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Oil Price Pass-Through to Disaggregated CPI Data of Pakistan: Evidence from VAR Approach

ABSTRACT

The aim of this paper is to investigate the oil pass-through to aggregate CPI and disaggregated CPI inflation in Pakistan. We estimated recursive VAR model to investigate the oil price pass-through to CPI and disaggregated CPI inflation for the period of July 1991 to April 2017. The major finding of the study are: (1) oil price shock has moderate effect on CPI inflation; (2) oil price pass-through is high in energy, nonfood, transport and WPI inflation as compared to food, non-energy, housing sector and aggregate CPI inflation; (3) oil price pass-through is high after the period of 2006 when government approved authority to OGRA to notify petroleum products;(4) oil price pass-through has asymmetric effect on disaggregated CPI inflation.

Key Words: *Oil price pass-through, disaggregated CPI, VAR, Pakistan.*

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Introduction

Oil price is global phenomena which is valid for each country. One of main impact of oil price falls on inflation. Fluctuation in inflation will further lead to economic changes. So inflation is main indicator for price stability and economic conditions. Many authors have found declining impact of oil prices on macroeconomic variables over the time for developed economies (DeGregorio et al 2007; Chen 2009; Blanchared and Gali 2010; Segal 2011; Valcharcel and Wohar 2013). But oil price and inflation relationship exist for oil importing economies (Barsky and Kilian 2002).

Since Second World War sharp fluctuation in oil prices got intention of the policy makers. There have been five major oil price shocks (1) in 1973-74 when OPEC increase oil prices (2) in 1978-79 Iranian revolution (3) in 1990 Iraq and Kuwait war (4) in 1999 when oil prices increases (5) from 2010 to date because of Arab spring and Middle East situation.

Oil price and inflation have connected in cause and effect in relationship. The main question is to what extent or how strong is the affinity between oil price and inflation. Oil is major input for transportation, heating and energy sectors (Langeger 2013). When oil prices increase the aggregate supply will decrease in a short run which will increase the price level (Tutor2u 2012).

There are six transmission channels through which oil shocks affect the macroeconomic performance (Jones et al 2004; Tang et al 2010 and Khan and Ahmad 2011). First channel is supply side effect i.e. increase in oil price will reduce the availability of inputs which cause to decrease output. Hence the unemployment will increase which reduces the income level. In wealth transfer channel, oil shocks will shift the purchasing power from oil importing economies to oil exporting economies. In third channel, many commodities in CPI basket are oil based items. So raise in oil prices will increase the inflation. In real balance effect channel, shock in oil price raises money demand but money supply will not

increase. So interest rate will increase and economic growth will decrease. The fifth channel is asymmetric impact of oil prices within sectors of the economy. In the last channel, uncertainty of oil price can adversely affect the economic activities.

Pakistan is continuing to maintain its GDP growth at 4.71 percent in the fiscal year 2016 which is highest rate for the last eight years. Pakistan depends on oil and Gas to fulfill its energy requirements. Pakistan meets its 32% energy demand by oil and 82% oil demand is carried out by imports. Transports and power sectors are major users of oil i.e. 57% and 34% respectively in Pakistan. Pakistan is producing 64% electricity through thermal sources (Economic Survey of Pakistan 2016-17).

Among nine major oil marketing companies, Pakistan State Oil (PS) has got leading role. Government of Pakistan kept strict control over the oil products till 1999. Government sanctioned authority "Oil Companies Advisory Committee (OCAC)" reviewed oil prices in 2001. But since April 16, 2006 Oil and Gas Regulatory Authority (OGRA) is responsible for price notification.

In developing economies like Pakistan oil and food prices are subsidized and taxed for political reasons. Oil price has asymmetric impact on the inflation (Torabi and Ahamdi 2015). Oil price shocks have asymmetric effect on oil exporting and oil importing economies (Naurin and Qayyum 2016).

The objective of this paper is to examine oil price pass-through to disaggregated CPI in Pakistan using monthly data from July 1991 to April 2017. As for as Pakistan is concerned there are a few studies available for oil price shocks at aggregate level. So this very treatise is pioneer research on this issue. We use the recursive VAR approach to analyze the oil price pass-through to CPI, WPI, energy, non-energy, food, non-food, transport and house rent inflation. For more detail disaggregated CPI analysis we have made price indexes for energy, non-energy, food, and non-food. In this treatise we also explore the asymmetric oil price pass-through to disaggregated inflation.

The rest of the study is planned as follows; section two we review literature on oil price pass-through. Section three will explain the model and data used in the paper. Section four results are explained, whereas section five elaborates the conclusion and policy recommendations.

Literature Review

This section will study previous papers about the oil price pass-through to CPI. Most of the literature is available for developed economies and it is assessed that impact of oil price pass-through decreases over the time.

Gelos and Ustyugova (2012) established that oil price pass-through is higher in developing economies as compared to advanced countries. It is due to integration of the economies and external shocks effect on domestic variables. Oil price shocks in 1973-74 got more attention of the policy makers. Abel and Bernanke (2005) claim that oil price shock is considered a supply side shock. Gomez-Losecos et al (2012) found that oil price shock was more effective in 1970s and continuously decreased till 1990s and showed increase since 2000s.

Gao et al (2013) used the bivariate VAR model and found oil price pass-through to inflation and disaggregated CPI's of energy, housing, transportation, food, and medical care. Oil price pass-through is high in energy and transport sectors and low in food, medical care, and housing sectors. Rahman and Serletis (2011) had analyzed oil price asymmetric behaviour and spill overs for US economy using data from 1981-1 to 2007-1 by general bivariate GARCH-in-Mean errors. Mordi and Adebiyi (2010) studied the effect of oil price asymmetric behaviour to inflation using monthly data from 1999-1 to 2008-12 by using SVAR approach for Nigeria. They found that decrease in oil price has greater impact as compared to oil price increase.

