CHAPTER 4

IMPACT OF CRUDE OIL PRICES ON INFLATION

4.1 Introduction

Inflation is a rise in the general level of prices of goods and services in an economy over a period of time (Abel & Bernanke 1995). Inflation after remaining persistently high over the past two years has started to show signs of moderation lately. In year 2009 and 2010 the inflation touched a double digit figures before slowing down to 8.87% in year 2011 and then climbing up to 9.13% in 2012[17]. Financial year 2011-12 started with a headline inflation of 9.7 per cent, which briefly touched double digits in September 2011 before coming down to 6.6 per cent in January 2012.

4.2 Headline Inflation

The raw inflation figure as reported through the Consumer Price Index (CPI) that is released monthly by Labour Bureau, Government of India. The CPI calculates the cost to purchase a fixed basket of goods as a way of determining how much inflation is occurring in the broad economy. The CPI uses a base year and indices current year prices based on the base year's values. Headline Inflation can also be defined as a measurement of price inflation that takes into account all types of inflation that an economy can experience. Unlike core inflation, headline inflation also counts changes in the price of food and

[17] http://dbie.rbi.org.in/OpenDocument/opendoc/openDocument.jsp

energy[18]. Headline inflation includes the entire sector (All articles, food, commodities like metal, fuel etc) commodities in the general price index; in this case, the WPI. Core inflation does not take into consideration commodities that have volatile prices, for example, food and fuel because food and energy prices can rapidly increase while other types of inflation can remain low[19]. Headline inflation is more useful for the typical household because it reflects changes in the cost of living, while core inflation is less volatile and shows the effects of supply and demand on Gross Domestic Product (GDP) better.

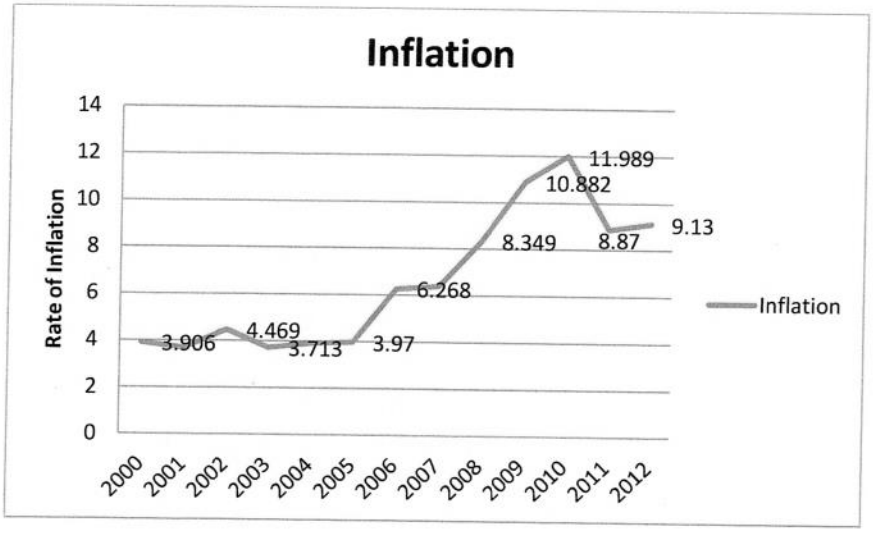

Figure 4.1: Trend of Inflation from 2000 to 2012 Data Source: www.rbi.gov.in

The X axis depicts the year from 2000 to 2012 and the Y axis gives the rate of inflation. Figure 4.1 depicts the variation in rate of inflation between 2000 and 2012.

