IMPACT OF EXTERNAL SHOCK ON INFLATION IN INDIA

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Abstract

The objective of this study is to find out the the impact of external shock in influencing inflation in India in the post reform era. The model used to study this objective is vector autoregression (VAR). The external variable considered for the study is the international crude oil price in terms of Indian rupee. Whereas, both India's series of consumer price index - industrial worker (CPI-IW) and wholesale price index (WPI) has been considered as the inflationary variable . The results show that there is direct causality from the crude oil price to wholesale price index (WPI) based inflation. It is also found that this causality is instantaneous, i.e., *any change in crude oil price immediately impacts WPI. But, when consumer price index (CPI) based index is taken for the analytical purpose then there is no relationship between inflation and external shock. This may be probably due to the fact that diesel and petrol (crude oil products) have 40.0 per cent weightage in WPI-fuel & power basket, whereas in CPI-fuel & light basket it has negligible weightage.*

***Keywords:** External Shock, Inflation, Crude Oil Price, Exchange Rate, Indian Economy*

1. INTRODUCTION

Due to sustained economic growth and increasing energy requirement India has become the world's third largest crude oil importing country after China and the United States. It imports around 80.0 per cent of its crude oil requirements. *Fall in crude oil prices by every one dollar brings down import bill down by around Rs. 6,500 crore and the government subsidy burden is reduced by around Rs. 2,900 crore. But at the same time every one rupee depreciation of rupee against dollar increases oil import bill by almost Rs. 7,455 crore.* Keeping these macroeconomic facts and the fact that import of crude oil constitute around one-third of India's total import payment, international crude oil price in terms of Indian rupee has been taken as a proxy for external shock with regard to imported inflation.

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Since opening up of the economy, the world commodity prices and fluctuations in exchange rates seem to have played an important role in domestic price level determination. Global commodity price shock was probably one of the factors which had exacerbated the inflation problem during 2010-11 to 2013-14 in India. Similarly, depreciation in Indian rupee since 2012-13 has offset the benefit which could have been enjoyed due to decreasing commodity prices. With decrease in the international crude oil prices by more than 50.0 per cent since June 2014-15, WPI based inflation had decreased considerably and was in the negative territory since November 2014-15 till April, 2016-17.

Hence two research questions arise : *(i) Is there direct relationship between external shock and inflation in India?; and (ii) if there is direct relationship between the two then how much of the variance in inflation is affected by external shocks?*

Keeping these research questions in mind the *objective of this chapter is to find out empirical relationship between the external shock to the economy and inflation rate in India.*

This study is further divided in five sections. In section 2 literature review related to the research question is discussed. Section 3 elaborates the research methodology. Whereas, section 4 analyses the choosen economic variables descriptively. Section 5 summarises result of empirical analysis and section 6 concludes the study.

2. LITERATURE REVIEW: ROLE OF GLOBAL FACTORS AND MONETARY POLICY IN INFLUENCING INFLATION IN INDIA

Exchange rate in India till 1990 was nominally pegged to a basket of currencies, and only after the payment crisis of 1991 a two step downward adjustment in the exchange rate was undertaken. This was followed by a transitional 11 month period of dual exchange rates before a market determined exchange rate system was set in place in March, 1993. Since then, the exchange rate is primarily market determined.

India abolished Administrative Pricing Mechanism (APM) in April,2002. Under the APM, the central government directly controlled the pricing of petroleum products, based on cost of operating capital plus formula.

Under the new formula, the Oil Marketing Companies (OMCs) were free to price their products, based on import parity pricing formula. But increasing price of crude oil since 2004 had made the government uncomfortable with rising petroleum prices, which would have fueled inflation, so again the Govt. of India (GoI) started sanctioning upward price revision of petroleum prices. The same arrangement is in place even now, as companies are free to decide their prices but are prone to government sanctions.

Given the importance of petroleum products in the economy, any increase in price has potential of fanning upward pressure on inflation, which in turn harms the overall economic progress of the nation. Popular perception in the Indian psyche is that whenever petroleum prices increase inflation increases. It is believed to be at the heart of soaring inflation during 2009 to 2011. But since Mid 2014 the crude oil price has fallen for more than 50 per cent and during the same period, the WPI growth has also been slower.

