sector. This indicates that the steep hike in 2000-01 had a lag effect on agriculture sector after two years coupled with the effect of the poor monsoon.
2. Impact of Oil Prices on Industrial Sector Growth

\[
\text{Index}_{ip} = f(O_t, O_{t-1})
\]

Where \(\text{Index}_{ip}\) = percentage change in index of industrial production

\(O_t\) = percentage change in oil prices

\(O_{t-1}\) = one year lag impact of oil prices

As the results depicts, a 1 percent increase in oil prices leads to .09 percent decrease in the rate of index of industrial production. A clear negative relation is depicted through the value of coefficient. The value of coefficient is statistically significant at 5 percent level. The results also depicts that there is negative one year lag impact of oil prices but its coefficient is not very significant. Thus the regression result depicts that there is immediate negative impact of percentage increase in the prices of oil.
According to the regression results a 1 percent increase in oil prices leads to .09 percent decrease in the index of industrial output. This is also confirmed by looking at figure 6.12, which shows the impact of oil prices on the industrial sector production. The increase of oil prices in 1973-74 led to an immediate decline from 5.92 percent in the previous year to 0.55 percent in 1973-74. In 1974-75, the oil prices peaked to 69.02 percent and the percentage increase in production was only 1.90 percent as compared to almost 6 percent in 1972-73. In the year 1975-76 percentages increase in oil prices came down to 7 percent and the industrial production again picked up to around more than 5 percent. In 1979-80, oil prices again rose from 0.75 percent in the previous year to 14.46 percent, which led to immediate decline of 1.22 percent in the index of industrial production. In 1980-81, there was a peak in oil prices to 33.97 percent. It affected the manufacturing sector with a dip from 1.22 percent to 0.81 percent. In the following year in 1981-82, when hike in oil prices slowly came down to 21 percent, the manufacturing sector recovered with a percentage increase of 9.3 percent. In spite of the dip in the increase in oil prices, the growth in the manufacturing sector has not responded immediately but there has been a
gradual improvement in the next two to three years. In 1990-91, oil prices again rose from 0.78 percent to 19.23 percent. The industrial production came down a little to 8.25 percent and had a delayed effect in 1991-92. In 1992-93 to 1995-96 when oil prices slowly came down, the manufacturing sector also slowly recovered. In 2000-01, oil prices again peaked to 41.25 percent from 11.89 percent in the previous year, the industrial production came down to 4.98 percent from 6.68 percent in the previous year and then dropped significantly to 20.70 percent in 2001-02 showing a lag effect. The oil prices dropped in 2001-02, and the manufacturing sector has started recovering slowly since 2002-03. The peak in oil prices have had a sobering effect on the growth of the manufacturing sector but the growth in the manufacturing sector has recovered.

3. Impact of Oil Prices on Construction Sector Growth

$$\text{Index}_{cs} = f (O_t, O_{t-1}, O_{t-2}, O_{t-3})$$

Where \text{Index}_{cs} = percentage change in the index of construction sector output

\(O_t\) = percentage change in the price of oil

\(O_{t-1} \ldots O_{t-3}\) = lag impact of oil prices

The regression results of impact of oil price increase on the construction sector output, as given in table 6.8 have come out to be statistically insignificant. Therefore no attempt is made to evaluate the sign of its coefficients.
There is no discernible impact of the oil peaks on the construction sector. The construction sector is influenced more by foreign direct investment, GDP growth etc

4. Impact of Oil Prices on Services Sector Growth

\[ \text{Index}_{ss} = f(\text{O}_t, \text{O}_{t-1}, \text{O}_{t-2}, \text{O}_{t-3}) \]

Where \( \text{Index}_{ss} \) = percentage change in the index of services sector output
\( \text{O}_t \) = percentage change in the price of oil
\( \text{O}_{t-1}, \ldots, \text{O}_{t-3} \) = lag impact of oil prices

As the results of services sector depicts there is no immediate adverse impact of increase in oil prices on the growth of services sector. The coefficient of \( \text{O}_t \) is .115 which shows no adverse impact and this is statistically significant at 10 percent level. The results of the lag impact of oil prices have come out to be statistically very insignificant which makes them less valid.
There is no significant immediate or lag effect of the oil peaks on the service sector. During the early peaks in oil price in 1973-74 and 1974-75 there was in fact increase in the growth of the service sector. During the oil peak of 1979-80 and 1980-81 there was no significant effect of oil prices on the services sector. Similarly during the increase in oil price in the period 1991 there is very minor decline in the growth of this sector. But during the period 1995-96 and 1998-99 when there was dip in the oil prices there is noticeable growth in the service sector. During the oil peak of 2000-01 there is again decline in the growth of the service sector. During the early periods there was no correlation between the oil peaks and the growth in the service sector. However during the period after 1995-96, the dip in the oil prices has had a positive effect on the growth of the service sector.