Chou and Tseng (2011) conducted study for Asian countries to analysis oil price pass through using Phillips curve approach.

They found high oil price pass through in the long run as compare to short run due to oil is a necessity good. Shioji and Uchino (2010) carried research for Japan economy for oil price pass-through using VAR (TVP-VAR) approach. They established that oil price pass through has decreased over the time because industries depend on the other energy inputs. Adenug et al (2012) studied oil price pass-through for Nigerian economy using the ARDL approach and quarterly data for the period of the 1990-2010. They found that oil price pass-through is incomplete.

Alvarez et al (2011) studied the oil price pass-through for Spain and euro area. They found that oil price pass-through is incomplete and that crude oil price is main drivers in the inflation fluctuation. The direct transmission channel is more important as compared to indirect channel. Al-Shawarby and Selin (2012) studied oil price pass-through in Egypt for the period of 2001 to 2011 by using the OLS and VAR approach. They found high oil price pass-through to inflation and OPPT in asymmetric behaviour. Catik and Karacuka (2012) analyzed oil price pass through to CPI for Turkey by using Markov Switching Autoregressive (MS-VAR) model. They found the incomplete pass-through for both low and high regimes.

Duma (2008) studied the oil price pass-through to inflation for Sri Lanka using the VAR approach. He used exchange rate, food, oil, import prices shocks as external shock. He found incomplete price pass-through of food prices, oil prices, import prices, and exchange rate to inflation. He explained that only 25% variations are explained by external shocks and 75% variation are explained by the fiscal and monetary policy. Sukatti (2013) studied oil price pass-through to inflation for South Africa by using the VAR and Co-integration approach. He found no relationship between inflation and oil prices.

Gregorio et al (2007) research carried out for Chile by using Augmented Phillips curve for 34 countries. They found the low oil price pass-through for developed economies because these countries are depending less on the oil. Mostly developed

economies have shifted to the other energy sources. Kiptui (2009) carried out research for Kenya's economy by using the Phillips curve approach. Oil price pass through to CPI is incomplete and that the demand has got more effects on inflation. Jalil and Zea (2011) studied oil price pass-through for Latin American economies. They found incomplete pass-through.

Dureval and Sjo (2012) studied the oil price pass through to CPI for Ethiopia and Kenya by applying Error Correction model. They used the CPI, food, nonfood, world prices, energy prices, exchange rate, and money supply. They found that world food prices and exchange rate have long run effect on inflation. And money supply and agriculture supply have short run effect on the inflation. Dedeoglu and Kaya (2014) studied oil price pass-through to inflation for Turkey using recursive VAR approach. They found incomplete oil price pass-through. High oil price pass-through is found in PPI as compare to CPI.

Limited numbers of studies are available on oil price pass-through to CPI in case of Pakistan. Khan and Ahmad (2011) studied oil and food price pass-through to prices for the economy of Pakistan by using SVAR approach. They found that oil and food prices have positive impact on the macroeconomic variables. Jafri et al (2012) studied oil and food prices pass-through to inflation using monthly data from 1993-2 to 2012-2. They used simply OLS technique. They found that oil and food prices positively affect the inflation.

Ansar and Asghar (2013) found the positive relationship between oil prices and inflation. Hanif (2012) carried out research for Pakistan and found positive relationship between oil price and inflation. Khan et al (2015) found the positive and significant relation between oil and inflation. Naurin and Qayyum (2016) found that oil price and inflation have positive relationship but positive news more effect than negative news.

All the literature discussed above, used different methodologies to analysis oil price pass-through to inflation. They assessed that oil price pass-through to inflation has decreased

over the time for developed economies. But oil and inflation relationship still exists for small open economies like Pakistan. So this study is conducted to fill this gap.

Model and Data

To analyze the domestic oil price pass-through to CPI and disaggregated CPI inflation we use six variable recursive VAR model based on the methodology of Dedeoglu and Kaya (2014), Hyder, and Shah (2004) and McCarthy (2000). The model consists of following endogenous variables supply shock (proxy by domestic oil prices), demand shock (proxy by quantum index of manufacturing), growth of money supply, nominal exchange rate, wholesale prices, consumer prices.

$$Oil_t = E_{t-1}\left[Oil_t\right] + \varepsilon_t^{oil}$$

$$\Delta D_t = E_{t-1}\left[\Delta D_t\right] + \gamma_1 \varepsilon_t^{oil} + \varepsilon_t^{\Delta D}$$

$$\Delta M2_t = E_{t-1}\left[\Delta M2_t\right] + \gamma_1 \varepsilon_t^{oil_t} + \gamma_2 \varepsilon_t^{\Delta D_t} + \varepsilon_t^{\Delta M2}$$

$$\Delta er_t = E_{t-1}\left[\Delta er_t\right] + \gamma_1 \varepsilon_t^{oil} + \gamma_2 \varepsilon_t^{\Delta D} + \gamma_3 \varepsilon_t^{\Delta M2} + \varepsilon_t^{\Delta er}$$

$$WPI_t = E_{t-1}\left[WPI_t\right] + \gamma_1 \varepsilon_t^{oil} + \gamma_2 \varepsilon_t^{\Delta D} + \gamma_3 \varepsilon_t^{\Delta M2} + \gamma_4 \varepsilon_t^{\Delta er} + \varepsilon_t^{WPI}$$

$$CPI_t = E_{t-1}\left[CPI_t\right] + \beta_1 \varepsilon_t^{oil} + \beta_2 \varepsilon_t^{\Delta D} + \beta_3 \varepsilon_t^{\Delta M2} + \beta_4 \varepsilon_t^{\Delta er} + \beta_5 \varepsilon_t^{WPI} + \varepsilon_t^{CPI}$$

The model relies on a pricing along a distribution chain. E_{t-1} Denotes the expectation of variable conditional on information is available at period t-1.