The RBI's monetary policy has been lauded by the economic commentators for breaking the rising inflationary expectation in India since mid 2014. But given the fact that, the period of cooling down in inflation has coincided with the cooling in international crude oil price, it has become imperative to study the relationship between inflation and crude oil price. Before undertaking this study by incorporating latest macroeconomic data, we have surveyed the literature on the subject, out of which some important studies have been discussed below:

[10] has noted that historically inflation in India had remained moderate with average annual headline WPI from 1950-51 to 2012-13 to be around 6.7 per cent.

In the paper the researchers have used Structural Vector Autoregression(SVAR) to identify the determinants of inflation in India. Their finding shows that global factors impact on inflation is immediate and significant.

[13] using the monthly data from January,1990 to March,2011 of China, India and Australia shows that the external factors account for a little variation in domestic prices of China and India. The authors conclude that decrease in international crude oil price has less impact on inflation in India and hence less effective in controlling inflation.

[1] analyses the impact of international oil price shocks and different configurations of pass through policy for oil on the major macroeconomic variables in India using structural macroeconomic model. The paper found that in case of partial pass through of international crude oil shock a 10.0 per cent rise in international crude oil price results in rise of WPI by 0.3 per cent whereas in case of complete pass through, the increase in WPI due to 10 per cent rise in international crude price is 0.6 per cent.

[9] April,1994 to March,2010 and VAR model have found that there is high pass-through impact of international prices on domestic inflation in India since 2002, when prices of some petroleum products began to adjust frequently in line with changes in international crude prices.

[7] using the quarterly data from April-June,1996 to March,2011 have found that, internationl crude oil prices have no statistically significant impact on inflation. The exchange rate pass-through was found to be 0.06 in the short run and 0.12 in the long run.

[14] using the data from January,2005 to December,2011 have found that, in short run, crude oil price did affect inflation and it granger caused inflation, whereas the exchange rate did not granger caused inflation.

[4] using the Global vector autoregression (GVAR) and data from 33 advanced and emerging economies have found that, oil and food price shocks have different inflationary effects. During the period 1999-2007, the inflationary effects of an oil price shock mostly affected developed regions while food price increases hit particularly to emerging economies.For the US and the euro area, there was no significant relationship between oil shocks and core inflation.

[2] using the data for the period April,1994 to December,2008 and using SVAR model have concluded that, when domestic prices are allowed to reflect changes in international prices, its contribution in inflation is about 39 per cent by the sixth month.

[6] in the paper had sought to identify the underlying sources of developing Asia's inflation, in particular the relative importance of demand pull factors versus cost push factors. They collected the data for nine asian economies including India. A VAR model had been used. Quarterly data from 2001 Q1-2009 Q1 was used for the purpose. The factors included were oil and food prices, output gap, exchange rate and domestic inflation. They found that the developing Asia's inflation was largely due to two factors, namely excess aggregate demand and inflationary expectations. According to the authors this finding was in sharp contrast to the prevailing misconception that the region's rising inflation was beyond the control of monetary policy because it was mostly the result of global food and oil price shocks.

They also found that, external food and oil price shocks explained less than 30 per cent of Asia's Consumer Price Index(CPI) inflation, except in Vietnam. In contrast, excess aggregate demand and inflationary expectations explained about 60 per cent of the CPI.

[3] using the monthly data from September,1997 to October,2007 and using the VAR and Vector Error Correction Model(VECM) have concluded that, exchange rate pass through in India is moderate. The long run pass through elasticity for WPI is 28.6 per cent. The authors also find out that the immediate effect on WPI of 100 per cent exchange rate shock is around 12 per cent which falls to 1.3 per cent in the next year.

They have also found that, crude oil prices have moderate impact on inflation which they argue is due to the administered fuel prices in India.

[11] using annual data for the period 1950-2007 and VECM model have found that, import prices, capital flows and exchange rate have statistically significant positive association with domestic inflation in the long run. The empirical findings of the paper suggested that, global factors (import prices, capital flows, movements of exchange rate) contributed 20 to 30 per cent in domestic inflation in India.

[8] investigates the exchange rate pass-through on inflation in India, since July 1991. He concludes that, there is no evidence of decline in the pass-through of exchange rate on domestic prices. He also observes that, there is asymmetry in pass-through between appreciation and depreciation of exchange rate changes.

