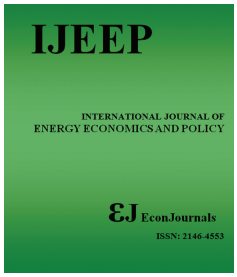

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Oil Price and Economic Growth: The Case of Indian Economy

Tarek Tawfik Yousef Alkhateeb[1,2], Zafar Ahmad Sultan[3]*

[1]Department of Marketing, College of Business Administration, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia, [2]Kafrelsheikh University, Egypt, [3]Department of Economics, L.S. College, B.R.A. Bihar University, Muzaffarpur, Bihar, India. *Email: zsultan.sultan@gmail.com

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ABSTRACT

Oil is an important input used in almost all the economic activities of any country. Hence, rise in its price is likely to adversely affect economic growth of oil importing countries like India. The present paper intends to examine the impact of oil price on economic growth of India. In order to examine the presence of cointegration relationship between economic growth, oil price, capital formation and inflation in the case of India, the study has used Pesaran's bound test method. The study finds that the variables under study exhibits long run cointegration relationship. Vector error correction model results suggest that oil price, capital formation and inflation Granger cause economic growth in the long run. Further, the result shows that the coefficient of oil price is negative and significant implying that oil price in India adversely affects country's economic growth. The study suggests that the government should refrain from imposing additional taxes in order to avoid rise in oil prices and its subsequent adverse effect on economic growth of the country.

Keywords: Oil Price, Economic Growth, Bound Test, India
JEL Classifications: E20, E22, E31

1. INTRODUCTION

Large amount of literature demonstrates that fluctuation in oil price have significant influence on economic activity of an economy. These influences arise from both sides, demand as well as supply side. On the demand side, the change in oil price comes from its effect on consumption and investment. The consumption depends upon the disposable income and if disposable income is altered some how by oil price, the consumption level will also be altered. The oil price affects investment level by changing the cost of production. Rise in price of oil makes the production more expensive and lessen the profit margin of the firm and hence reduce the incentives for investment. Besides these, increase in oil price also feeds inflation in the economy which also has an impact on economic activity of the country.

Recent rise in oil prices in India owing to mixed of factors like change in crude oil price, depreciation of Indian rupee and indirect taxes has raised the concern of many about its impact on growth of Indian economy. The price of crude oil has recently witnessed rising trend after steep fall since 2014 from about $130 per barrel in 2012 to as low as $34 per barrel in 2017 and is expected to reach $70 per barrel by 2019. Increase in price of crude oil disturbs the economic activity of the country by influencing country's current account balance and foreign exchange reserves, inflation rate in the economy and value of the domestic currency. However, decline in international price has not always reflected a corresponding and proportionate decline in domestic price of oil products due to tax and exchange rate factors. It is the domestic price of petroleum products and not crude oil price which directly affects the inflation and economic activity of a country. The period since 2014 also witnessed higher growth rate and low inflation which correspond to declining crude oil prices globally. From this perspective, the paper aims to study the relationship between price of oil and economic growth in the case of India.

The paper is organized as follows. Next section reviews some of the studies done to examine the relationship between oil price and economic growth. Econometric methodology has been discussed in section III. In section IV empirical results have been presented. Then, we conclude the paper.

2. LITERATURE REVIEW

Since oil is one of such products which touches almost every unit of the economy and affects the economic activity of a nation, the association between oil price and growth of an economy has drawn the attention of many scholars that resulted in large number of studies examining this relationship. Burno and Sachs (1982) while examining the impact of input prices on economic growth focusing on manufacturing sector have found that the input prices particularly high price of oil did have an effect on economic growth of United Kingdom. Hamilton (1983) applied VAR method to analyse the effect of oil price change on economic growth. He further reiterated negative relationship between oil price and economic growth (Hamilton, 1996) He observed that increased oil price has significant impact on growth rate of an economy. He further argued that rise in oil price was one of the factors responsible for recession during the post war period. Study by Jimenez-Rodriquez (2004) about the rise in petroleum price on gross domestic product (GDP) of OECD nations divulges that there is significant connection between oil price shock and macroeconomic variables. Both, linear and non-linear method gives the same result that increase in oil price negatively affect GDP growth of most of the oil importing economies. Kilian (2008), on the basis of his empirical examination of impact of exogenous oil supply shock on US income growth and consumer price level, inferred that oil supply shock adversely affects income growth of US till five quarters which may even continue until seven quarter at 68% level. However, at 95% confidence level, the adverse effect lasts for one quarter. Zhang (2008) enquired about the influence of crude oil price on growth of Japan and found negative impact on growth. Further, he observed non-linear and asymmetric relationship between the two. Similar finding was also observed by Carlton (2010) in the case of US.

