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EFFECT OF CRUDE OIL PRICE SHOCK ON STOCK MARKETS OF INDIA

Dr. Bhaskar Bagchi

Associate Professor, Department of Commerce, University of Gour Banga, Malda – 732 103,West Bengal, India

ABSTRACT

The present study makes an attempt to investigate the effect of sharp continuous surging crude oil prices on stock market indices of India, and also the long-term and short term relationships between crude oil prices and stock indices. The period of the study spans from July 2009 to December 2016. We have found surge in oil price has positive correlation with equity indices and negative correlation with the exchange rates. The result is suited with the existing economic theory. Multivariate cointegration techniques along with vector error correction mechanism have been applied in the study.

KEYWORDS: *crude oil prices; emerging economy; exchange rates; oil price shock; stock indices.*

JEL code: M210

1. MOTIVATION OF THE STUDY

Global crude oil prices have experienced a continuous and steady rise particularly over the last twelve months, leading to a noteworthy revenue increase in many crude oil exporting nations, while for consumers in many crude oil importing countries higher crude oil price means paying more to heat their homes or drive their cars. But a higher oil price is also having far-reaching and unexpected geopolitical and economic consequences around the world

On the other hand, falling crude oil price is just like a blessing for Indian economy, though there are many hitches. It helps to narrow down India's current account deficit - the amount India owes to the world in foreign currency. A fall in oil prices by $10 per barrel helps to reduce the current account deficit by $9.2 billion, according to a report by Livemint. This amounts to nearly 0.43% of the Gross Domestic Product - a measure of the size of the economy (www. kotaksecurities.com/ksweb/). Moreover, falling oil prices also help to curb down inflation. As per the report published by Moneycontrol, an Indian financial agency, every $10 per barrel fall in crude oil price helps reduce retail inflation by 0.2% and wholesale price inflation by 0.5% (www.moneycontrol.com/ business/reports). Again, the Indian rupee (INR) exchange rates also gets affected though, to a very few extent. The value of a free currency like rupee depends on its demand in the currency market. This is because it significantly depends on the current account deficit. A towering deficit means the country has to sell rupees and purchase dollars to disburse its bills. This diminishes the value of the rupee. A plunge in oil prices is, thus, good for the rupee. However, the disadvantage is that the dollar strengthens each and every time, whenever crude oil prices plunge down, which counteracts any benefits that have been derived from a fall in current account deficit (www. kotaksecurities.com/ksweb/).

The objective of this paper is to examine the dynamic relationship between crude oil price and stock market indices of India in the context of continuous fall in the crude oil price in recent past. It may be relevant to point out that the recent shock is different than the previous shocks. Major oil shocks after World War II include Suez Crisis of 1956-57, the OPEC oil embargo of 1973-1974, the Iranian revolution of 1978-1979, the Iran-Iraq War initiated in 1980, the first Persian Gulf War in 1990-91, and the oil price spike of 2007-2008. All these historical oil shocks are associated with increase in crude oil price and its negative effects on the economy.

2. LITERATURE REVIEW

Oil price shocks that originate from the energy markets are defined in various ways. According to Hamilton (2003), oil price shock is an increase in net oil price, i.e. the logarithm change in the nominal price of oil in the current year in relation to the previous years. He argues that oil price shocks may precisely affect short-run economic performance of a country due to its temporary ability to disrupt bulk purchases for consumption and investment goods. The findings of Hamilton are reflected in the earlier study conducted by Gisser and Goodwin (1986) and Darby (1982). Again the study results of Mork (1989) reveal an asymmetric affiliation between changes in oil price and output growth. On the other hand, Kilian (2008a) states that oil price shocks may be demand driven and the nominal oil price shocks measured by Hamilton (2003), does not sort out or wiped out the oil price changes caused by the exogenous political actions. Moreover, it cannot be implied that nominal oil shocks necessarily includes corresponding real oil price shocks. So, in order to overcome

these problems, Kilian (2009) employs vector autoregression (VAR) by using real oil price, oil supply and a proxy variable for measuring global demand for industrial commodities as three variables.