[5] using the data from 1970-71 to 1984-85 and applying input-output system have found that, if administered price pf petroleum rose by 7 per cent it resulted in WPI increase of 1 per cent.

3 Data and Methodology

3.1 Data Source

Since our endevour is to find out the impact of external shock (international crude oil price and exchange rate) on inflation after the liberalization, our sample period is, from April, 1991 to May, 2015. Accordingly, we have collected the series of india's Wholesale Price Index (WPI), nominal exchange rate from the RBI's data base *database on Indian Economy (dbie)*. We have collected data on international crude oil price from the World bank database of *GEM Commodities*. We have taken WPI as inflation measure since the RBI communicated indicative level of inflation in terms of WPI itself till february,2015. We have also multiplied average international crude oil price in terms of dollar with average nominal exchange rate to find out crude oil prices in domestic currency. This, crude oil price in domestic currency has been taken as the global factor influencing WPI.

WPI series has been converted to the base year of 1981-82 using linking factor of 2.478 for 1993-94 base year. 2004-05 base year has been first converted to the base year 1993-94 by multiplying 1.875 and again it has been converted to 1981-82 by multiplying by 2.478. These multipliers has been suggested by the office of the Economic Adviser,the Govt.of India, Ministry of Commerce and Industry, Department of Industrial Policy and Promotion(DIPP). Finally we have taken natural logarithm of all the time-series data.

CPI-IW has ben taken as alternate measure of inflation, as WPI does not capture price movement at the point of consumption. Till 2013, three different indicators of Consumer price index (CPI) were provided by the Labour ministry of the government of India out of which CPI-IW has been used for this study. The rationale for selecting CPI-IW is the fact that it has strong and statistically significant correlation with the new monetary policy target of CPI-combined [12].

The base year of CPI-IW has been taken as 1982 and 2001 base year index is being converted into 1982 index using conversion rate at 4.63 as provided by the Labour Bureau, Government of India.

3.2 Model Specification

To find out the impact of changes in internation crude oil price and money supply

on inflation we have employed Vector Autoregression(VAR). The test in described below:

Vector Autoregression(VAR)

Since the criticism of [15] of the paradigm of simultaneous equation models laid out by Cowles Foundation in the 1940s and 1950s, VAR has become a standard instrument for analysis of multivariate time-series analysis.

In basic form, a VAR consists of a set of K endogenous variables $y_t=(y_1 t,....., y_k t,....., y_K t)$ for K=1,....K. The VAR(p)-process is then defined as

$$Y_t = A_1 Y_{(}t-1)+......+A_p Y_{(}t-p) + CD_t + u_t \qquad (3.1)$$

Where A_i are (K × K) coefficient matrices for $i = 1,....,p$ and u_t is a K-dimensional white noise process. The matrix C is the coefficient matrix of potentially deterministic regressors with dimensions (K × M), and D_t is an (M × I) column vector holding the appropriate deterministic regressors, like constant, trend and dummy variables.

4 Impact of External Shocks on Inflation: Descriptive Analysis

Fluctuation in international crude oil price (in terms of rupee) and trend in WPI based inflation have been summarized in table 1 and figure 1. From the table and figure it becomes clear that there is wide variance in the price of crude oil during the period of analysis. For example in the wake of the Asian financial crisis in 1997-98 crude prices went below $ 10 per barrel, later it suddenly went up by 80.3 per cent in 1999-2000. Inflation rate too decelerated to 4.6 per cent and 4.4 per cent in 1996-97 and 1997-98 respectively and again increased to 7.2 per cent in 2000-01 from 3.3 per cent in 1999-2000. In July 2008-09, crude oil price again reached $ 147.27 per barrel before crashing down to $ 30.28 a barrel on December 23, 2008-09 and in accordance with it inflation first increased to 8.1 per cent in 2008-09 from 4.7 per cent in the previous year and then got decelerated to 3.8 pre cent in 2009-10. This points out at some relationship between crude oil prices and inflation.

From the figure it becomes clear that crude oil price has followed positive growth path in ten years and negative path in eleven years out of the twenty-one years analyzed. Similarly, WPI based inflation has followed eleven years of positive path and ten years of negative path. On the other hand, these two variables have followed same growth path eleven years and opposite growth path in ten years. So, from this descriptive analysis there seems to be some relationship between these two variables which warrants further in-depth empirical analysis.

