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Influence of Crude Oil Price Shock on Economic Growth: Evidence from India

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Abstract
Fluctuation in oil price is criteria in the worldwide economy which is posing a great challenge to researchers and policy makers studying the stochastic nature of macro -economic dynamics. This research endeavour tries to analyze the influence of oil price change either domestic oil price or international oil price on economic growth in India for the period from February,1990 to March,2015.Result suggests that international crude oil price increase has significant negative impact on economic growth of India which is at par our expectation and crude domestic oil price increase has unexpectedly significant positive impact on economic growth of India which is contrary to our expectation. Our long run analysis suggests that variables in the series are cointegrated and exhibits a stable long-run equilibrium relationship. There exist unidirectional causality between growth in GDP(GDP) and international oil price (IOIL), growth in GDP(GDP) ,domestic oil price(DOIL).The causality runs from international oil price (IOIL) to growth in GDP, domestic oil price(DOIL)to growth in GDP respectively. This means that international oil price as well as domestic oil price granger causes economic growth but not vice versa so far as our study period and results are concerned.
Keywords: Oil price, economic growth, India, causality, cointegration.
JEL-C58, Q32, Q43, G00.

1. Introduction:

Shock of oil price change on economic growth of a country received substantial attention in economic and financial literature since late seventies. Oil is a thrilling word that always makes news. Therefore, oil pricing has, for all time, been a controversial issue since oil as a commodity is a necessity and has direct shock on prices of most other essential commodities causing the price of goods and services sensitive to oil price shock. The direct consequence of a given oil price boost for importer countries like India is an income losses. This loss in income depends on the oil-intensity of production and the degree to which the demand for oil is price inelastic. Then, if oil product prices rise and consumers are not capable or reluctant to reduce oil product consumption, consumers may reduce expenditures on other goods and services, potentially slowing the rate of GDP growth. Obviously, the bigger the oil-price increase and the longer higher prices are sustained, the larger will be the macroeconomic effect. Several empirical studies suggest that the boost to economic growth in oil-exporting countries provided by higher oil prices in the past has always been less than the loss of economic growth in importing countries.

Economists through empirical analysis of different economies have indicated that oil price volatility has significant impact on economic growth (Hamilton, 1983, Mork et.al, 1994, Carlton, 2010). "IEA [International Energy Agency (2004)] in its report concludes that impacts are even more severe for developing economies. Report mentions that the reason behind these severe impacts is that the use of energy in developing economies is inefficient. Alternative energy resources are not much developed for most of the developing countries as compared to developed countries. Further, net oil importing developing countries use oil double quantity as compared to developed countries to produce a unit of economic output. Moreover, developing countries are less capable to deal with financial crises created by higher oil import costs"[1]. Majority of empirical studies related to change in crude oil price and its impact on economic growth has been conducted for developed countries (Bruno and Sachs, 1982, Hamilton, 1983, Hooker, 1996).This is mainly because share of developing countries is small in overall world economy and data for developing countries is not straightforwardly available as is for developed countries.

Therefore, it would be appealing to investigate the impact of crude oil price changes on economic growth of India using monthly empirical data and econometric method.

2. Methodology and data:

This research has econometric and analytical appeal. The econometric and analytical study has used secondary data. One of the major obstacles for economic research about developing countries is non-availability of periodic time series data. The empirical investigation is carried out using annual data ranging from February, 1990 to March, 2015 which covers 303 monthly observations which is secondary by nature. The series of Brent crude oil spot price expressed in the US dollar per barrel is obtained from the US Energy Information Administration. The oil price series is international oil price. Multiplying the oil price series by respective US dollar-rupee exchange rate, the domestic oil price series is obtained. In this study, we have used GDP growth as proxy for economic growth. Collecting quarterly GDP data series from Handbook of Statistics on Indian Economy (several issues covering our study period), we have converted it into monthly series although process of conversion is not beyond criticism. As because developing economy like India has agriculture as one of the major contributor to its GDP growth. The nature of agricultural products does not allow them to mature on monthly or quarterly basis. The majority of crops yield either once a year or it takes them a complete year to be produced. However, all series are transformed into logarithmic series to remove heteroscadasticity as far as practicable.

2.1.Research question:

The research question is: Does Oil Price change influence economic growth in Indian context?

2.2. Research hypothesis:

Null hypothesis

H_0: There is no significant influence of oil price change on economic growth.

Alternative hypothesis

H_1: There is significant influence of oil price change on economic growth.