Basher et al. (2010), applies six-variable SVAR model and impulse response functions to find out the affiliation between oil price shock, exchange rates and stock markets of the emerging countries. Their study results reveal that oil prices react positively to a surprising hike in demand for oil consumption, while it reacts negatively to sudden increase in oil supply. Bittlingmayer (2005) shows that increase in oil price is interrelated with decrease in stock prices. Hamilton (2009) are of the opinion that consistent rise in real oil price during the period of 2002 to 2008 are mainly because of strong and growing demand for crude oil from China, India and other emerging economies. The impact of oil price shock on the stock markets of three BRIC countries, i.e. Russia, India and China have been analyzed by Fang (2010). He uses the model proposed by Kilian and Park (2009) and the study results reveal that oil price shocks and oil specified demand shocks do not have any significant impact on Indian stock markets, whereas these shocks have positive impact on Russian stock markets. Again, in case of China, he finds that oil specified demand shocks alone positively affect the stock markets of China, while oil price shocks has mixed condition on the stock markets of China. Abdelaziz et al. (2008) investigates the linkages between oil prices, exchange rates and stock prices of four Middle East countries – Kuwait, Oman, Saudi Arabia and Egypt. VECM and FIML estimations suggest that there exists long-run positive impact of oil prices on the stock prices of these four oil exporting countries and long-run equilibrium readjustments in each stock market take place through changes in oil prices.

Ono (2011) investigates the effect of oil prices on real stock returns for BRIC countries for the period of 1999:1 to 2009:9. Using vector autoregression (VAR) model he found that real stock returns positively respond to some of the oil price indicators for China, India and Russia, but, in the case of Brazil no significant responses are found. Variance decomposition analysis shows that the contribution of oil price shocks to volatility in real stock returns is relatively large and statistically significant for China and Russia. Morales and Gassie-Falzone (2014) examines the volatility spillovers between oil prices and emerging economies like BRIC. The paper investigates the BRIC financial markets and their movements with regards to energy markets (oil, natural gas and electricity) and to US stock returns fluctuations.

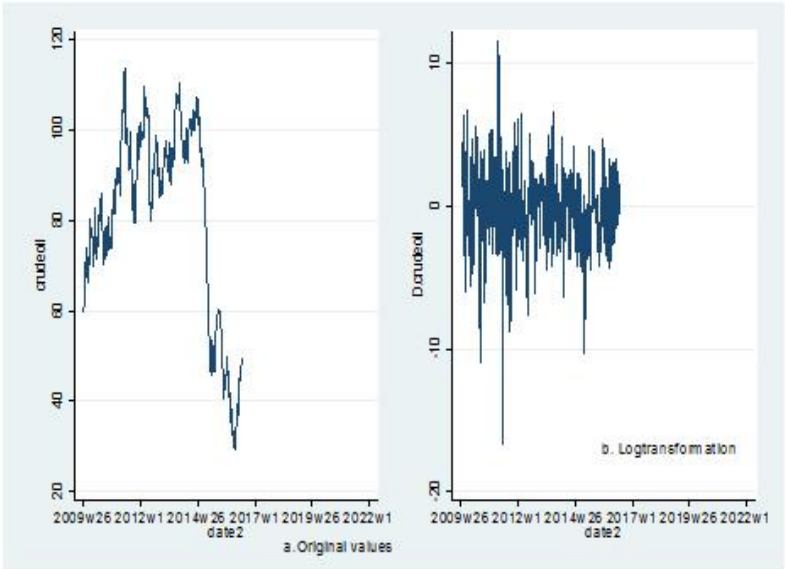
Most of the studies on oil price shocks and stock markets concentrate on developed countries rather than putting their attention on emerging economies. Very few studies like Hammoudeh and Aleisa (2004); Hammoudeh and Huimin (2005) and Basher and Sadorsky (2006) examine the relationship between oil prices and stock markets of emerging economies. In general, they are of the opinion that oil price shocks affect stock indices of these emerging countries.

The present study seeks to find out the effect of declining oil prices which is also regarded as "new oil price shock" on the stock markets of India.