Table 1: Yearly Average Crude Oil Price (in rupee) and Yearly Average WPI based Inflation: April 1994-95 to May 2014-15)

*Year	Crude Price pre cent change	Inflation per cent growth
1994 − 95	6.7	12.4
	11.0	8.0
1996 − 97	27.9	4.6
1997 − 98	-13.2	4.4
1998 − 99	-19.5	5.9
1999 − 2000	80.3	3.3
2000 − 01	36.3	7.2
2001 − 02	-14.6	3.6
2002 − 03	21.4	3.4
2003 − 04	0.2	5.5
2004 − 05	38.8	6.5
2005 − 06	36.4	4.4
2006 − 07	13.5	6.6
	13.0	4.7
2008 − 09	15.9	8.1
2009 − 10	-11.9	3.8
2010 − 11	16.4	9.6
2011 − 12	33.3	8.9
2012 − 13	9.2	7.4
2013 − 14	12.0	6.0
2014 − 15	-19.3	2.0

(Compiled by the researcher from the Reports of the RBI and the World Bank. Data Retrieved from www.rbi.org.in/Scripts/AnnualReportMainDisplay.aspx. and data.worldbank.org/data-catalog/commodity-price-data).

5. Empirical Analysis

The time series variables utilized in the present study are WPI, CPI and Crude oil price in Indian rupee for the period of April 1994-95 to May 2015-16. This study has taken two different time periods for analysis, one from April 1994-95 to May 2015-16; the time when the exchange rate in India became market determined and another from April 2002-03 to May 2015-16; when price determination of some of the petroleum products got deregulated.
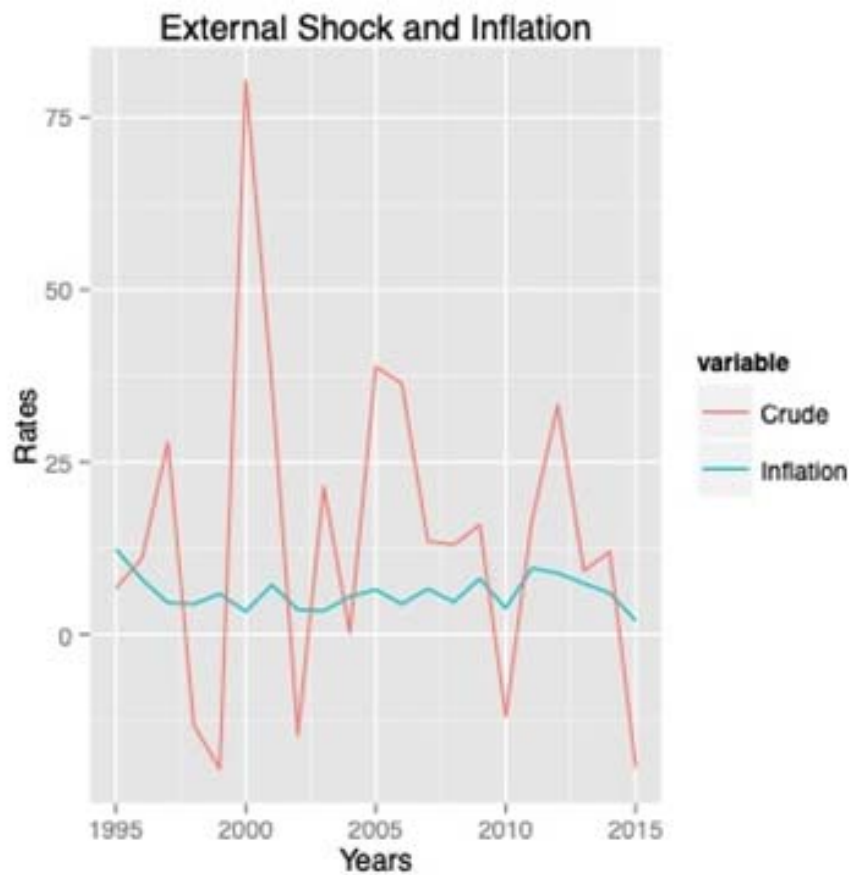

**Figure 1: Crude oil Price Changes (In Indian rupee) and Rate of Inflation
(WPI): April 1994-95 to May 2014-15**

5.1 Impact of Crude Oil Price on Inflation: April 1994-95 to May 2015-16

Stationarity of the macroeconomic variables have been tested in level and first difference form and have been reported in table 2. The results show that all the variables are non stationary in level form but stationary in first difference, *i.e.*, they are integrated to level one, *I(1)*.

