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IMPACT OF OIL PRICE FLUCTUATIONS ON WPI INFLATION

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ABSTRACT

Oil plays a significant role in the economy of a nation. Crude oil is one of the biggest necessities of the world and India imports around seventy percent of its energy needs by importing crude oil. This, in turn, results in spending huge amounts of foreign exchange. The increasing trend of imports of petroleum products has a dramatic impact on the Indian economy, that too when crude oil prices are shoring up internationally. Persistently high inflation is a key challenge facing India today.

Crude oil not only serves as a source of energy but also as a major raw material to various industries. With no major discoveries in the recent years, the increasing costs of production have pushed up crude oil prices globally. The trends have been reversed only in near future when crude oil prices have moderated since 2014.

Crude oil price increase leads to a sharp increase in the general price level as costs on account of direct and indirect use of oil in producing final goods go up. Given the magnitude of the shock and high oil-intensity of the Indian economy, the policy-makers' concern relating to full pass through is by no means exaggerated.

According to the Reserve Bank of India (2005)[i] , with no government intervention, each US dollar increase in crude oil price raises WPI inflation by 30 basis points, half of which is due to the direct effect and the other half to the indirect effect.

KEY WORDS- *WPI Inflation, wage-effect, money supply.*

TRANSMISSION MECHANISM OF OIL PRICE SHOCKS

First, since oil products are as consumption commodities by economic agents, an increase in the oil price has a direct effect on inflation. At the same time expensive oil price increases the costs of production for firms. If the firms decide to partially or totally pass the cost increase onto the households by increasing prices of goods, including those not related to energy, this will push up core inflation (indirect effect).

The magnitude of these two effects together depends on the country's relative position in the oil market, i.e. whether the country is a net-importer or net-exporter of oil, its level of oil intensity, and the degree of competition within each industry that is affected by the oil prices.

Second-round effects are more complicated and more interesting from policy maker's point of view, and emphasize impact of a rise in the oil price on nominal wages. On the one hand, higher consumer prices might raise demand for higher nominal wages to maintain purchasing power, which would hike up costs for the firms resulting into a wage price spiral which can lead to a persistent impact on inflation.

Undoubtedly this wage-effect is determined on whether or not wages are automatically indexed to prices, as well as on the bargaining position of the labor force and labor market imperfections.

Model Specification

We employ a Time Series Analysis to assessing the quantitative significance of crude oil prices on inflation (wholesale price index).

$$\Delta Y_t = a + \beta X_t$$

$$\Delta wpi_t = a + \beta_1 \Delta p_t + \beta_2 \Delta mlag10_t + \beta_3 \Delta plag2_t + \beta_4 \Delta elag2_t + \beta_5 \Delta t_t + u_t$$

We regress first difference of wholesale price (wpi) on first difference of crude oil price (p), first difference of money supply lagged by 10 months (mlag10), first difference of price of crude oil lagged by 2 month (plag2) , first difference of real exchange rate lagged by 2 months (elag2) and first difference of interest rate on call money(t).

We use first difference of wholesale price index (wpi1) as our dependent variable and first difference of crude oil price (p1) as independent variable along with first difference of value of broad money supply lagged by ten months (mlag10_1), first difference of price of crude oil lagged by two periods, first difference value of real exchange rate lagged by two periods, first difference of value of call lending rate as other explanatory variables.

The choice of **Wholesale Price Index NewSeries (Base : 2004-05=100)**[ii] as representative measure of inflation is due to the fact that the data for the same is monthly available, includes a comprehensive set of commodities and is better representative of overall inflation in the economy.

We use monthly data from RBI to monitor changes in wholesale price index vis a vis other explanatory variables.

We use first difference of **crude oil price (Indian basket)** as an explanatory variable.

We use data on monthly price of crude oil. The Indian basket of Crude Oil represents a derived basket comprising of Sour grade (Oman & Dubai average) and Sweet grade (Brent Dated) of Crude oil processed in Indian refineries in the ratio of 71.03:28.97 during 2015-16.

We use **broad money supply (m3)** as measure of monetary aggregate in the model.

Economic theory proposes that as money supply increases the price level in the economy increases. The mechanism for the same is traced through an increase in Aggregate Demand on account of increase in money holding on part of individuals which leads to inflationary pressure if supply remains unchanged.

But in a demand constrained economy (less than full-employment output and with high levels of involuntary unemployment) like India the mechanism for increase in inflation on account of increase in money supply is less likely to operate. Nonetheless we include the variable on monetary aggregate as it impacts inflation as well as exchange rate in principle. Hence dropping out the variable would **produce biased estimates.**

We use **price of crude oil lagged by two periods** in the model so as to understand the time frame in which a crude oil shock impacts WPI.