Model is finding the impact of domestic oil shock on CPI along with supply chain proceeding from demand shock to money supply, exchange rate, wholesale prices and lastly to CPI inflation (Leigh and Rossi 2002).

McCarthy (2000) developed this model to study the exchange rate pass-through. Hyder and Shah (2004) made some adjustments and used this famous model for Pakistan to examine exchange rate pass-through to aggregate CPI, WPI and

disaggregated CPI, WPI. Dedeoglu and Kaya (2014) used similar model to find out the oil price pass-through to inflation for Turkey. In this study we use same McCarthy (2000) model to assess oil price pass-through to aggregate CPI and disaggregated CPI inflation.

In the Vector Autoregressive approach the ordering is very important. The following ordering is used in this study

$$OIL \rightarrow \Delta D \rightarrow \Delta M2 \rightarrow \Delta ER \rightarrow WPI \rightarrow CPI$$

Oil price pass-through is found by two methods firstly impulse response and cumulative pass-through coefficients and secondly variance decomposition of CPI and disaggregated CPI inflation. In this study we use the Cholesky Decomposition of the residual variance covariance matrix to recover structural shocks.

In all the previous studies it was assumed that oil price increase and decrease had same impact on the domestic prices. We used Rodriuez and Sanchez (2004), Mendoza and Vera (2010) and Mork (1989) methodology to test the symmetric effect of oil shocks on the inflation, to distinguish between positive and negative changes in domestic oil prices and to find out oil price pass-through. They are explained as follows;

$$OIL^{+} = \begin{cases} Oil & \text{if oil} > 0 \\ 0 & \text{otherwise} \end{cases}$$

$$OIL^{-} = \begin{cases} Oil & \text{if oil} < 0 \\ 0 & \text{otherwise} \end{cases}$$

After getting positive and negative values of domestic oil prices we find out the asymmetric oil price pass-through to inflation.

We used monthly data in the study ranging from July 1991 to April 2017. We made the energy, non-energy, food, and non-food price indexes by using the COICOP methodology. We analyzed the oil pass-through on eight price indexes which are the Consumer prices (CPI), Transport (CPIT) House rent (CPIH), Energy (CPIEN), Non-energy (CPINE), Food CPIF, and Non-food (CPINF)

and aggregate Wholesale price inflation (WPI). The source of data for all variables except domestic oil prices is taken from SBP statistical Bulletin, while domestic oil prices are taken from monthly review of Pakistan Bureau of Statistics.

Results and Discussion

Before we proceed towards estimation, it is essential to find the order of the integration of the variables and select the optimal lag length. The Augmented Dickey Fuller (ADF) unit root test is employed to decide the stationarity of the variables and all the variables are in order I (1) integration. The result of ADF is reported in table 1. The VAR is estimated with first difference with 2 lags as optimal lag length based on the Akaike information criterion (AIC).

Table 1: Augmented Dickey Fuller Test

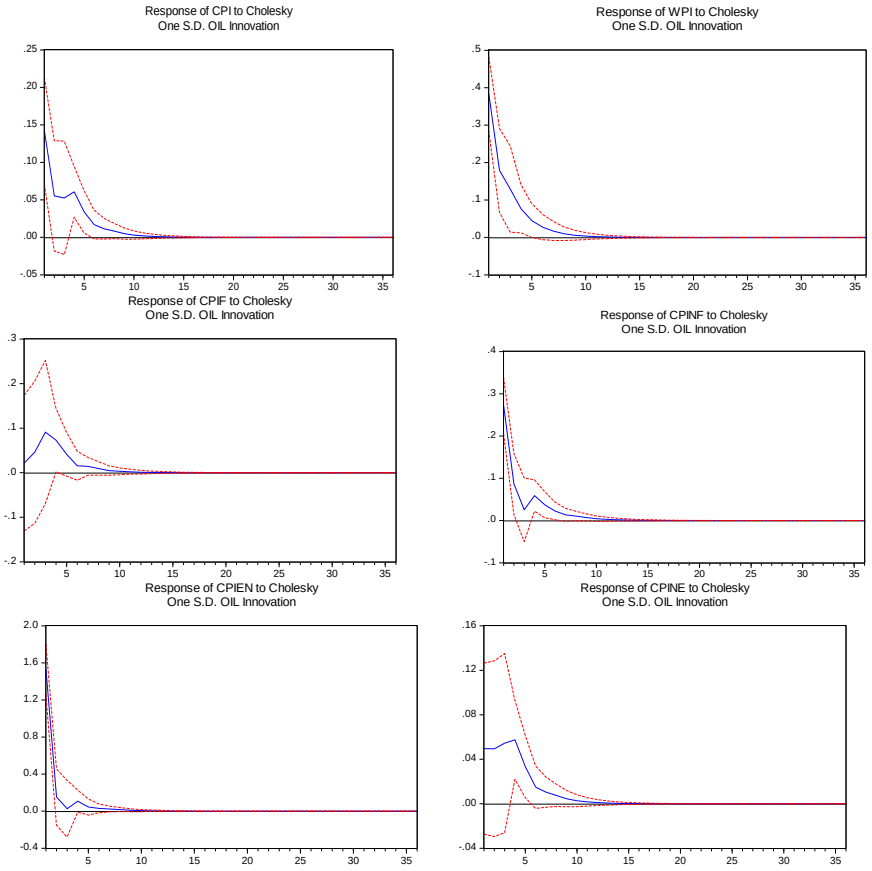
VARIABLES	LEVEL	FIRST DIFFERENCE	ORDER OF INTEGRATION
LER	-1.94	-13.72	I(1)
LOIL	-1.30	-15.89	I(1)
LMP	-0.94	-16.61	I(1)
LM2	-2.04	-20.66	I(1)
LWPI	-0.99	-8.41	I(1)
LCPI	-0.71	-7.69	I(1)
LCPIF	-0.61	-18.97	I(1)
LCPINF	-0.89	-17.72	I(1)
LCPIEN	-1.21	-17.55	I(1)
LCPINE	-0.31	-7.36	I(1)
LCPIH	-0.79	-10.89	I(1)
LCPIT	-1.23	-14.34	I(1)