Number of studies has been done to assess the effect of oil price variations on income growth in the case of developing countries too. For example, Abeysinghe (2001) studied the impact of shock in oil price on growth of twelve economies taking sample of both developed as well as developing countries. He found that the adverse effect of oil price shock on GDP growth is more severe in the case of developing countries than that of developed countries. For example, in the case of developing economies like Philippines and Thailand, an increase of oil price by 50% causes decrease in long run growth rate of GDP by about 5.5% and 5.7% respectively. But for developed nations like USA and rest of OECD countries, negative impact on GDP was of 0.7% magnitude. Bacon (2005) did more comprehensive study by taking 131 countries in his sample and arrived at similar inference about the impact of crude oil price rise on economic growth. His results show that $10 per barrel increase in price could decrease the GDP growth by 4% in the case of oil importing poor economies with per capita income of less than $300. For economies with good foreign exchange balance and per person income of over $9000, a similar shock of oil price would decrease income only by 0.4%.

Figure 1: Plot of CUSUM test

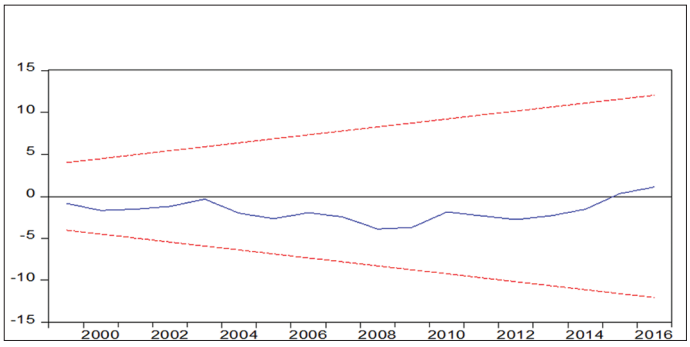


Figure 2: Plot of CUSUM of square test

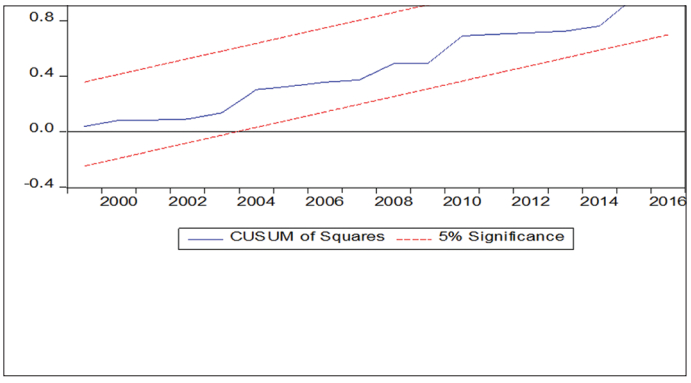


Figure 3: Plot of CUSUM test

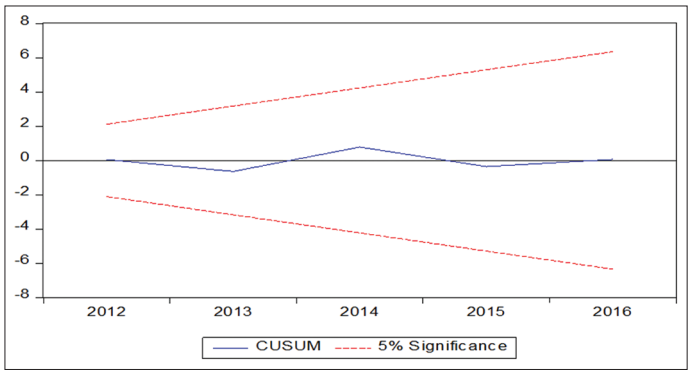
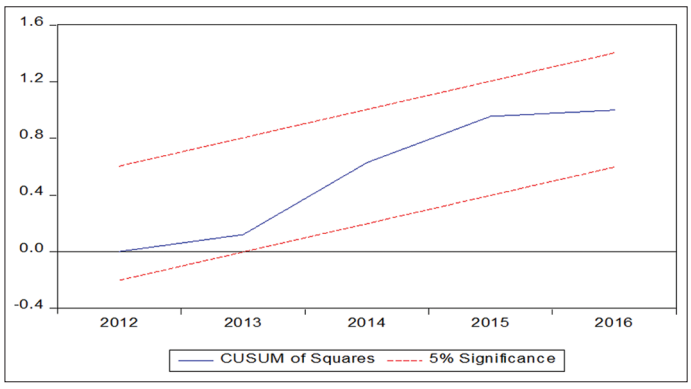


Figure 4: Plot of CUSUM of square test



Kumar (2009) studied about India and found that 10% increase in oil price decreases India's growth rate measured in terms of index of industrial production by about 0.1%. Du et al. (2010) did a similar study about China using VAR analysis but observed opposite of what most of the investigations observed. They observed a positive link between oil price and rate of growth of China.

By mid 1980s, researchers started observing that rise in oil price does not have same impact on economic activity as downward movement in oil price. Hence, non-linear method to observe the impact of oil price changes on economic activity has become more popular than linear method. For example, Mork (1989) used rise and fall in oil price as separate variable to forecast the changes in output of US economy and found that the result of fall in oil price is not significant. Such finding is departure from earlier linear approach where increase and decrease in oil has same effect on economic activity. Besides Mork, Hamilton (2003), Rodrigues (2005), Alkhateeb et al. (2017) also applied non-linear approach to scrutinize the association between the two.