Table 2: Stationarity and Integration of WPI, CPI and Crude Oil Price In Indian Rupee: ADF and KPSS test, April 1998-99 to May 2015-16)

*Variable	In level form		Stationarity	first difference		Stationarity
	ADF	KPSS	result	ADF	KPSS	result
lnWPl	-2.14	6.65	non stationary	-5.57	0.17	stationary
lnCPl	-1.05	6.52	non stationary	-6.94	0.17	stationary
Crude (in Rs.)	-2.89	6.47	non stationary	-6.69	0.05	stationary

(ADF and KPSS critical values at 95% are -3.42 and 0.46 respectively.)

Impact of Crude Oil Price in Terms of Indian Rupee on WPI: April 1994-95 to May 2015-16

Diagnostics of VAR for WPI and Crude oil price (in Indian rupee) has suggested using lag length of 4 (BG LM test p-value= 0.65). After selecting the lag of 4, cointegration rank has been calculated, the result of which has been shown in table 3. The table suggests that there is no cointegration relationship between WPI and crude oil price.

Table 3: Cointegration Rank (Johansen Cointegration Test for WPI and crude oil price: April 1994-95 to May 2015-16)

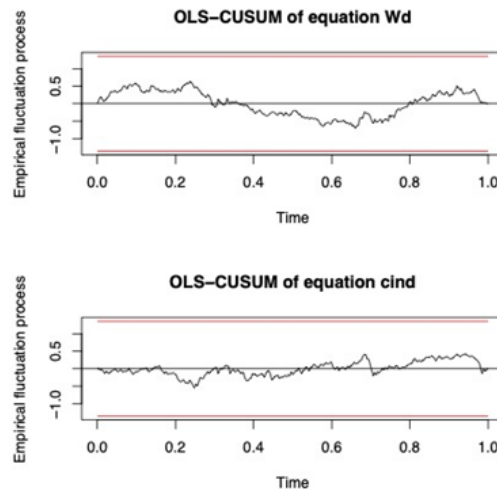| Cointegration Rank- eigenvalue statistics				
Cointegration				
Rank	Test Statistics	10%	5%	1%
r < = 1	1.29	6.50	8.18	11.65
r < =	013.88	12.91	14.90	19.19

Figure 2: VAR-Structural Stability Plot Δ WPI and   Crude oil: April 1994-95 to May 2015-16

Since there is no cointegrating relationship between these two variables, in the next step first difference of the variables have been taken to make them stationary (table 2) and then vector autoregression (VAR) model has been applied. Diagnostics of VAR lag length selection criteria has suggested using the lag length of 4 (BG LM test value= 0.18). The stability test suggests structural stability of the model (figure 2). After the diagnostic tests the model is used for further analysis. For this analytical purpose Granger causality test, impulse response function (IRF) and forecast error variance decomposition (FEVD) are used.

The Granger causality result has been reported in table 4. From the table it is clear that *crude oil price Granger causes WPI, i.e., crude oil price helps in predicting WPI. Similarly, the hypothesis that there is no instantaneous causality is also rejected, which implies that crude oil price have instantaneous impact on WPI.*

Table 4: Granger Causality Result (VAR model for crude oil price and WPI: April 1994-95 to May 2015-16)

Granger causality from	crude oil price to WPI	
Test	p value	Inference
Granger causality	0.000	Null hypothesis of no Granger causality is rejected
Instant causality	0.000	Null hypothesis of no instantaneous causality is rejected

Granger causality only tells about the direction of causality but does not quantify it. For the quantification of the relationship, impulse response function (IRF) and forecast error variance decomposition (FEVD) are used. IRF result has been shown in figure 3. The figure depicts impulse response of WPI in response of a unit shock to crude oil price at time t. From the figure it is clear that once the shock is given to crude oil price, it will have immediate impact on WPI and the impact will get diluted after twelve months. *If 100.0 per cent shock is given to crude oil price it will impact positively to WPI by 0.21 per cent in the next month, with cumulative six month impact being 0.46 per cent.*