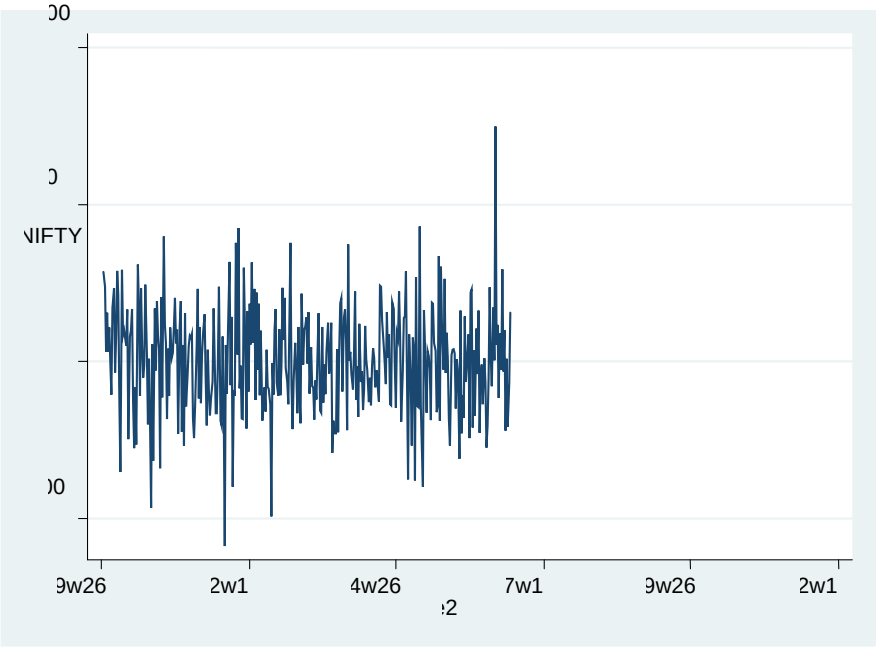
3. DATA SET AND METHODOLOGY

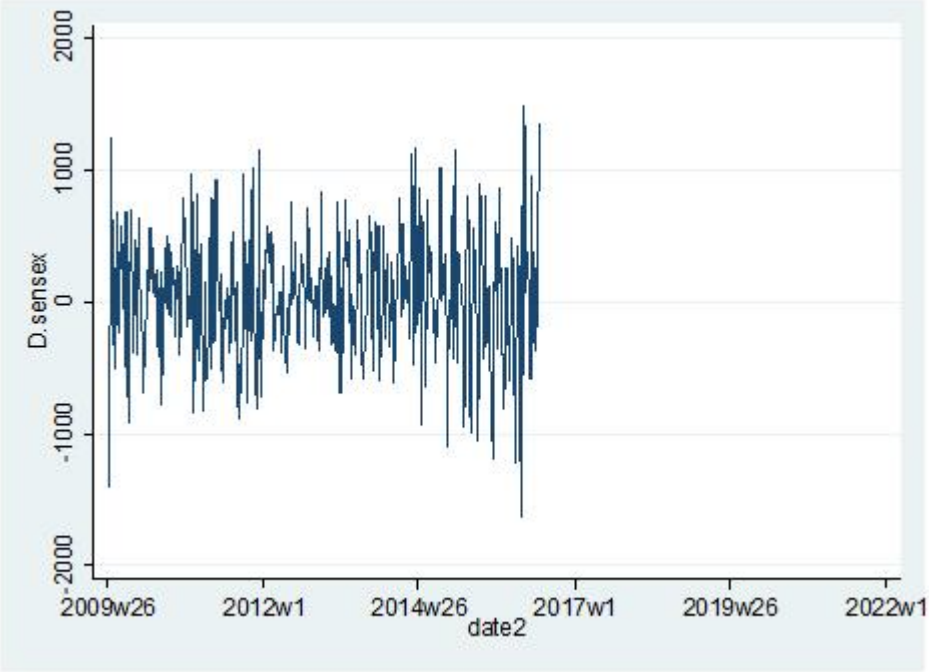
For the present study, weekly data of the closing indices of BSE Sensex and NIFTY as well as the closing prices of the crude oil index represented by the Brent crude oil prices have been considered. Brent crude oil index is used as a benchmark for world oil markets. Data on stock market indices are retrieved from Bloomberg database. Because of non-synchronous data we have taken weekly data and to avoid the weekend effect we have chosen Wednesday's closing prices. The total study period spans from 05 July, 2009 to 31 December, 2016. However, it needs to mention that this is the period of post-global recession. For better analysis, all the data values are expressed in terms of logs. To analyze the data obtained from different sources as mentioned above, econometric tools like Elliott, Rothenberg and Stock point optimal (ERS) unit root test, Vector Error Correction Model (VECM), and Impulse Response Function have been used.

4. RESULTS AND DISCUSSION



CRUDE OIL PRICE TREND





4.1 Test of Stationarity: Unit Root Test

In our study we examine the presence of unit root by using Elliott, Rothenberg and Stock point optimal (ERS) unit root test (1996) to determine whether the time series is non-stationary. ERS test is a modified version of the Dickey-Fuller *t* test and it is substantially powerful than ordinary ADF unit root test. The results of ERS unit root test are given in table 1.