[18] FRBSF economic letter, Aug 01, 2011, http://www.frbsf.org/publications/economics/letter/2011/el2011-24.html
[19] FRBSF economic letter, Aug 01, 2011, http://www.frbsf.org/publications/economics/letter/2011/el2011-24.html

Inflation which started at 4% at the start of the millennium has climbed slowly and reached a peak of 11.98 % in 2010 before coming down in 2011 and marginally rising in 2012. The factors contributing to this situation and their relative importance have, however, been changing over time. Some of the contributory factors during this period include

1. Higher primary articles (like food clothing etc) prices driven by vegetables, eggs, meat and fish.
2. Increasing global commodity prices especially metal and chemical prices which ultimately led to higher domestic manufactured prices.
3. Persistently high international crude petroleum prices in the last two years.

As is evident that International crude oil price has been one of the contributing factors in determining the inflation. The same has been statistically tested that increase in International crude oil price increases the inflation rate.

4.3 **Hypotheses**

Since one of the objectives is to study the impact of international crude prices on Inflation in India, there is a need to first make hypotheses. Based on data of crude oil price and inflation over the years statistical analysis will explain the relationship between crude oil price and Inflation. Hence the hypotheses constructed are:-

H_o = Increase in oil prices have no impact on Inflation

H_1 = Increase in oil prices has an impact on Inflation

4.4 Measurement of Inflation

The Inflation is determined as brought out by the weighted contribution of major product groups to Wholesale Price Index (WPI) inflation. There are three measures of inflation used in India. The Wholesale Price Index (WPI), Consumer Price Index (CPI) and the implicit Gross Domestic Product (GDP) deflator. There are four consumer price indices namely-the CPI for industrial workers (CPI-IW), CPI for agricultural labour (CPI-AL), CPI for rural labour (CPI-RL) and CPI for urban non-manual employees (CPI-UNME)[20]. Until 2005, the base years for CPI–IW, CPI-UNME and CPI–AL were 1982, 1984-85 and 1986-87 respectively. The base years for the WPI and CPI are not revised frequently. The current base year for the WPI is 2006. With effect from 2006, the base year for CPI – IW was revised to 2001[21]. The difference between headline inflation and core inflation has been explained in section 4.2. It follows that supply shocks that arise from a poor crop yield or hikes in international prices on fuel will lead to increases in headline inflation. In contrast, core inflation would not be affected by these shocks and would only serve as an indicator of the price levels of commodities that have (relatively) non-volatile prices.

[20-21] Labour Bureau, Government of India, http://labourbureau.gov.in/indexes.htm

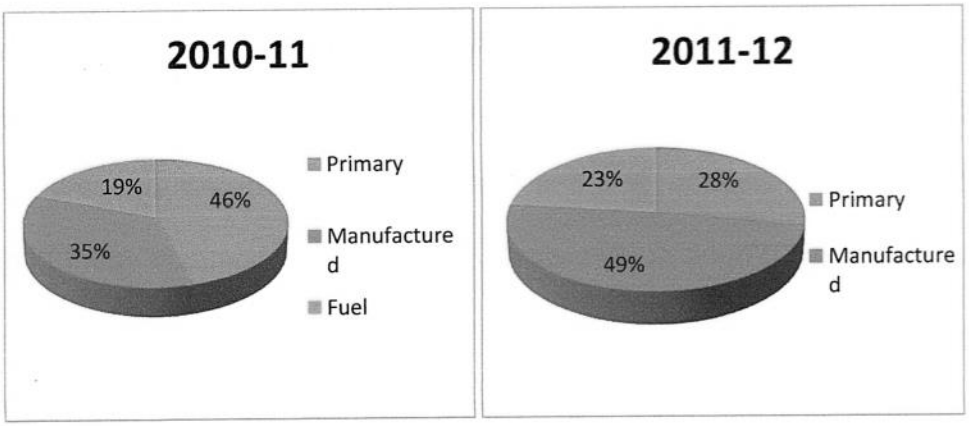

Figure 4.2: Contribution to Inflation by Major Groups Source: http://dbie.rbi.org.in