Forecast error variance decomposition (FEVD) has been presented in table 5. From the table it becomes clear that *11.5 per cent variance error in WPI at t+1 is explained by shock in crude oil price, which points to the immediate impact of shock in international crude oil prices on WPI based inflation in India.*
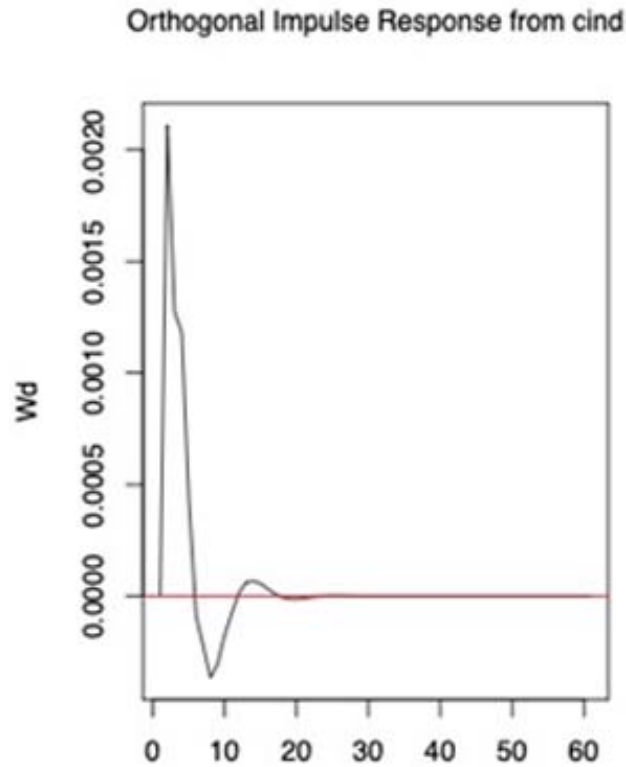
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Figure 3: Impulse Response of   WPI in Response of Shock to   crude oil price:
April 1994-95 to May 2015-16

Table 5: Forecast Error Variance Decomposition- Crude Oil Price and WPI:
April 1994-95 to May 2015-16

FEVD-IIP				
Variable	Variance	Variance	Variance	Variance
	error in WPI explained-1 month ahead(%)	error in WPI explained-3 months ahead(%)	error in WPI explained-6 months ahead(%)	error in WPI explained-12 months ahead(%)
WPI	88.5	83.2	83	82.6
Crude	11.5	16.8	17	17.4

Impact of crude oil price in Indian rupee on CPI: April 1994-95 to May 2015-16

Diagnostics of VAR for CPI and Crude oil price (in Indian rupee) has suggested using lag length of 3 (B-G LM test p-value= 0.097). After selecting the lag of 3 ,

cointegration rank has been calculated, the result of which has been shown in table 6. The table suggests that there is no cointegration relationship between CPI and crude oil price.

Table 6: Cointegration Rank (Johansen Cointegration Test for CPI and Crude oil Price: April 1994-95 to May 2015-16)

Cointegration Rank- eigenvalue statistics				
Cointegration Rank	Test Statistics	10%	5%	1%
	0.36	6.50	8.18	11.65
	8.14	12.91	14.90	19.19

Since there is no cointegrating relationship between these two variables, in the next step first difference of the variables have been taken to make them stationary (table 2) and then vector autoregression (VAR) model has been applied. VAR lag length selection criteria has suggested using lag length of 3. Diagnostics of the model has suggested that there is serial correlation in the residuals of the model (B-G LM test p-value= 0.004). Due to this serial correlation in the residuals of the model, it cannot be taken further for the analytical purposes.

5.2 Impact of Crude Oil Price on Inflation: April 2002-03 to May 2015-16

Stationarity of the macroeconomic variables have been tested in level and first difference form and have been reported in table 7. The results show that all the variables are non stationary in level form but stationary in first difference, *i.e.*, they are integrated to level one, *I(1)*.