Lag lengths and model of the test are preferred according to the MAIC (Modified Akaike Info Criterion). The test is run taking first differences of all the series allowing intercept and deterministic time trend in the regression. The null hypothesis is rejected at 1 per cent level of significance indicating that all the series are stationary. This means that the selected series are integrated of order one, i.e. *I*(1) and thus suitable for long memory test.

Table 1: ERS Point-Optimal unit root test results

Indices	Level		First difference	
	constant	Constant + trend	constant	Constant + trend
BSE Sensex	53.8488	16.1975	1.5483***	1.6598***
NIFTY	6.4340	15.3511	0.8196***	2.2585***
Crude Oil	14.1021	42.7076	1.5653***	1.8842***

**** represent the statistical significance level of 1%; ** represent the statistical significance level of 5%;*

4.2 Vector Error Correction Model (VECM)

Our VECM analysis is two-fold. The multivariate cointegration test results show that while allowing for the (linear) trend, there is no long-term relationship between crude oil prices and stock markets in case of India, although very short-term relationship may exist along with disequilibrium. Therefore, it is equally important to see whether any adjustments for short-run disequilibrium are made by VECM. The VECM which is first used by Sargan and later popularized by Engle and Granger has cointegration relations built into the specifications so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term, since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. In this connection, VECM is applied in this study and corresponding VEC model is:

$$\Delta SI_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta SI_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta COP_{t-i} + \alpha_1 Z_{t-1} + e_{1t} \quad (1)$$

$$\Delta COP_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta COP_{t-i} + \sum_{i=1}^{n} \delta_{2i} \Delta SI_{t-i} + \sigma_1 Z_{t-1} + e_{2t} \quad (2)$$

Where, SI_t and COP_t represent stock indices and crude oil price and Z_{t-1} is the error correction term which we get from the cointegration equation, so that changes in variables ΔSI_t and ΔCOP_t are partially driven by past values of Z_t. The coefficient of error correction α_1 and σ_1 are expected to capture the long-run equilibrium adjustments of ΔSI_t and ΔCOP_t while the coefficients on ΔSI_{t-i} and ΔCOP_{t-i} are expected to capture the short-run dynamics of the model. Table 2 and 3 displays the results of VECM for BSE Sensex and NIFTY.

Table 2: VECM estimations for BSE Sensex

	Δ BSE Sensex	Δ Crude oil Price
Z_{t-1}	5.66E-05 [0.00794]	-0.000160*** [-3.22238]
Δ BSE Sensex$_{t-1}$	0.056465 [1.03579]	-0.000172 [-0.45324]
Δ BSE Sensex$_{t-2}$	-0.053217 [-1.03567]	0.000228 [0.63786]
Δ *Crude oil Price* $_{t-1}$	43.48208*** [5.61247]	0.024051 [0.44667]
Δ *Crude oil Price* $_{t-2}$	-1.869818 [-0.23101]	-0.036996 [-0.65765]
Constant	33.03923 [1.34995]	-0.110736 [-0.65101]
R^2	0.094963	0.034574
Adj. R^2	0.081455	0.020164
F-statistics	7.030150	2.399387

*, ** and *** denotes significance at 10%, 5% and 1% levels. [ ] t statistics.

Table 3: VECM estimations for NIFTY

	Δ NIFTY	Δ Crude oil Price
Z_{t-1}	-0.039158*** [-2.70667]	-0.000378 [-0.82840]
Δ NIFTY $_{t-1}$	0.058399 [1.06805]	0.000810 [0.47024]
Δ NIFTY $_{t-2}$	0.027710 [0.50526]	0.001103 [0.63812]
Δ *Crude oil Price* $_{t-1}$	0.359843 [0.20567]	0.033203 [0.60205]
Δ *Crude oil Price* $_{t-2}$	1.184586 [0.67682]	-0.038073 [-0.69012]
Constant	-2.228188 [-0.40878]	-0.105967 [-0.61675]
R^2	0.023329	0.005814
Adj. R^2	0.008752	-0.009025
F-statistics	1.600385	0.391813

*, ** and *** denotes significance at 10%, 5% and 1% levels. [ ] t statistics.