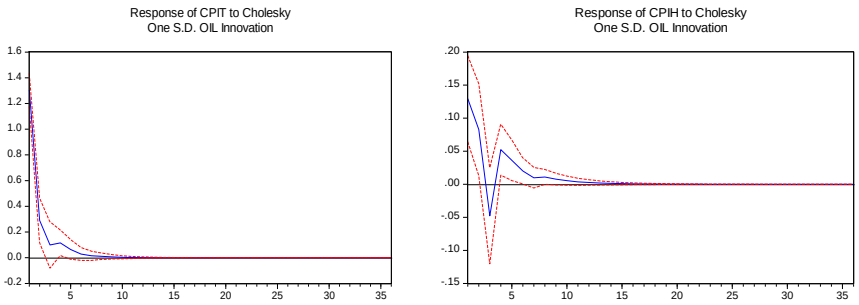
The results of IRF are reported in figure 1, from which it may be clear that the domestic oil price pass-through to CPI is

incomplete which is comparatively consistent with previous studies (Khan and Ahmed 2011; Jafri et al 2012; Ansar and Asghar 2013; Khan at el 2015; Naurin and Qayyum 2016).

The prices CPI, WPI and disaggregated CPI immediately responded to the oil price shocks and gradually decreased. The main reason that oil price pass-through is incomplete for CPI inflation is that the oil price in Pakistan is administrative price (subsidized or taxed by government for political reason). So consumer does not face actual international oil prices.

Figure 1: Impulse Responses of Domestic Prices to Oil Prices





For more detail analysis we may see the table 2 in which estimated cumulative pass-through coefficient is reported.

Table 2: Estimated Cumulative Pass through Coefficient

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.14	0.38	0.02	0.27	1.53	0.049	0.12	1.30
6	0.39	0.84	0.28	0.50	1.89	0.25	0.27	1.90
12	0.39	0.88	0.32	0.54	1.95	0.28	0.31	1.93
18	0.39	0.88	0.32	0.54	1.96	0.28	0.31	1.93
24	0.39	0.88	0.32	0.54	1.96	0.28	0.32	1.93
30	0.39	0.88	0.32	0.54	1.96	0.28	0.32	1.93
36	0.39	0.88	0.32	0.54	1.96	0.28	0.32	1.93

The oil price pass-through is more pronounced in WPI as compared to the CPI, with same estimated cumulative pass-through coefficient CPI (0.39) and WPI (0.88). It is because WPI has larger share of tradable goods as compared to CPI and CPI includes the service items which are not affected directly by oil prices. The oil price has more impact on the non-food sectors as compare to food sectors. The non-food sector includes the energy and other manufacturing products which are highly affected from oil prices.

The energy sector has high estimated cumulative pass-through coefficient (1.96) as compared to non-energy sector estimated cumulative pass-through coefficient (0.28). Pakistan is meeting its energy requirements through the oil. So fluctuations in oil prices have major impact on the energy sector.

The oil price pass-through is much pronounced in transport sector (estimated cumulative pass-through coefficient 1.93) as compared to the housing sector (estimated cumulative pass-through coefficient 0.32). In Pakistan the transport sector is the highest consumer of the oil products in Pakistan.

The result of the variance decomposition is reported in table 3 verifying our result which is discussed above. The result of variance decomposition, which shows the contribution of innovation in the oil price shock to aggregate CPI, WPI and disaggregated CPI is in table 3 while the contribution of other explanatory variables are reported in table A1 in appendix. The oil price shock only explains 6.82% variation in CPI and other variations are explained by further variables. The 66.77% variations are explained by its own innovation followed by demand shock which explains 0.83% variance.

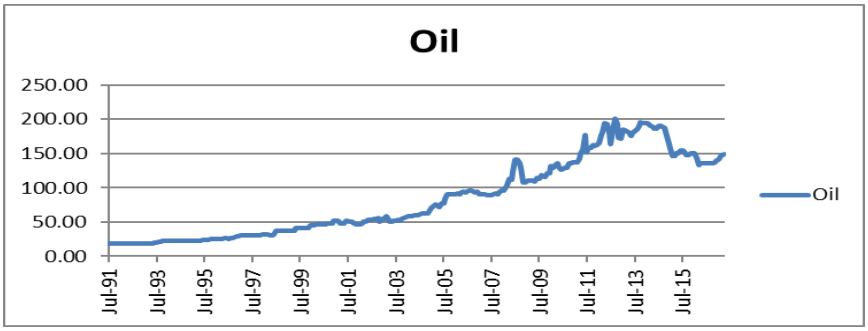
The oil price shock is explaining more variation in the WPI, Non-food, energy, and transport sectors. The variance decomposition results are consistent with the estimated cumulative pass-through coefficient result.

Table 3: Variance Decomposition

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	5.09	17.97	0.02	19.40	34.53	0.54	5.02	80.50
6	6.78	18.96	0.89	18.97	32.98	2.39	7.17	70.43
12	6.81	18.97	0.91	18.98	32.97	2.43	7.21	70.36
18	6.82	18.97	0.91	18.98	32.97	2.43	7.21	70.36
24	6.82	18.97	0.91	18.98	32.97	2.43	7.21	70.36
30	6.82	18.97	0.91	18.98	32.97	2.43	7.21	70.36
36	6.82	18.97	0.91	18.98	32.97	2.43	7.21	70.36

We made two sub samples of the data keeping in view the transfer of authority to OGRA for notification of oil prices in April 2006. The first sub sample starts from 1991-7 to 2006-4 and second sub sample is from 2006-5 to 2017-4. Figure 2, shows that oil prices are highly fluctuated after the period of 2006. These sub samples will give better understanding about oil price pass-through to CPI and disaggregated CPI inflation.