We can conclude that the Indian economy has been shielded against sharp spike in oil prices. Up to the end 2003, OPEC was successful in keeping the oil crude prices in $22-28 band but with the steep increase in the demand in China, US and the wars in the oil producing countries namely Kuwait and Iraq has made the oil prices spiral and there has been
double digit growth in the crude oil prices which has continued in the third consecutive year. Crude oil prices went up by 16.1 percent in 2003 followed by 30.4 percent in 2004 and increased by 11.5 percent in 2005 with a further increase of in 2006 resulting in crude oil price, which is hovering around $ 70m per barrel. India’s limited oil reserve, which barely meets one third of our requirement, has resulted in a huge oil poll deficit resulting into acute BOP problems. In order to shield the population below the poverty line the government is unable to pass on the oil shock to the common man who would have huge political fallouts if the price hikes are transferred to the common man. This has resulted in mounting oil pool deficits and passing on some burden to the diesel and gasoline while protecting kerosene and to some extent LPG. It is fortunate that the country is going through a phase of healthy GDP growth rate, which has gradually risen from around 5 percent to over 8 percent, which has helped mitigate the effect of the spiraling oil prices. That’s because the relationship between crude oil consumption and GDP has weakened today. In 1970-71, 1 tonne of crude oil was associated with Rs 200,000 of GDP, which came down to Rs 143,000 in 2003-04, meaning thereby that the impact of oil price on GDP has been moderated despite higher consumption levels as GDP is driven by other factors such as the services sector which is less dependent on oil compared with industry and agriculture.

The growth in the economy is backed by a robust growth in the IT, pharmaceutical and manufacturing sector because of India’s growing competitiveness in these sectors. India has prospects of becoming the global base for these sectors. However the oil shocks have a significant effect on the GDP and according to our results a 1 percent increase in oil prices will lead to .105 percent decrease in our GDP rate. Besides affecting the GDP, the oil shocks have adversely affected the WPI, wages, the manufacturing sector and to a lesser extent the agriculture sector.
The Indian economy has shown a very resilient nature against the spiraling oil prices. However the continued effect of the high oil prices will eventually affect a number of our industries, which are dependent on diesel, based captive power plants for energy. The Indian industry as a whole has a dependence on diesel based captive power plants of around 14 percent because of shortages in hydel and coal based power. The spiraling cost of power will affect the global competitiveness of our industry, which will affect our exports and have a negative effect on our BOP.

But in India, despite the global economic slowdown, the macroeconomic indicators have thus far been satisfactory. If the Iraq war had been a protracted one, rising inflation, uncertainty over exports, the possible fallouts would have been falling investments (negating the incentives offered in Budget 2003), drop in tourism traffic (which is yet to recover from the 9/11 impact) and a worsening of the current account balance (which is in surplus after a gap of 27 years).

Experience shows that oil price shocks have had only a marginal impact on the Indian economy, especially in the long-term perspective. Any effect on major economic segments has often been more because of inflationary fears rather than economic weaknesses.

During the past years, India did confront several oil price spurts, prompting policy-makers to think of various alternatives, besides raising petrol and diesel prices. In June-August 2000-01, international oil prices rose to $32 a barrel. The average price of imported crude during the whole year was $27 a barrel. In mid-2000, when the oil prices surged to $31-32 per barrel, the Petroleum Ministry hiked petro-product prices by over 20 per cent in September. This pushed up the monthly inflation to 8 per cent in the second-half of 2000-01 compared to 6 per cent in the first. But the following year, inflation rolled back to 3.7 per cent negating all fears of a prolonged period of high inflation. Thus, the impact on inflation was short-lived despite international oil prices rising 35 per cent, from $22 to $30 a barrel.
The key to this riddle is the two advantages, which insulate India from any long-term impact: low dependence on the global economy and the structure of oil product consumption, which is very different from those in other Southeast Asian countries.

The oil consumption pattern and the abundance of non-oil energy resources have shielded the country from the effects of oil-price shocks. In India, the major energy source is coal — accounting for over 52 per cent of total commercial energy — followed by oil at 34 per cent. Such a situation is unique to India. The direct impact of oil is largely on the transport sector, which consumes over 42 per cent of the oil products. Nearly 84 per cent of the energy consumed by industry comes from coal. Similarly, in agriculture, the main energy source is power (about 90 per cent) or coal; oil accounts for a mere 10 per cent and is used mainly for operating agricultural pumps.

Hence, contrary to general perception, the direct impact of oil price shocks on industry is not that grave. Also, any decline in exports would be more because of sluggishness in the US economy, which accounts for one-fifth of India’s exports, than oil price hikes. Moreover, exports contribute only 12 per cent of GDP.

Also, despite the Administrative Price Mechanism (APM) being done away with from April 1, 2002, the Petroleum Ministry continues to covertly exercise full power over petro-product pricing. Hence, even in the event of oil prices shooting up, the major sectors of the economy are unlikely to be affected. In India, oil price/supply volatility impacts inflation mainly through the transport sector. Stagnancy in the development of the Railways is to blame for this. Essentials as well as consumer durables are now largely transported by road and, so, whenever diesel and petrol prices are hiked, the prices of these goods also go up, affecting mainly the poor and the middle class. Moreover, the nexus between truck owners and traders often adds to the problem.
As opposed to the situation during the 1991 Gulf War, the country now has a sizeable foreign exchange reserves and a current account surplus. The foreign exchange reserves can meet up to four years' oil import requirement compared to only five months' in 1991.

As regards international oil pricing, analysts are not only apprehensive of the US' role but also skeptical of OPEC's dominance. They feel that, in the post-Saddam regime, the US will start pumping Iraqi oil, which has been under-utilized for a decade because of the UN embargo. Iraq's supplies can slacken the OPEC's grip on the supplies, and oil prices may crash. For India, the post-war period is more important. American occupancy may jeopardize India's oil investments in Iraq. Though India has two months' oil stock, efficient management of other energy sources, including oil, is essential. Creation of strategic oil reserves is warranted. This war would not be the end, but the beginning, of consolidation by oil-producing countries against the US. Even though the US may rein its power in West Asia, bickering will shackles the free flow of oil.

Thus Indian manufacturing sector has been able to retain its competitiveness because of the relatively low wage rates, slight improvement in labour prod, more efficient use if energy and investment in technology and up gradation of infrastructure and equipment.