Thus, most of the studies have shown a negative influence of oil price on economic growth of an economy. But most of the studies, while examining the relationship between growth and oil price, used international price of crude oil and not the domestic price. Many a times, the change in crude oil price does not cause a proportionate change in domestic prices too. Due to exchange rate, tax and subsidy factors, the domestic price may move in different direction or remain constant despite change in international price. It is the domestic price and not the international price which directly affects the input cost or transportation cost in the domestic economy and thus may affect the economic activity of the country. This is what we have also observed in the case of India that despite the decline in international price of crude oil during the last few years, the domestic price of petrol and diesel did not decline in same proportion. With this perspective, the present paper aims to study the impact of change in domestic oil price on economic growth of India.

3. MODEL SPECIFICATION, DATA AND METHODOLOGY

In the case of India which is oil deficient country, increase in oil price affects economic growth negatively. Oil is used as an important input in almost all kinds of economic activities. Increase in its price may adversely affect economic growth by discourage the investors' incentives due to decrease in profit margin if the increased cost is not shifted to consumers. Hence, oil price may be claimed as an important determining factor in economic growth of the country. Further, gross fixed capital formation and inflation are also important factors which may determine the economic growth of a country. Hence following model may be used to examine the impact of changes in oil price on GDP of India.

$$lGDP_t = f(lOilP_t, lGFCF_t, lP_t) \quad (1)$$

Where,
GDP is real gross domestic output
GFCF symbolizes real gross fixed capital formation
OilP denotes oil price, and
P refers to inflation level in the country
l denotes log of respective variables
t is time period

The study has covered period from 1989 to 2017 and the data has been taken from http://freefincal.com and Indian Oil Corporation.