Figure 2: Domestic Oil Price



The first subsample (1991-7 to 2006-4) results are reported in figure A1 and table A2, A3. In figure A1, aggregate and disaggregated CPI inflation are responding the oil price shocks.

In estimated cumulative pass-through coefficients are high in WPI, energy, non-food, and transport sectors. The oil prices are explaining high variation in the WPI, energy and transport sectors. The results of second sub sample (2006-5 to 2017-4) are reported in figure A2 and table A4, A5. The oil price pass-through is high in WPI, non-food, energy, and transport sectors. The oil price pass-through to CPI and disaggregated CPI prices are high in second sub sample when government transferred authority to OGRA as compare to first sub sample (1991-7 to 2006-4).

Next we test the oil price pass-through to inflation is symmetric or asymmetric behaviour. The result provide us evidence against that oil price pass-through to inflation has symmetric impact (see figure A4, A5 and table A6, A7, A8, A9 in appendix).

Figures A4 and A5 IRF's in appendix are showing that oil prices increase more has more impact as compared to oil prices decrease. The estimated cumulative pass-through coefficient is 0.65 when oil price increase and 0.31 when oil price decrease. The variance decomposition results show that 7.12% variation is recorded when the oil price increases and 6.08% variation is found when oil price decreases.

The oil price pass-through is high in non-food, energy, and WPI and Transport sectors. The results of asymmetric OPPT are showing that oil prices increase has more effect on inflation as compared to the oil price decrease. Our results confirm that oil price pass-through has asymmetric impact on aggregate CPI and disaggregated CPI inflation. It proves Keynesians theory that Prices are upward flexible and downward rigid.

Conclusion and Policy Recommendation

In this study we used recursive VAR methodology to assess the domestic oil price pass-through to aggregate CPI and disaggregate CPI inflation by using monthly data from July 1991 to April 2017. We construct energy, non-energy, food, and non-food

price indexes for detail analysis of the domestic oil price pass-through to inflation. We conclude that (1) oil price has moderate effect on CPI inflation because CPI consistent on the many administrative products. (2) Oil price pass-through is high in WPI as compared to CPI because of higher share of tradable goods in WPI. (3) Oil price pass-through is more pronounced in period after 2006 when OGRA started revising the prices. (4) Oil price pass-through is high in non-food, energy, and transport sectors. And that food, non-energy, and housing sectors are less sensitive to oil prices (5) Oil price pass-through has asymmetric impact on aggregate CPI and disaggregated CPI inflation. Oil price increase has more impact as compared to oil price decrease.

We observed that there is positive relationship between oil prices and inflation. But oil price pass-through is incomplete to inflation. There is much space for the government to control the inflation fluctuations. Pakistan is heavily dependent on the crude oil for transport and energy purpose. So government should shift to other energy resources like coal, natural gas, and renewable energy. Government can increase the strategic oil reserves and protect market from the risk of supply shortage.

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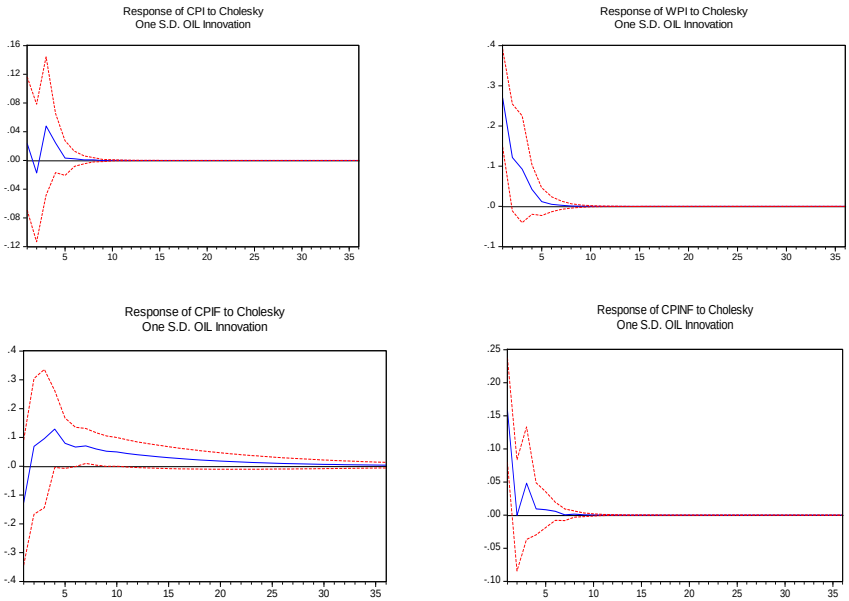
Appendix

Table A1: Variance Decomposition of Domestic CPI

Period	OIL	MP	M2	ER	WPI	CPI
1	5.08	0.00	0.031	0.64	17.16	77.07
6	6.77	0.83	0.47	2.95	22.02	66.92
12	6.81	0.83	0.47	2.95	22.13	66.77
18	6.81	0.83	0.47	2.95	22.13	66.77
24	6.81	0.83	0.47	2.95	22.13	66.77
30	6.81	0.83	0.47	2.95	22.13	66.77
36	6.81	0.83	0.47	2.95	22.13	66.77