The responses of each selected series to correct the disequilibrium are captured by the significance and size of the estimated coefficients α_1 and σ_1 of the VECM equations 1 and 2.However, the VECM estimations give varied results. In case of BSE Sensex, σ_1 is found to be statistically significant at 1% level and only 0.02% of disequilibrium is corrected each week by changes in crude oil price. For NIFTY, only α_1 is found to be significant at 1% level and about 3.92% of short-run disequilibrium is corrected each week by changes in NIFTY.

The short-run interactions are shown by the coefficients of the lagged differenced terms of the respective stock indices and crude oil price series for each country. In tables 2 and 3 it has been found that few short-run adjustment coefficients of stock indices series are statistically significant. This implies that there is very little evidence of short-run dynamics among the variables of interest in all the emerging economies.

4.3 Impulse Response Analysis

Impulse response function has been proposed and employed by Christopher Sims (1980), which states that, a shock to the i^{th} variable has a straightforward and direct impact on the i^{th} variable and at the same time it is also transmitted to the other endogenous variables in the system with the help of the dynamic lagged structure of the VAR. Impulse response functions are simply dynamic simulations that demonstrate the response of an endogenous variable to a one-time shock. Thus, to measure the impulse response functions, we applied structural VAR (SVAR) model as used by Kilian & Park (2009).

$$e_t = \begin{pmatrix} e_{1t}^{crude\ oil\ price} \\ \\ e_{2t}^{stock\ indices} \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} \\ \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} \epsilon_{1t} \\ \\ \epsilon_{2t} \end{pmatrix}$$

Here, ε_{1t} and ε_{2t} correspond to white noise error term and e_{1t} and e_{2t} represents the residuals from VECM equations. Any disturbance in ε_{1t} is quickly and directly transmitted to e_{1t} through the first equation and also to e_{2t} through the second equations respectively. Similar reactions occur in case of any disturbances in ε_{2t}. Therefore, it is found that a random shock in one innovation in SVAR model form a chain reaction with the other variables over time in the system. These chain reactions for BSE Sensex and NIFTY are measured by impulse response functions which are displayed in figures 1 and 2

Figure 1: Impulse response of BSE Sensex to crude oil prices.
Response to Cholesky one S.D. innovations (+,-) 2 S.E.

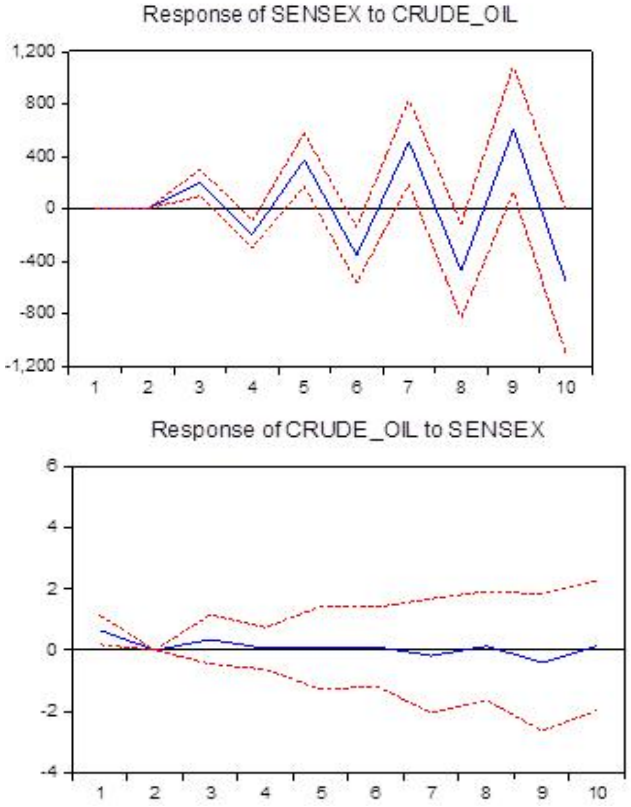
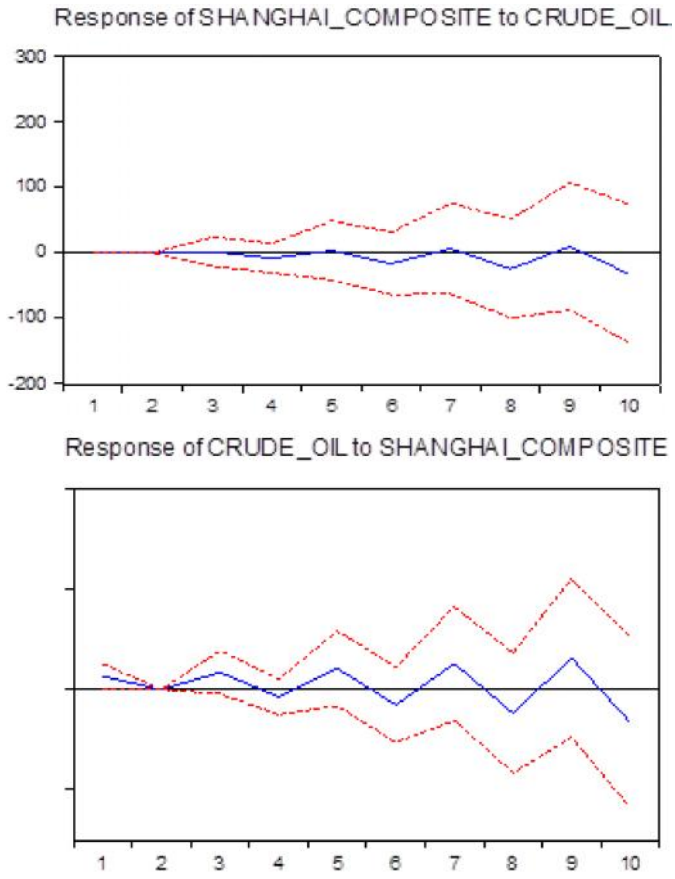