We use **value of real exchange rate lagged by two periods** as one of the explanatory variables in the model as increase in real exchange rate (real depreciation of currency) makes imports expensive and diverts the demand from our trading partners to home economy hence leads to stimulated Aggregate Demand and hence causes inflation.

But again in a demand constrained economy (less than full-employment output and with high levels of involuntary unemployment) like India the mechanism the same is less likely to operate.

Hence a priori we do not expect to see variables of money supply and exchange rate to have any significant impact on inflation.

It has been found that faced with a sudden rise in crude prices (in backdrop of high inflation) RBI has often gone in for a monetary tighteningso as to neutralize the cost-push effect of the shock on the price level and hence inflation. Hence to avoid biasedness in results it makes sense to include above discussed variables in the model.

We include the **interest rate on call lending** as another explanatory variable as interest rate in call money market goes up indicates liquidity crunch in the economy. This will further lead to decline in the credit creation in the economy by financial intermediaries and hence will drive up the prices.

Hence a priori we expect to see very significant impact of interest rate on call lending on WPI.

Data Sources

• Data on WPI was taken from RBI archives.
• Data on monthly price of crude oil of Indian basket was taken from archives of Petroleum Planning & Analysis Cell (PPAC) .
• Data on real effective exchange rate was taken from RBI archives.
• Data on call interest rate month wise was procured from averaging the daily data of call interest rate available in RBI archive.

We use the time period from 2005-2015 for the analysis.

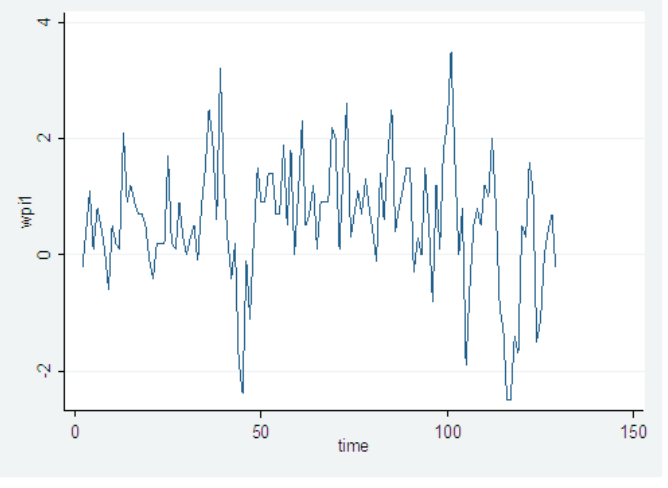
Empirical Results

Dickey Fuller test was applied to check the stationary of variables across time. The result is summarized in the table below.

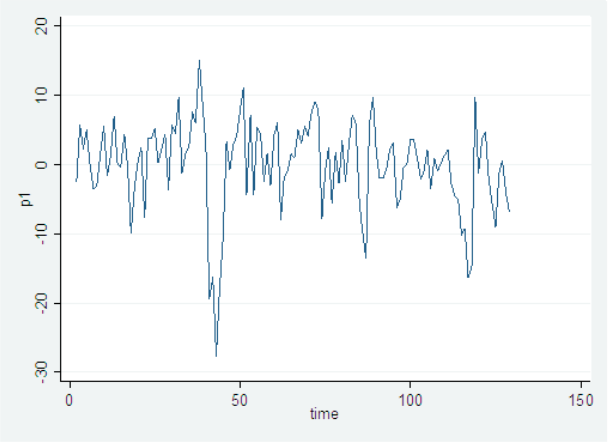
S.No.	Variable	p-value of test statistic in level form	p-value of test statistic in first difference form
1	wpi	.7	0
2	p	.65	0
3	mlag10	.9	0
4	Plag2	.6	0
5	t	.7	0
6	elag2	.5	0

Result: The variables wpi, p, mlag10,plag2,t and elag2 have been found to be non stationary. Hence the technique of first differencing has been used to rectify for the same.
After first differencing the variables have become stationary.