Figure A, 1: July 1991 to April 2006 Before OGRA Impulse Responses



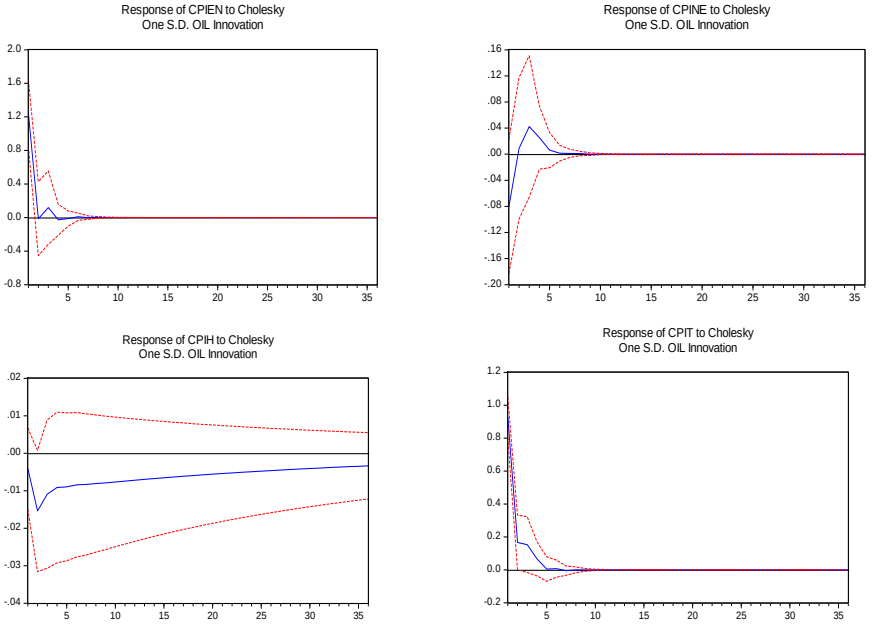


Table A, 2: Estimated Cumulative Pass through Coefficient

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.02	0.27	-0.12	0.15	1.24	-0.08	-0.00	0.92
6	0.08	0.54	0.31	0.23	1.32	0.00	-0.05	1.32
12	0.08	0.55	0.63	0.24	1.32	0.01	-0.10	1.31
18	0.09	0.55	0.80	0.24	1.33	0.01	-0.14	1.31
24	0.09	0.55	0.89	0.24	1.33	0.01	-0.17	1.31
30	0.09	0.55	0.94	0.23	1.33	0.01	-0.20	1.32
36	0.09	0.55	0.97	0.23	1.33	0.01	-0.22	1.32

Table A 3: Variance Decomposition

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.14	10.61	0.76	8.89	20.12	1.39	0.31	79.51
6	0.94	12.66	2.18	8.92	19.26	1.78	1.93	72.34
12	0.95	12.67	2.72	8.93	19.27	1.79	1.81	72.32
18	0.95	12.67	2.87	8.93	19.27	1.79	1.78	72.32
24	0.95	12.67	2.91	8.93	19.27	1.79	1.76	72.33
30	0.95	12.67	2.93	8.93	19.27	1.79	1.75	72.33
36	0.95	12.67	2.93	8.93	19.27	1.79	1.74	72.33