2.3.Method:

2.3.1.Ordinary least square method:

The objective of the study is to investigate the effect of oil price change-domestic as well as international (DOIL& IOIL) on economic growth (proxied by GDP growth) as well as causal connection between oil price and economic growth in Indian context. A bivariate regression model is designed to test the effects of oil price change on economic growth via GDP growth.

$LnGDP_t = \alpha + \beta_1 \, LnIOIL_t + \beta_2 \, LnDOIL_t + \varepsilon_t$ -------------------------(1)

ε_t represents the "noise" or error term; α and β_i represent the slope and coefficient of regression. The coefficient of regression, β indicates how a unit change in the independent variables [in our study, international oil price(IOIL), domestic oil price(DOIL) etc] affects the dependent variable [GDP growth]. The error, ε_t, is incorporated in the equation to cater for other factors that may influence GDP growth. The validity or strength of the Ordinary Least Squares method depends on the accuracy of assumptions. In this study, the Gauss-Markov assumptions are used and they include that the dependent and independent variables are linearly co-related, the estimators (α, β) are unbiased with an expected value of zero i.e., $E(\varepsilon_t) = 0$, which implies that on average the errors cancel out each other. The procedure involves specifying the dependent and independent variables. But it depends on the assumptions that the results of the methods can be adversely affected by outliers.

In addition, whereas the Ordinary Least squares regression analysis can establish the dependence of either GDP growth on international oil price(IOIL), domestic oil price(DOIL) or vice versa; this does not necessarily imply direction of causation. Stuart Kendal noted that "a statistical relationship, however, strong and however suggestive, can never establish causal connection." Thus, in this study, another method, the Granger causality test, is used to further test for the direction of causality.

2.3.2.Unit root test:

In economic research with econometric tools, test for stationery condition of time series data is becoming crucial. Usually, regression estimates obtained through standard estimation for a non-stationery time series are misleading. Granger and Newbold (1973) observed that in non-stationery time series analysis, usual t and F tests will be misleading, while the estimates are characterized by high R^2 and low Durbin-Watson statistics. This phenomenon in the literature is known as spurious or non-sense regression.

When dealing with time series data, a number of econometric issues can influence the estimation of parameters using OLS. Regressing a time series variable on another time series variable using the Ordinary Least Squares (OLS) estimation can obtain a very high R^2, although there is no meaningful relationship between the variables. This situation reflects the problem of spurious regression between totally unrelated variables generated by a non-stationary process. Therefore, prior to testing and implementing the Granger Causality test, econometric methodology needs to examine the stationarity; for each individual time series, most macro economic data are non stationary, i.e. they tend to exhibit a deterministic and/or stochastic trend. Therefore, it is recommended that a stationarity (unit root) test be carried out to test for the order of integration. A series is said to be stationary if the mean and variance are time-invariant. A non-stationary time series will have a time dependent mean or make sure that the variables are stationary, because if they are not, the standard assumptions for asymptotic analysis in the Granger test will not be valid. Therefore, a stochastic process that is said to be stationary simply implies that the mean [(E(Y_t)] and the variance [Var (Y_t)] of Y remain constant over time for all t, and the covariance [covar (Y_t, Ys)] and hence the correlation between any two values of Y taken from different time periods depends on the difference apart in time between the two values for all $t \neq s$. Since standard regression analysis requires that data series be stationary, it is obviously important that we first test for this requirement to determine whether the series used in the regression process is a difference stationary or a trend stationary.

Different tests have been developed by researchers to test for unit root. Two popular tests for time series data are Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller(1979) and Phillips-Perron (PP) test proposed by Phillips-Perron(1988). Null hypothesis of both ADF and PP test is that unit root exist in time series with the alternative being no unit root. The major difference between these two tests is how they treat serial correlation in the test regression.

In our analysis, to test the stationary of variables, we use the Augmented Dickey Fuller (ADF) test which is mostly used to test for unit root. Following equation checks the stationarity of time series data used in the study:

$$\Delta y_t = \beta_1 + \beta_1 t + \alpha y_{t-1} + \gamma \sum_{t=1}^{n} \Delta y_{t-1} + \varepsilon_t \text{------(2)}$$

Where ε_t is white nose error term in the model of unit root test, with a null hypothesis that variable has unit root. The ADF regression test for the existence of unit root of y_t that represents all variables at time t. The test for a unit root is conducted on the coefficient of y_{t-1} in the regression. If the coefficient is significantly different from zero (less than zero) ,then the hypothesis that y contains a unit root is rejected. The null and alternative hypothesis for the existence of unit root in variable y_t is H_0; $\alpha = 0$ versus H_1: $\alpha < 0$. Rejection of the null hypothesis denotes stationarity in the series.