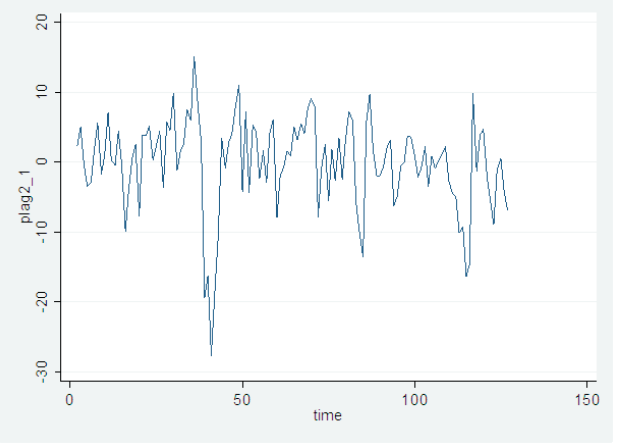
Graph of variables after first differencing.
a) wpi1 versus time



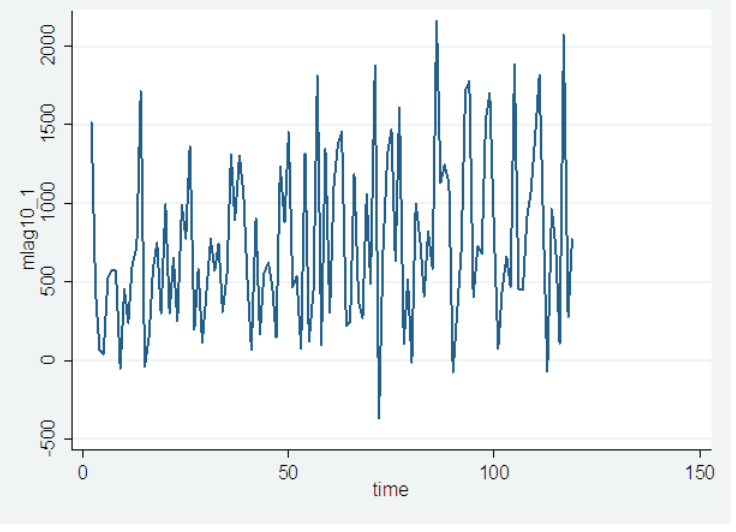
b) p1 versus time



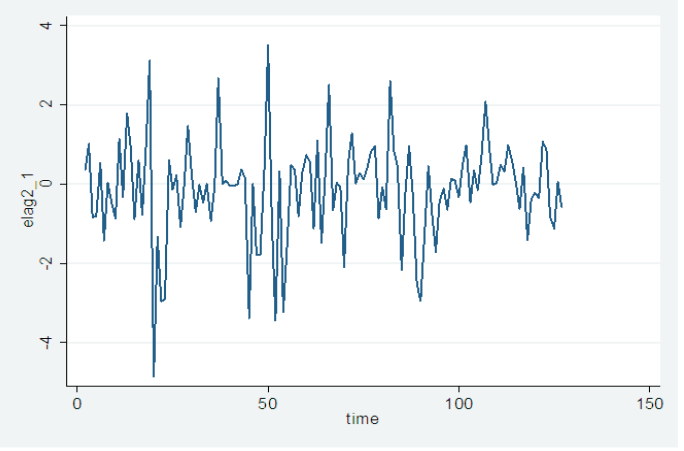
c) plag2_1 versus time



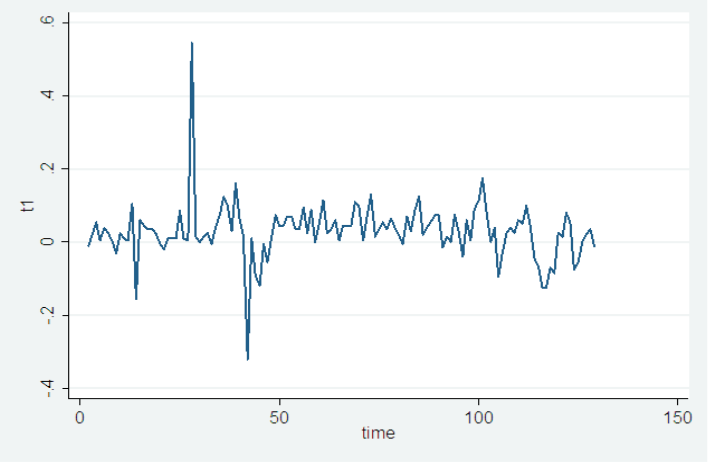
d) mlag10_1 versus time



e) elag2_1 versus time

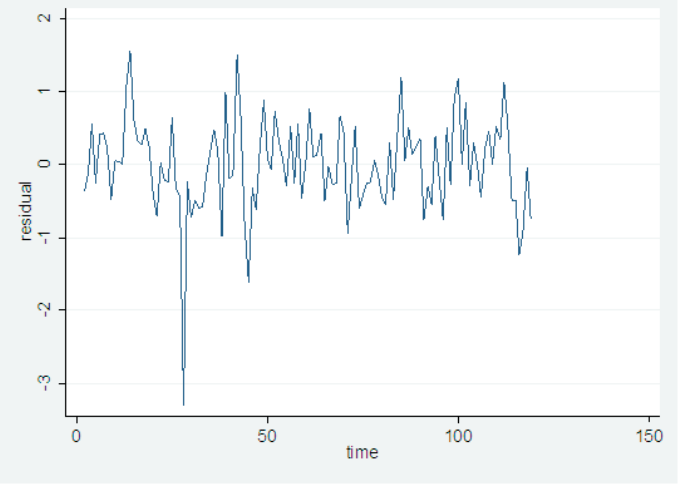


f) t1 versus time

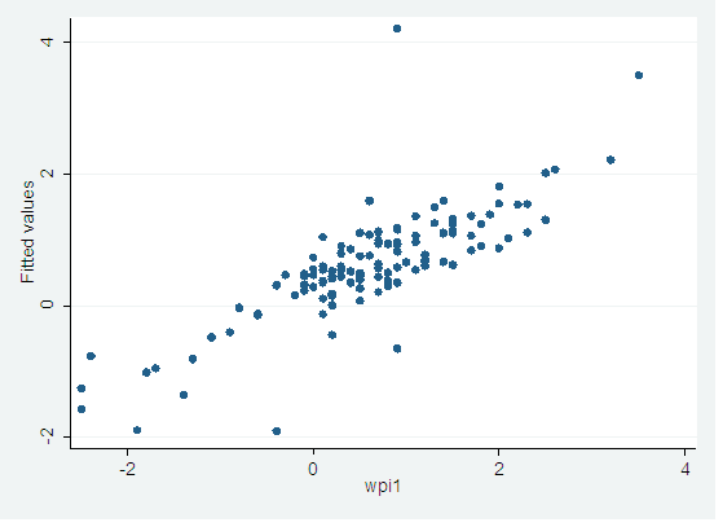


The graphs indicate that after first differencing the non stationarity has been removed

The graph of "residual" versus time variable.



The graph of fitted values against actual values



Interpretation of Regression Results

```
. reg wpi1 p1  d105 mlag10_1 plag2_1  t1 elag2_1 d59,robust

Linear regression                               Number of obs =     118
                                                F(  5,   110) =       .
                                                Prob > F      =       .
                                                R-squared     =  0.5787
                                                Root MSE      =  .72126
```

wpi1	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
p1	.039272	.0174281	2.25	0.026	.0047335	.0738105
d105	-1.7457	.4822289	-3.62	0.000	-2.701365	-.790036
mlag10_1	.0001407	.0001028	1.37	0.174	-.0000631	.0003445
plag2_1	-.0241777	.0118549	-2.04	0.044	-.0476713	-.0006841
t1	8.04024	3.525258	2.28	0.024	1.054006	15.02647
elag2_1	.0629995	.0416688	1.51	0.133	-.0195784	.1455774
d59	-.2360798	.1249794	-1.89	0.062	-.4837596	.0116
_cons	.2901959	.123145	2.36	0.020	.0461515	.5342404

RESULTS:

1)The coefficient of p1 is highly significant. This indicates that a change in price of crude oil (Indian basket) by 1% point on an average shows up as .0318% increase in WPI.

2)We did not find any significant impact of change in WPI and money supply lagged for 4,6 and 10 months respectively.