Figure A, 2: After Pricing Decisions to OGRA May 2006 to April 2017

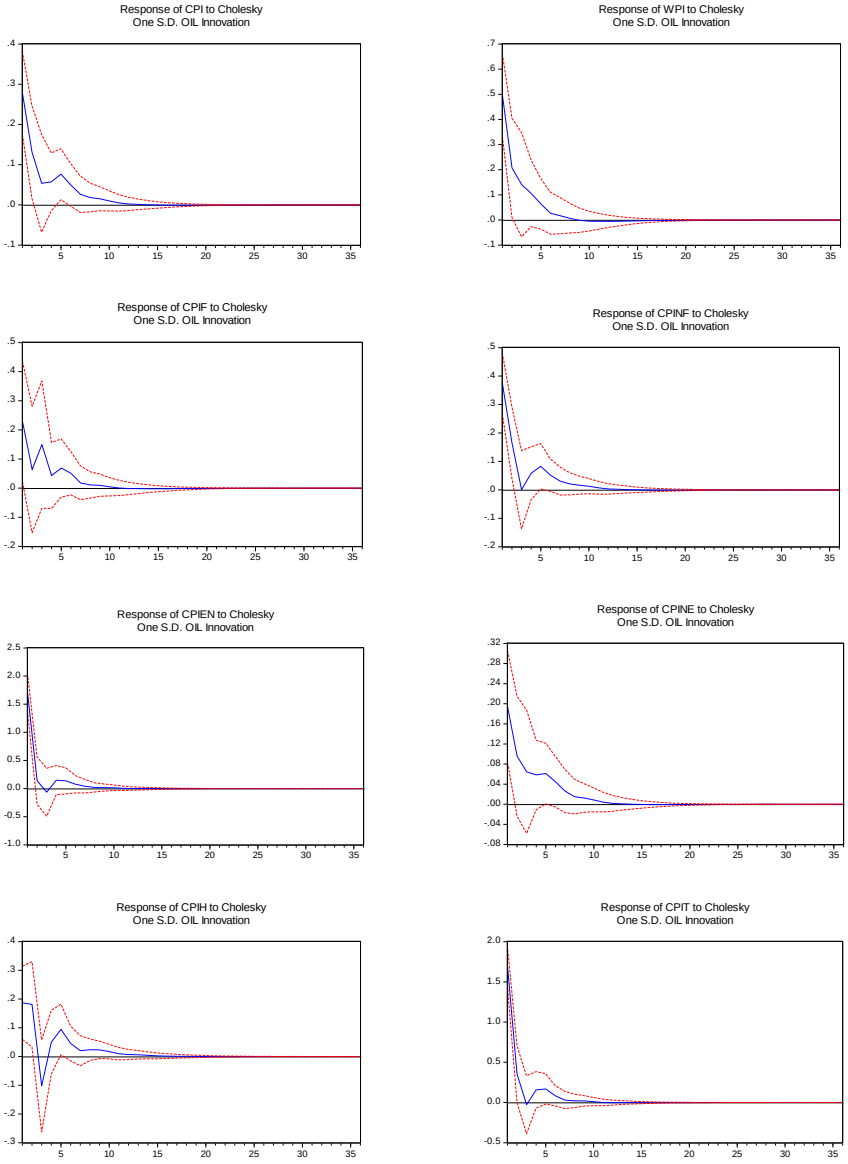


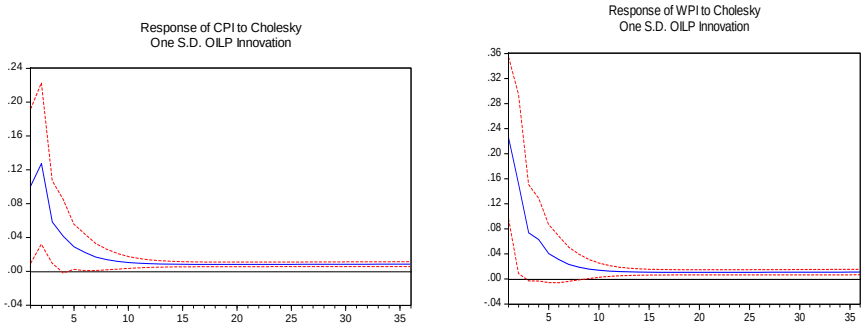
Table A, 4: Estimated Cumulative Pass through Coefficient

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.27	0.49	0.22	0.37	1.71	0.19	0.18	1.70
6	0.64	1.04	0.60	0.73	2.15	0.52	0.45	2.44
12	0.72	1.05	0.64	0.82	2.24	0.58	0.57	2.51
18	0.73	1.03	0.63	0.83	2.23	0.58	0.58	2.50
24	0.73	1.03	0.63	0.83	2.23	0.59	0.58	2.50
30	0.73	1.03	0.63	0.83	2.23	0.59	0.58	2.50
36	0.73	1.03	0.63	0.83	2.23	0.59	0.58	2.50

Table A 5: Variance Decomposition

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	19.81	24.57	3.67	31.90	56.21	8.90	6.30	84.49
6	19.29	20.32	5.11	25.59	43.78	10.36	10.11	66.53
12	19.17	20.20	5.11	25.38	43.62	10.36	10.17	66.16
18	19.17	20.20	5.12	25.39	43.62	10.38	10.18	66.15
24	19.17	20.20	5.12	25.39	43.62	10.38	10.18	66.16
30	19.17	20.20	5.12	25.38	43.62	10.38	10.18	66.16
36	19.17	20.20	5.12	25.38	43.62	10.38	10.18	66.16