Figure 2: Impulse response of NIFTY to crude oil prices.
Response to Cholesky one S.D. innovations (+,-) 2 S.E.



Here impulse response functions have been derived using lag intervals of 3 and 4. In Indian context, it is observed that BSE Sensex is also quite sensitive to changes in crude oil prices although, BSE Sensex does not adjust to innovations in crude oil prices. Next, in the case of NIFTY, the first figure that measures responses of NIFTY to crude oil price, the graph of NIFTY is almost flat even after taking higher lag intervals of 4 and 5, 5 and 6, 6 and 7, etc. Thus, NIFTY is less susceptible to changes in crude oil prices but, of course in the short-run it adjusts to crude oil price innovations at a moderate speed to correct disequilibrium.

5. CONCLUSIONS

This study investigates the dynamic linkages between crude oil prices and BSE Sensex and NIFTY, the major stock indices of India. Our study results reveal that there does not exists any long-run relationship between crude oil prices and Indian stock indices like BSE Sensex and NIFTY. The results of VECM are further strengthened by the findings of Impulse Response Functions. BSE Sensex is also somewhat sensitive to changes in crude oil prices although, BSE Sensex does not adjust to innovations in crude oil prices. NIFTY is less susceptible to changes in crude oil prices but, of course in the short-run it adjusts to crude oil price innovations at a moderate speed to correct disequilibrium.

Lower oil prices also underline the necessity for real and financial sector reforms in order to promote diversification of the economy of the oil exporting countries (IMF Discussion Note, 2015).Oil importers like India on the other hand, need to balance rebuilding room for policy along with managing and administering domestic cyclical risks. However, the countries with severe financial vulnerabilities should go for saving much of the windfall, while the countries that are facing large output gaps should spend it. In a nutshell, the oil importing countries should use thisperiod as a chance to reinforce and fortify their monetary policy frameworks (IMF Discussion Note, 2015).

Lower crude oil prices offer an opportunity to commence and carry out serious fuel pricing and taxation reforms in both oil-importing and oil-exporting countries. The resulting stronger fiscal balances would create room for rising priority expenditures and cutting distortionary taxes that boosts up economic growth. Moreover, in a number of low- and middle-income countries, energy sector reforms are being aimed at enlarging the access to reliable energy that has significant developmental advantages (IMF Discussion Note, 2015).

For oil importing countries, the economic impact of plummeting oil prices depends on various geopolitical factors and also on the motive that are behind the fall in oil prices. If the oil prices plunge down due to increase in production and supply, consumers have more money in hand to spend on domestic products instead of imported oil, which in turn boosts up the domestic economy. On the other hand, if oil prices fall because of dilemma in the global economy, nevertheless, then the lower oil price is more an indication for problems than a reason to celebrate. Consequently, some modest stimulus can be expected from low oil prices for oil importing countries. But low oil prices are also a reason to worry, as they are partly a symptom of slowing global growth.(www.bruegel.org/2016/01/the-oil-price-slump-crisis-symptom-or-fuel-for-growth/)

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