Figure 4.2 depicts contribution of various commodities towards inflation in the year 2010 and 2011. The primary articles refer to basic necessities which include food and clothing. The manufactures refers to industry produced products like utensils, bicycle etc. and the fuel represents all types like petrol, diesel, Kerosene, LPG etc. It can be seen that the primary articles contribution towards inflation came down from 46% in 2010-2011 to 28% in 2011-12. The contribution of manufacturing sector towards inflation increased from 35% in 2010-11 to 49% in 2011-12 and the contribution of fuel towards inflation increased from 19% in 2010-11 to 23% in 2011-12. This was due to rise in international crude oil prices in 2011-12. It is evident that Inflation in primary articles has declined drastically over a period of two years i.e. from 2010 to 2012; however, inflation due to fuel has continued to remain high during the last two years. Inflation in manufactured products had started to accelerate since January 2011 due to a surge in metal and chemical prices[22].

[22] http://www.stcipd.com/UserFiles/File/Headline%20vs.%20Core%20inflation%20-%20Indias%20Case.pdf

Compared to a relatively benign and stable inflationary period in the earlier part of the last decade, inflation started to rise in 2008-9 and persisted (refer figure 4.1). The pressure was mainly from primary and fuel products with the average inflation in these commodities remaining persistently in double digits for a major period since 2008-9[23]. In comparison, inflation in manufactured products remained relatively stable, dropping sharply in 2009-10 because of the global economic crisis and impacts in India, before it started to pick up and exceed its long-run average of around 5 per cent[24]. Among individual product groups, inflation in food products, beverages, textiles, chemicals, and basic metals remained elevated mainly on account of high global commodity prices and cost push pressures[25].

4.5 **Calculation of Inflation**

Inflation in India is calculated using wholesale Price Index (WPI). In this WPI for two time zone is taken, say beginning and end of the year. If at the beginning of the year 2011 the WPI was 133.9 and at the end of 2011 the WPI was 145.8 then the formulae for calculation of Inflation is:-

$$\text{Inflation} = \frac{(\text{WPI at end of year} - \text{WPI at beginning of year})}{(\text{WPI at beginning of year})*100.}$$

Hence for 2011 the Inflation = (145.8-133.9)/133.9 = 8.87

Thus Inflation for the year 2011 can be said to be 8.87%.

[23-25] http://dbie.rbi.org.in/DBIE/dbie.rbi?site=home

4.6 **Impact of Fuel Prices**

Apart from primary articles and manufactured goods, fuel is another major contributory factor behind high headline inflation in the last two years. The sharp rise and volatility of prices of oil and petroleum products in international markets has become a matter of global concern. Crude oil prices remained volatile during financial year 2011-12 due to political upheaval in the major oil-exporting countries coupled with increasing uncertainly in the global economic environment.

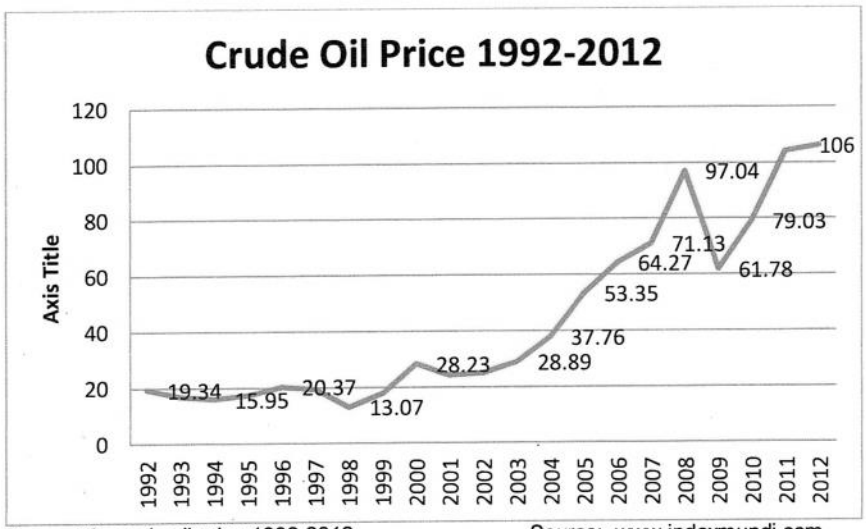

Figure 4.3: crude oil price 1992-2012 Source: www.indexmundi.com

It is evident from figure 4.3 that the Crude oil prices have steadily been increasing since beginning 2009. International crude oil (Brent) prices have moved up very sharply from US $ 75 per barrel to over US $ 106 per barrel in June 2012[26]. Simultaneously, the average price of the Indian basket of crude oil (The Indian crude basket represents the published prices of averaged Oman/Dubai crude oils for sour grade and Brent for sweet grade and the