Since time series data from 1989 to 2017 is being used to estimate the effect of oil price on economic growth of India, stationary test requires to be applied as most of the macroeconomic data reveals some sort of trend over time. In such cases, the application of ordinary least square method fails to give reliable results (Granger and Newbold, 1974). Hence, as a first step in estimating the influence of oil price on economic growth of India, unit root test will be applied on the variables to check the presence of unit root in the variables. For this, augmented Dicky-Fuller (ADF) test (Dicky and Fuller, 1979) and Philips-Perron (PP) test (Philips and Perron, 1988) will be used. If the results reveal that the variables are not integrated of more than first order I(1) and the dependent variable is stationary at first difference, we will apply autoregressive distributed lag model of cointegration developed by Pesaran et al. (2001). The method has the merit of application even in the case when the variables displays mixed order of integration. In order to estimate long run cointegration relationship between the variables following unrestricted error correction model (UECM) will be used.

$$\Delta lGDP_t = \alpha_0 + \alpha_1 lGDP_{t-1} + \alpha_2 lOilP_{t-1} + \alpha_3 lGFCF_{t-1} + \alpha_4 lP_{t-1} + \sum_{i=1}^{m}\beta_{1i}\Delta lGDP_{t-i} + \sum_{i=1}^{m}\beta_{2i}\Delta lOilP_{t-i} + \sum_{i=1}^{m}\beta_{3i}\Delta lGFCF_{t-i} + \sum_{i=1}^{m}\beta_{4i}\Delta lP_{t-i} + \varepsilon_t \quad (2)$$

Where, Δ is first difference operator, α_i shows long run parameters and β_{mi} are short run parameters. Akaike information criterion has been used to decide about lag period for UECM. The null hypothesis of no cointegration is inferred by testing the significance of lagged level variables of the above equation on the basis of Wald test or F-statistics.

H_0: $\alpha_1=\alpha_2=\alpha_3=\alpha_4=0$; (no cointegration exists), and

H_A: $\alpha_1\neq\alpha_2\neq\alpha_3\neq\alpha_4\neq0$. (cointegration exists)

If the calculated F-value falls outside the critical upper bound values provided by Pesaran et al. (2001) at conventional 1%, 5% or 10% significance level, then we will reject the null hypothesis that there is no cointegration relation between the variables.

Once cointegration is established, we will proceed to examine the causal relationship among the variables using following vector error correction model (VECM) as suggested by Engle and Granger (1987).

$$\Delta lGDP_t = \delta_0 + \sum_{i=1}^{m} \delta_{1i} \Delta lGDP_{t-i} + \sum_{i=0}^{m} \delta_{2i} \Delta lOilP_{t-i} + \sum_{i=0}^{m} \delta_{3i} \Delta lGFCF_{t-i} + \sum_{i=0}^{m} \delta_{4i} \Delta lP_{t-i} + \delta_5 ECT_{t-1} + \dot{o}_t$$

If δ_5 is found to be negative and significant, we may conclude that oil price and other variables Granger cause change in GDP in the long run.

4. EMPIRICAL ANALYSIS

The results of unit root are given in Table 1a and b. Both the test (ADF and PP) results reveal that the variables at level are non-stationary but stationary at first difference.

This implies that cointegration method should be applied to examine the long run relationship between oil price and economic growth in the case of India. As the sample is not very large, we have used bound test approach which is prudent even in small sample. For bound test, we have estimated UECM which is given in Table 2. All the criteria recommend zero lag period for UECM as is evidenced from Table 3.

Table 1a: Results of augmented Dicky-Fuller unit root test

Variables	Level		First difference		Order of integration
	C	C & T	C	C & T	
lRGDP	1.937239	−1.508559	−3.767471*	−4.335637*	I (1)
lOilP	−1.703600	−2.517566	−6.147248*	−6.848298*	I (1)
lGFCF	−0.090905	−2.686451	−4.551700*	−4.478859*	I (1)
lP	−3.414855**	−3.216091	−2.784503***	−3.418180***	I (1)
Critical values					
1%	−3.699871	−4.339330			
5%	−2.976263	−3.587527			
10%	−2.627420	−3.229230			

Critical values are Mc Kinnon Values (1996). *, ** and ***shows significant at 1%, 5% and 10% respectively. Number of lags is based on Schwarz information criterion

Table 1b: Results of Philips-Perron unit root test

Variables	Level		First difference		Order of integration
	C	C & T	C	C & T	
lRGDP	1.937239	−1.508559	−3.779568*	−4.356540*	I (1)
lOilP	−2.005818	−2.559652	−7.908574*	−9.957064*	I (1)
lGFCF	−0.131125	−2.030634	−4.599168*	−4.535544*	I (1)
lP	−2.860140	−2.371476	−2.694002***	−3.418180***	I (1)
Critical values					
1%	−3.699871	−4.339330			
5%	−2.976263	−3.587527			
10%	−2.627420	−3.229230			