**Table 7: Stationarity and Integration of , and Crude Oil in Indian Rupee: ADF and KPSS, April 2002-03 to May 2015-16**

*Variable Stationarity	In level form		Stationarity	first difference		
	ADF	KPSS	result	ADF	KPSS	result
inWPI	-1.57	4.02	non stationary	-5.44	0.14	stationary
lnM3	-2.91	4.02	non stationary	-5.56	0.46	stationary
Crude(in Rs.)	-2.10	6.56	non stationary	-5.44	0.14	stationary

Impact of Crude Oil Price in Indian rupee on WPI: April 2002-03 to May 2015-16

Diagnostics of VAR for WPI and Crude oil price (in Indian rupee) has suggested using lag length of 3 (B-G LM test p-value= 0.78). After selecting the lag length, cointegration rank has been calculated, the result of which has been shown in table 8. The table suggests that there is no cointegration relationship between WPI and crude oil price.

**Table 8: Cointegration Rank (Johansen Cointegration Test for WPI and Crude Oil Price:
April 2002-03 to May 2015-16)**

Cointegration Rank- eigenvalue statistics

Cointegration Rank	Test Statistics	10%	5%	1%
	0.33	6.50	8.18	11.65
	12.91	12.91	14.90	19.19
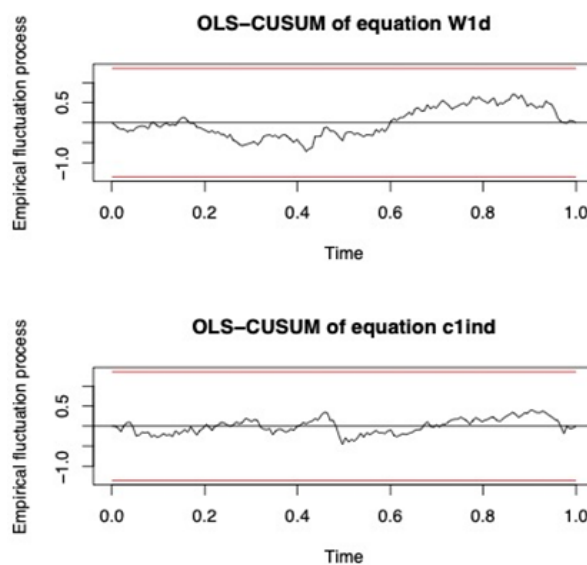
Figure 4: VAR-Structural Stability Plot WPI and Crude oil: Apirl 2002-03 to May 2015-16

Since there is no cointegrating relationship between these two variables, in the next step first difference of the variables have been taken to make them stationary (table 7) and then vector autoregression (VAR) model has been applied. VAR lag length selection criteria has suggested using lag length of 4. Diagnostics of the model has suggested that there is no serial correlation in the residuals of the model (B-G LM test p-value= 0.23). The stability test suggests structural stability of the model (figure 4). After the diagnostic tests the model is used for further analysis. For this analytical purpose Granger causality test, impulse response function (IRF) and forecast error variance decomposition (FEVD) are used.

The Granger causality result has been reported in table 9. From the table it is clear that *crude oil price Granger causes WPI, i.e., crude oil price helps in predicting WPI. Similarly, the hypothesis that there is no instantanious causality is also rejected, which implies that crude oil price have instantanious impact on WPI.*

Table 9: Granger Causality Result (VAR model for   Crude Oil Price and   WPI: April 2002-03 to May 2015-16)

Granger causality from	crude oil price to	WPI
Test	p value	Inference
Granger causality	0.000	Null hypothesis of no Granger causality is rejected
Instant causality	0.01	Null hypothesis of no instantaneous causality is rejected

For further analytical purpose impulse response function (IRF) and forecast error variance decomposition (FEVD) are used. IRF results have been shown in figure 5. It depicts impulse response of   WPI in response of a unit shock to   crude oil price at time t. From the figures it is clear that once the shock is given to   crude oil price , it will have immediate impact on   WPI and the impact will die after twelve months. *If 100.0 per cent shock is given to crude oil price it will impact positively to   WPI by 0.30 per cent in the next month, with cumulative six month impact being 0.75 per cent.*