[26] http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm

composition is determined by the processing capacity)[27] which was US $ 69.76 per barrel in 2009-10 has gone up to US $ 85.09 per barrel in 2010-11 and further to US $ 104 per barrel in 2011-12[28]. The effect of higher international crude oil prices on the domestic front was clearly evident as inflation in non-administered mineral oil, which consists of aviation turbine fuel, bitumen, furnace oil, and naphtha, recorded an increase of 41 per cent between September 2010 and January 2011[29]. In comparison, inflation in administered mineral oil prices (liquefied petroleum gas [LPG], kerosene and diesel) recorded an increase of only 11 per cent in the same period[30]. Therefore it is evident that the price of crude oil and petroleum products in the international oil markets has considerable impact on domestic prices of petroleum products.

With the dismantling of administered petrol prices (with effect from 26 June 2010), prices of petrol have risen sharply and continuous to rise[31]. Despite the increase in international oil prices, Indian consumers have been partially insulated from the adverse impact of price rise, as the prices of three important petroleum products, namely public distribution system (PDS) kerosene, LPG, and diesel continued to be administered by the Indian Government and the price rise has been passed on only partially. With effect from 13 Jan 2013, the government has put a cap on issue of subsidised LPG cylinders and thus only 9 LPG cylinders per family will get subsidised[32].

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[27] http://www.pib.nic.in/archieve/eec/2010/PetrobackEEC2010.pdf.
[28] http://ppac.org.in/writereaddata/PS_1_ii_CrudeOilPrice(H).xls
[29-30] http://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics

[31] http://ppac.org.in/writereaddata/PS_1_ii_CrudeOilPrice
[32] http://articles.timesofindia.indiatimes.com/2013-01-17/india/36393017_1_diesel-price-hike-ways-for-fiscal-consolidation-main-transportation-fuel. Accessed on 20 Jan 2013.

Having seen that fuel has a contributing factor to inflation and inflation is determined by WPI it is necessary to see how crude oil price and WPI Index moved together.

Table 4.1: Crude Oil Price and WPI Index

Year	Crude Oil Price	WPI Index
1992	19.34	47.77
1993	16.79	51.34
1994	15.95	56.75
1995	17.2	62.05
1996	20.37	64.83
1997	19.27	67.77
1998	13.07	71.75
1999	17.98	74.22
2000	28.23	79.09
2001	24.33	82.9
2002	24.95	84.99
2003	28.89	89.6
2004	37.76	95.49
2005	53.35	100
2006	64.27	104.74
2007	71.13	109.85
2008	97.04	119.39
2009	61.78	122.2
2010	79.03	133.88
2011	104.01	145.8
2012	106	159.1

Source: www.rbi.gov.in and http://www.eaindustry.nic.in

Table 4.1 gives the Crude Price and WPI Index from 1992 to 2012. To understand if there is any relationship exist between the two there is a necessity to draw a graph depicting both crude oil and WPI Index. The same is depicted in Figure 4.4