3)The coefficient of t1 is highly significant. This indicates that a 1% point change in call lending on an average shows up as 8% increase in WPI.

4)The coefficient of elag2_1 is significant at 13% level of significance. This indicates that a 1% point change in exchange rate lagged by 2 months causes .06 % change in WPI.

5)The coefficient on time dummies is highly significant indicating drop in wpi corresponding to those time periods due to some exogenous factors

The variables in the model explain 57% variation in WPI. All variables put together are coming out to be

highly significant and bear expected sign in conformity with economic theory.

As expected the impact of change in monetary aggregate has negligible impact on wholesale price index as expected in a demand constrained economy. The impacts of rest of the variables are in line with economic theory.

The regression results are robust to minor issue of heteroscedasticity detected in the model. This is done by estimating the standard errors using the Huber-White sandwich estimators. Such robust standard errors can deal with a collection of minor concerns about failure to meet assumptions, such as minor problems about normality, heteroscedasticity, or some observations that exhibit large residuals, leverage or influence.

With the robust option, the point estimates of the coefficients are exactly the same as in ordinary OLS, but the standard errors take into account issues concerning heterogeneity and lack of normality.

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i.https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/62589.pdf
ii.Press Information Bureau (http://pib.nic.in/newsite/PrintRelease.aspx?relid=161071)
iii.http://ppac.org.in/WriteReadData/userfiles/file/PP_1_b_CrudeOilPrice(H).xls

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