Critical values are Mc Kinnon Values (1996). *, ** and ***shows significant at 1%, 5% and 10% respectively. Number of truncation lags is based on Newey-West criterion

Table 2: Result of UECM: Dependent variable is lRGDP

Variable	Coefficient	Standard error	t-Statistic	P
LRGDP (-1)	−0.199505	0.045747	−4.361015	0.0004
LOILPRICE(-1)	−0.066362	0.025689	−2.583326	0.0187
LWPI (-1)	0.059762	0.045760	1.305996	0.2080
LRGFC (-1)	0.208726	0.047576	4.387160	0.0004
D (LOILPRICE)	−0.036210	0.026002	−1.392616	0.1807
D (LWPI)	−0.640343	0.141576	−4.522958	0.0003
D (LRGFC)	0.250031	0.057667	4.335763	0.0004
Diagnostic test				
AR^2		0.721740		
Serial correlation LM (1) test: Breusch-Godfrey test		F-statistics: 0.451343		Probability F (1,17): 0.5107
Serial correlation LM (2) test: Breusch-Godfrey test		F-statistics: 1.273064		Probability F (2,16): 0.3069
Jarque-Bera normality test		0.296912		Probability 0.862021
Breusch-Pagan-Godfrey Heteroskedasticity test		F-statistics: 0.137141		Probability F (7,17): 0.9937
ARCH Heteroskedasticity test		F-statistics: 1.836585		Probability F (1,21): 0.1898
White Heteroskedasticity test		F-statistics: 0.122148		Probability F (7,17): 0.9956
Ramsey RESET test		F-statistics: 0.573576		Probability F (1,17): 0.4592

UECM: Unrestricted error correction model

The diagnostic tests also confirm that the model is good. For example, like Breuch-Godfrey serial correlation LM test shows that there is no problem of serial correlation in the model as estimated F- value is too small to reject the null hypothesis of no correlation. The ARCH test, Breusch-Pagan-Godfrey test and White test also confirms that the model does not have the problem of heteroskedasticity. Jarque-Bera test proves that the residual term is normally distributed. Stability tests like RESET and CUSUM and CUSUM of square of residual (shown in Figure 1 and Figure 2 respectively) shows that the parameters are stable. Since the plot of the curves in Figures 1 and 2 lies within the 5 percent region, we may infer that the coefficients are stable

Bound test result shows that the F-value is much higher than the upper critical value at 1% significance level which implies that

Table 3: Results of various criteria for lag selection for UECM

Lag period	Akaike information criterion	Schwarz information criterion	Hannan-Quinn criterion
0	−5.223653*	−4.833613*	−5.115472*
1	−4.808683	−4.216251	−4.659688
2	−4.904980	−4.109153	−4.732265

*Indicates selection of lag period. UECM: Unrestricted error correction model

Table 4: Result of bound test for cointegration

Estimated F-value: 28.39*		
Level of significance	Critical values	
	Lower bound	Upper bound
1%	2.54	3.91
5%	1.97	3.18
10%	1.70	2.83

The reported critical bound values have been taken from Pesaran et al. (2001); table CI (i) Case I: No intercept no trend. *Indicates significant at 1%

India's economic growth measured in terms of GDP has long run cointegration relationship with oil price, capital formation and price level (Table 4). UECM further shows that the coefficient of lagged level oil price is negative and significant implying that change in oil price adversely affects economic growth of India in the long run and vice-versa as has been observed by most of the studies reviewed above too. Further, the coefficient of oil price obtained by taking ratio of lagged level coefficient of oil price and lagged level coefficient of GDP multiplied by minus one gives value of 0.33. This result is very close to findings of Hamilton (2003) in the case of USA after the 1973 oil price shock who estimated 10% increase in oil price produced 3.2% fall in output. The coefficient of lagged level capital formation has been found to be positive and significant. This suggests that if oil price by increasing input costs reduce the profit margin and discourages the investors to invest more, it will have secondary negative effect on economic growth of the country. Inflation level, however, has not been found to be significantly affecting economic growth in India at least during the sample period.