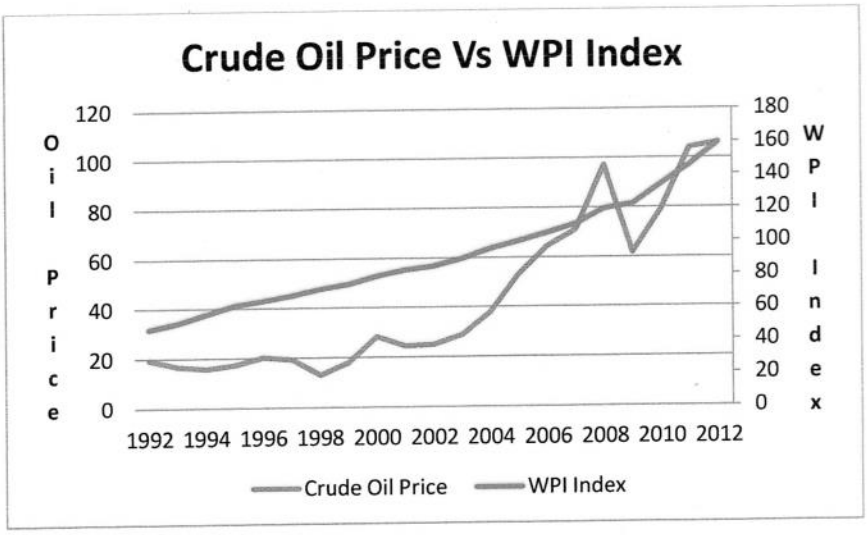

Figure 4.4: Crude Oil Price vs WPI Index

Figure 4.4 is a double Y axis graph. The x axis gives the year from 2002 to 2012 where as the Y axis on left gives the WPI Index and the Y axis on the right gives the Crude oil price in US$. Figure4.4 depicts the variation in crude oil price and WPI Index from 1992 to 2012. It can be seen that both crude oil price and WPI Index have been generally rising since 1992 to 2012 less for a interim period from 2008 to 2009 when the crude oil price declined. Thus a relationship exists between crude oil price and WPI Index.

To analyse the relationship statistically a hypotheses testing is conducted in the next section

4.7 **Scatter Plot**

Before the correlation is checked it is necessary to see the scatter plot to see if any linear relationship exists

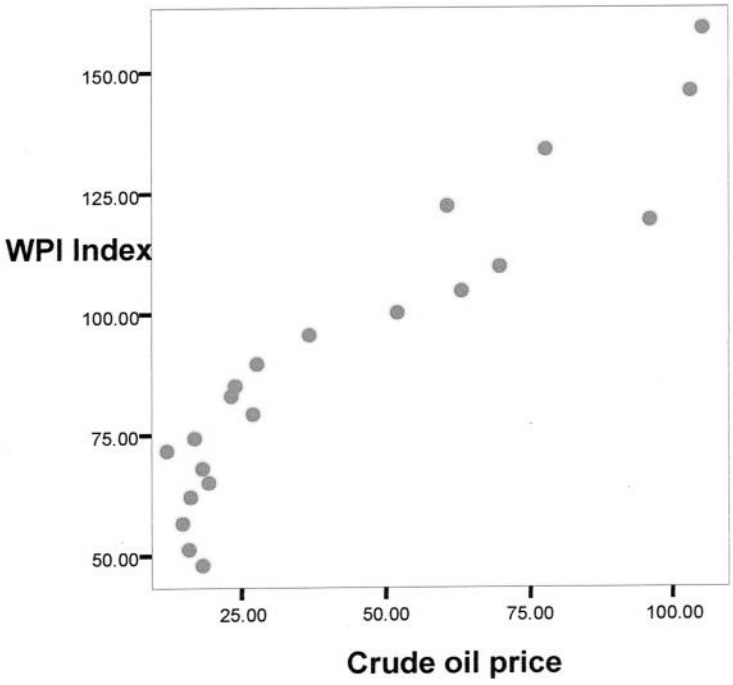

Figure 4.5: Scatter plot between Crude oil price and WPI Index

A scatter diagram shown in Figure 4.5 reveals that the relationship between Crude Oil price and WPI Index is not linear. Therefore the linear correlation does not exist and thus it is necessary that curve estimation is carried out for prediction