Figure A, 4: Asymmetric Pass-Through OPPT When Oil Price Increase



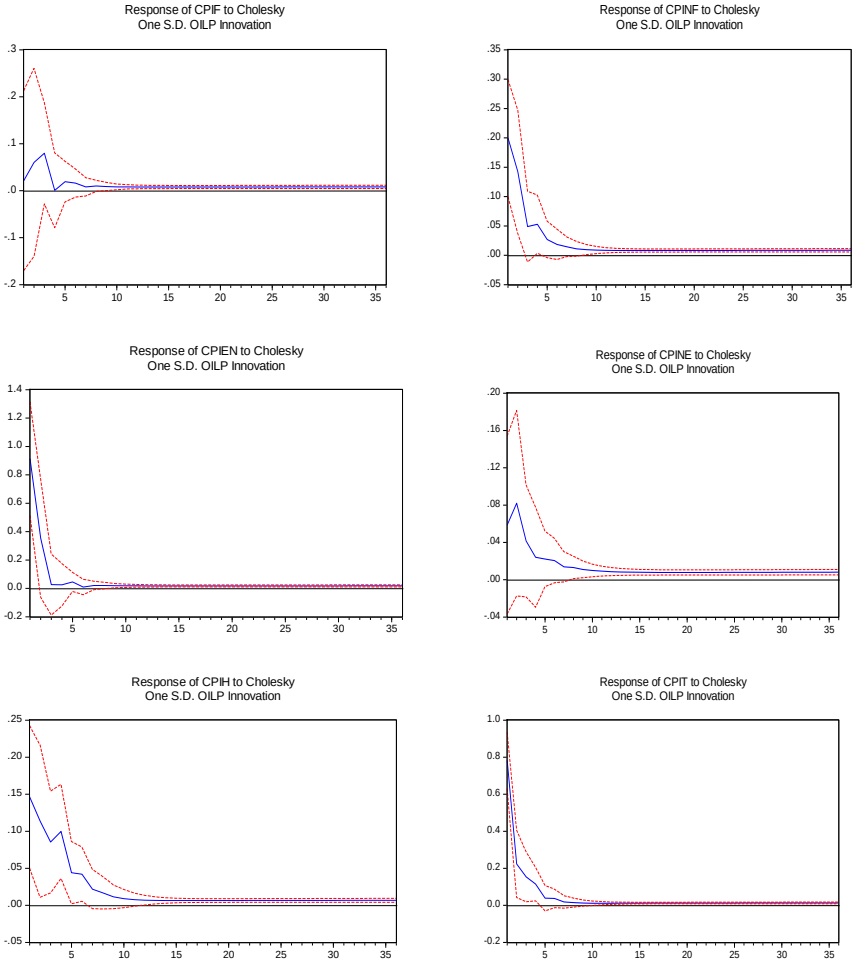


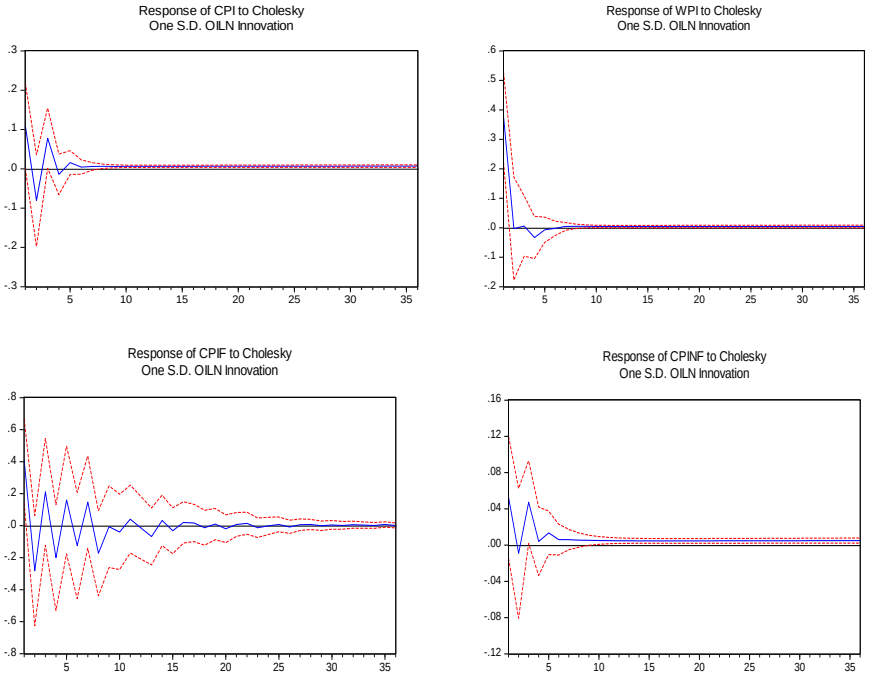
Table A, 6: Estimated Cumulative Pass through Coefficient

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.10	0.22	0.02	0.19	0.91	0.05	0.14	0.78
6	0.37	0.58	0.19	0.48	1.37	0.24	0.53	1.35
12	0.45	0.68	0.24	0.55	1.48	0.31	0.60	1.43
18	0.50	0.74	0.29	0.59	1.59	0.36	0.64	1.50
24	0.55	0.80	0.34	0.64	1.69	0.40	0.68	1.57
30	0.59	0.87	0.39	0.69	1.80	0.45	0.72	1.65
36	0.65	0.93	0.44	0.75	1.90	0.50	0.76	1.73

Table A, 7: Variance Decomposition

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	2.58	6.33	0.02	8.29	10.64	0.80	4.85	44.35
6	6.65	7.83	0.54	10.95	11.35	2.41	8.31	40.36
12	6.81	7.95	0.57	11.01	11.37	2.53	8.41	40.27
18	6.89	8.01	0.58	11.07	11.39	2.60	8.44	40.30
24	6.96	8.06	0.60	11.13	11.41	2.66	8.48	40.33
30	7.04	8.12	0.62	11.19	11.43	2.73	8.51	40.36
36	7.12	8.18	0.64	11.25	11.45	2.80	8.55	40.39

Figure A 5: Asymmetric Pass-Through OPPT When Oil Price Decrease



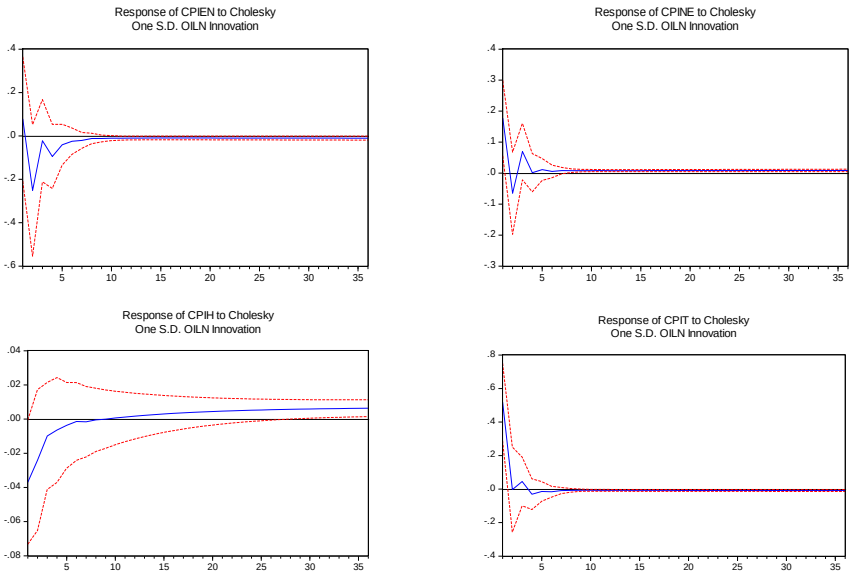


Table A, 8: Estimated Cumulative Pass through Coefficient

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	0.11	0.37	0.40	0.05	0.07	0.17	-0.03	0.51
6	0.11	0.33	0.17	0.11	-0.35	0.20	-0.08	0.50
12	0.15	0.36	0.12	0.14	-0.42	0.24	-0.08	0.45
18	0.19	0.38	0.08	0.17	-0.48	0.29	-0.06	0.40
24	0.22	0.41	0.08	0.20	-0.54	0.34	-0.03	0.35
30	0.27	0.43	0.09	0.23	-0.60	0.39	0.00	0.30
36	0.31	0.46	0.11	0.26	-0.66	0.44	0.03	0.25

Table A, 9: Variance Decomposition

Period	CPI	WPI	CPIF	CPINF	CPIEN	CPINE	CPIH	CPIT
1	3.33	18.18	7.95	2.02	0.24	6.80	3.35	15.37
6	5.81	14.71	12.98	3.02	2.63	7.30	2.50	14.11
12	5.86	14.71	13.45	3.09	2.66	7.36	2.05	14.12
18	5.91	14.72	13.47	3.16	2.68	7.43	1.98	14.14
24	5.96	14.73	13.46	3.24	2.69	7.56	2.06	14.15
30	6.02	14.74	13.45	3.31	2.71	7.56	2.20	14.17
36	6.08	14.75	13.44	3.39	2.73	7.63	2.39	14.19