Forecast error variance decomposition (FEVD) has been presented in table 10. From the table it becomes clear that *25.0 per cent variance error in   WPI in t+3 (three months after the shock) is explained by   crude oil price, which points to the immediate and significant impact of shock in international crude oil prices on WPI based inflation in India.*
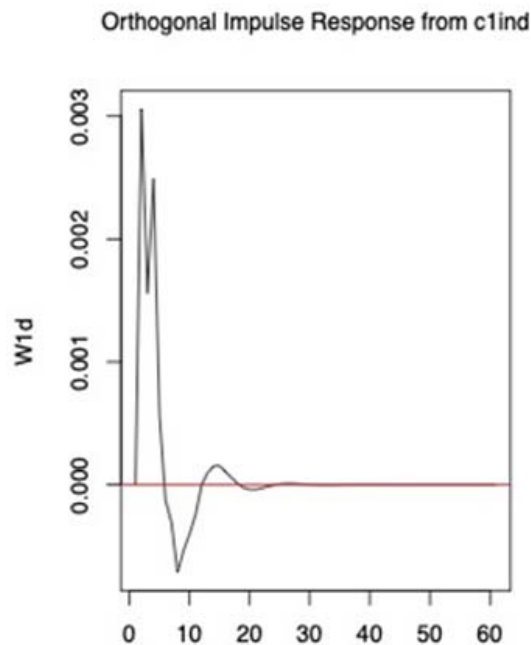

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Figure 5: Impulse Response of WPI in Response of Shock to Crude Oil Price:

April 2002-03 to May 2015-16

Table 10: Forecast Error Variance Decomposition-
Crude Oil Price and WPI: April 2002-03 to May 2015-16

FEVD-IIP

Variable	Variance error in WPI explained-1 month ahead(%)	Variance error in WPI explained-3 months	Variance error in WPI explained-6 months ahead(%)	Variance error in WPI explained-12 months ahead(%)
	84.0	74.3	73.4	73.3
	16.0	25.7	26.6	26.7

Impact of Crude Oil Price in Indian rupee on CPI: April 2002-03 to May 2015-16

Diagnostics of VAR for CPI and Crude oil price (in Indian rupee) has suggested using lag length of 3 (B-G LM test p-value= 0.10). After selecting the lag, cointegration rank has been calculated, the result of which has been shown in table 11. The table suggests that there is no cointegration relationship between CPI and crude oil price .

Table 11: Cointegration Rank (Johansen Cointegration Test for CPI and Crude Oil Price: April 2002-03 to May 2015-16)

Cointegration Rank- eigenvalue statistics				
Cointegration Rank	Test Statistics	10%	5%	1%
	0.60	6.50	8.18	11.65
	8.77	12.91	14.90	19.19

Since there is no cointegrating relationship between these two variables, in the next step first difference of the variables have been taken to make then stationary (table 7) and then vector autoregression (VAR) model has been applied. VAR lag length selection criteria has suggested using lag length of 7. Diagnostics of the model has suggested that there is serial correlation in the residuals of the model (B-G LM test p-value= 0.00). Due to this serial correlation in the residuals the model, it cannot be taken further for the analytical purposes. This shows that since still almost all petroleum product prices were subsidized in the domestic market obviously its impact would be almost nil on CPI.

6 Conclusion

This study has empirically assessed the impact of external sector on inflation in India since the start of liberalization of the economy in 1991-92. Given the importance of crude oil in total import of India, international crude oil price in Indian rupee has been taken as a proxy for external sector.

The study has been broken into two periods, one starting from April 1994-95 (when exchange rate became market determined) till May 2015-16 and another

from April 2002-03 (when pricing of some petroleum products were deregularized) till May 2015-16.

The results show that in both the periods there were direct causality impact of crude oil price on wholesale price index (WPI) based inflation. It was also found that this causality was instantaneous, *i.e.,* any changes in crude oil price directly and immediately impacted WPI. The results also show that this transmission of external shock to inflation has strengthened since April 2002-03 when some of the petroleum prices were deregulated (contribution of crude oil in the error variance of WPI six month after a shock was 17.0 per cent for the period of April 1994-95 to May 2015-16, whereas it was 26.0 per cent during the partial deregulated phase of April 2002-03 to May 2015-16).

But, when consumer price index (CPI) based index is taken for the analytical purpose then there is no relationship between inflation and external shock. This may be probably due to the fact that diesel and petrol (crude oil products) have 40.0 per cent weightage in WPI-fuel & power basket, whereas in CPI-fuel & light basket it has negligible weightage. This discrepancy in weightage may also be one of the factors which explains the divergence between WPI and CPI during much of 2015 and 2016 (WPI was in negative territory for seventeen straight months, whereas CPI was hovering between 5.0 and 6.0 per cent.)

FOOTNOTES

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