Table 4.2: Model Summary and Parameter Estimates

Dependent Variable: wpiindex

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.882	141.609	1	19	.000	50.931	.927		
Logarithmic	.877	134.899	1	19	.000	-55.431	41.525		
Inverse	.778	66.733	1	19	.000	138.474	-1313.503		
Quadratic	.887	70.872	2	18	.000	44.122	1.295	-.003	
Cubic	.901	51.631	3	17	.000	16.439	3.462	-.046	.000
Compound	.809	80.324	1	19	.000	56.756	1.010		
Power	.849	107.044	1	19	.000	17.945	.445		
S	.791	71.812	1	19	.000	4.977	-14.412		
Growth	.809	80.324	1	19	.000	4.039	.010		
Exponential	.809	80.324	1	19	.000	56.756	.010		
Logistic	.809	80.324	1	19	.000	.018	.990		

The independent variable is crudeoilprice.

4.8 Statistical Output

Table 4.2 summarizes all linear and curvilinear models with various parameter estimates. The model summary gives R Square which defines that amount of variation in dependent variable explained by the Independent variable. The significance value gives the P value of the ANOVA test conducted in Regression to check the overall validity of the model. A model to be significant, its P value should be less than α, the level of significance. The parameter estimates gives the value of constant and other estimates used in the model.

From Table 4.2 it is seen that in all the models the P value is 0.000 and is < α (0.01). Thus all the models are statistically significant. The R square in case of cubic has the maximum value which is 0.901 implying that 90.1%of variation in WPI is explained by the independent variable Crude Oil Price. Thus the equation for the model is

$\check{y} = 0.0002x^3 - 0.0461x^2 + 3.4617x + 16.439$ 4.1

Where $\check{y}$ is the estimated WPI and X is the crude oil price.

To check the model the crude oil price is taken as $ 53.35 and putting the value in equation 4.1 the $\check{y}$= 100.28 which is very near to the actual value

4.9 **Statistical Technique**

In statistics, regression analysis is a statistical technique for estimating the relationships among variables. It includes many techniques for modelling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. More specifically, regression analysis helps one understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. Regression analysis is widely used for prediction and forecasting. Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships

The Regression Model thus is

i.e. WPI Index = 0.0002* (Price of Crude Oil)^3 - 0.0461*(Price of Crude Oil)^2 + 3.4617*(Price of Crude Oil) + 16.439

4.10 **Prediction**

The model is being used to predict WPI as and when the crude oil price reaches 150$

Using equation 4.1

$WPI = 0.0002*(150)^3 - 0.0461*(150)^2 + 3.4617*(150) + 16.439$

WPI =173.44

At WPI =173 44 the inflation is (173.33 – 159.1)/159.1 = 0.090 = 9.01%

4.11 **Implications**

Inflation leads to change in fiscal and monitory policy. Fiscal policy is issued by Ministry of Finance whereas monitory policy is issued by Reserve Bank of India (RBI). Based on Inflation rate the RBI changes the Cash Reserve Ratio(CRR) and Statutory Liquidity Ratio(SLR). The cash reserve ratio is a RBI regulation that sets the minimum fraction of customer deposits and notes that each commercial bank must hold as reserves. These required reserves are normally in the form of cash stored physically in a bank vault (vault cash) or deposits made with the RBI. Statutory Liquidity Ratio refers to the amount that the commercial banks require to maintain in the form gold or govt. approved securities before providing credit to the customers. Thus less the CRR and SLR more money flow is available for lending and more growth

Similarly increase in inflation leads to increased non plan expenditure in terms of dearness allowance increase to government employees and other expenditures. Thus the finance ministry can tighten the budget in spending by putting certain restrictions

4.12 **Conclusion**

The rate of inflation is dependent on the WPI Index which has a correlation with crude oil price and varies as per crude oil price. The regression equation developed gives an indication on the variation in WPI Index in case the crude oil price increases by one US $. Thus the suggested model can be used to predict the inflation rate for future on an assumed increase or decrease in crude oil price and can be a tool for planning.