Having found cointegration relationship, VECM has been estimated to examine long run causal relationship between the variables as suggested by Granger. The result of VECM is given in Table 5. The diagnostic tests show that the residual term is normally distributed and does not have the problem of serial correlation, hetroskedasticity. Further, Figures 3 and 4 shows that the parameters are stable as the curves lie within the 5 percent region. The lagged error correction term is negative and significant. This advocates that oil price, capital formation and price level Granger cause economic growth in the long run. The policy implication of the result is that the government should keep an eye on rise in the oil prices and not to let it to rise. Despite the fact that the government has deregulated the price of petroleum products, it has not let the price to fall proportionally in the domestic market

Table 5: Estimated results of VECM: Dependent variable is lRGDP

Variable	Coefficient	Standard error	t-statistic	P
C	0.266328	0.045561	5.845590	0.0021
D (LRGDP(-1))	0.535204	0.133952	3.995498	0.0104
D (LRGDP(-2))	−0.978299	0.158410	−6.175746	0.0016
D (LRGDP(-3))	−0.490093	0.150102	−3.265065	0.0223
D (LOILPRICE)	−0.230018	0.034126	−6.740269	0.0011
D (LOILPRICE(-1))	−0.134895	0.034077	−3.958528	0.0108
D (LOILPRICE(-2))	−0.127846	0.024927	−5.128824	0.0037
D (LOILPRICE(-3))	−0.167608	0.027740	−6.042196	0.0018
D (LWPI)	−0.760367	0.106203	−7.159569	0.0008
D (LWPI(-1))	0.485979	0.133013	3.653623	0.0147
D (LWPI(-2))	0.287308	0.180957	1.587716	0.1732
D (LRGFC(-2))	0.360827	0.061738	5.844490	0.0021
D (LRGFC(-3))	−0.117407	0.065362	−1.796273	0.1324
ECT (-1)	−0.116638	0.043020	−2.711240	0.0422
Diagnostic test				
AR^2	0.898941			
Breusch-Godfrey serial correlation LM test	F-statistics: 24.57466		Probability F (4,1): 0.1500	
Jarque-Bera normality test	0.078705		Probability 0.961412	
Breusch-Pagan-Godfrey Heteroskedasticity test	F-statistics: 1.456283		Probability F (13,5): 0.3580	
ARCH Heteroskedasticity test	F-statistics: 1.547301		Probability F (1,16): 0.2315	
White Heteroskedasticity test	F-statistics: 1.651586		Probability F (13,5): 0.3027	
Ramsey RESET test	F-statistics: 2.733691		Probability F (1,4): 0.1736	

VECM: Vector error correction model

even after sharp fall in international prices through indirect taxes during the recent years. This might have slowed down the rate of growth. The growth rate of output and employment would have been even higher had the petroleum products' price been lower in proportion to international price.

5. CONCLUSION

During recent years, there was much hue and cry in India due to rise in domestic price of petrol and diesel at a time when international price of crude oil was not at its peak. Many economists argue that rising price adversely affect the economic activities and hence economic growth. In this background the study has tried to examine the impact of oil price on economic growth of the country.

The study has used bound test method of estimating cointegration relationship between the variables because this method can be applied even in the case when sample is small and variables are not integrated of more than first degree. The bound test result confirms that there is long run cointegration relationship between oil price, GDP, price level and capital formation. Further, the coefficient of lagged level oil price in UECM is found to be negative and significant. This supports the earlier findings that rise in oil price adversely affects economic growth of oil importing countries like India.

The coefficient of capital formation has been found to be positive and significant. This also indicates towards the fact that if investors are discouraged due to low profit margin, this will slow down the investment rate and hence economic growth of the country. Inflation, however, has not been found to be statistically significant to affect economic growth.

The VECM result shows that oil price, capital formation and inflation cause economic growth in the long run as lagged error correction term is negative and significant. The implication of this result is that the government should check the price from rising in the domestic market so that it should not discourage the investors to invest because of reduction in their profit margins and promote economic activities in the country.

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