The decision on whether we analyze a time series in levels or differences is an important aspect of forecasting. Visual methods have been around for a long time. Relatively recently, statistical tests for the null hypothesis that the series is nonstationary, meaning that differencing is required, have been developed. Therefore, we should start test for stationery from intercept, intercept&trend in level (i.e no differences) and if the result is non-stationery, data need to be differenced at intercept, intercept and trend respectively in first differences to attain stationery of time series.

If the ADF test-statistic (t-statistic) is less (in the absolute value) than the Mackinnon critical t-values, the null hypothesis of a unit root can not be rejected for the time series and hence, one can conclude that the series is non-stationary at their levels. The unit root test tests for the existence of a unit root in two cases: with intercept only and with intercept and trend to take into the account the impact of the trend on the series.

2.3.3. Testing for Cointegration Test (Johansen Approach):

The necessary criteria for stationarity among non-stationary variables are called cointegration. Testing for cointegration is necessary step to check if our modeling has empirically meaningful relationships. Cointegration refers to a scenario where linear combination of nonstationery variables is stationery.If two series are non-stationary and integrated of same order (either I(1) or I(2) or...), their linear combination can be stationary. If this is the case, series are called co-integrated. The very concept of cointegartion was introduced to examine if there exist co-movements (long-run equilibrium relationship) among the time series which originally are non-statonary, but happen to attain stationarity after first-ordered differencing. Therefore, cointegration needs be examined only among the variables which were tested to be I(1).

Cointegration, an econometric property of time series variable, is a precondition for the existence of a long run or equilibrium economic relationship between two or more variables having unit roots (i.e. Integrated of order one). The Johansen approach can determine the number of co-integrated vectors for any given number of non-stationary variables of the same order. Two or more random variables are said to be cointegrated if each of the series are themselves non – stationary. This test may be regarded as a long run equilibrium relationship among the variables. The purpose of the Cointegration tests is to determine whether a group of non – stationary series is cointegrated or not.

Having concluded from the ADF results that each time series is non-stationary, i.e it is integrated of order one I(1), we proceed to the second step, which requires that the two time series be co-integrated. In other words, we have to examine whether or not there exists a long run relationship between variables (stable and non-spurious co-integrated relationship). In our case, the mission is to determine whether or not domestic as well as international oil price fluctuation t (DOIL &IOIL) and economic growth (GDP) variables have a long-run relationship in econometric time series framework. Engle and Granger (1987) introduced the concept of cointegration, where economic variables might reach a long-run equilibrium that reflects a stable relationship among them. For the variables to be co-integrated, they must be integrated of order one (non-stationary) and the linear combination of them is stationary I(0).

The crucial approach which is used in this study to test r cointegration is called the Johansen cointegration approach. The Johansen approach can determine the number of cointegrated vectors for any given number of non-stationary variables of the same order.

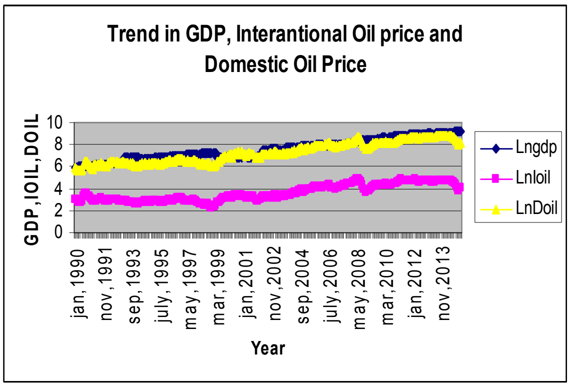
2.3.4. The Granger Causality test :

Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models. Historically, Granger (1969) and Sim (1972) were the ones who formalized the application of causality in economics. Granger causality test is a technique for determining whether one time series is significant in forecasting another (Granger. 1969). The standard Granger causality test (Granger, 1988) seeks to determine whether past values of a variable helps to predict changes in another variable. The definition states that in the conditional distribution, lagged values of Y_t add no information to explanation of movements of X_t beyond that provided by lagged values of X_t itself (Greene, 2003). We should take note of the fact that the Granger causality technique measures the information given by one variable in explaining the latest value of another variable. In addition, it also says that variable Y is Granger caused by variable X if variable X assists in predicting the value of variable Y. If this is the case, it means that the lagged values of variable X are statistically significant in explaining variable Y. The null hypothesis (H_0) that we test in this case is that the X variable does not Granger cause variable Y and variable Y does not Granger cause variable X. In summary, one variable (X_t) is said to granger cause another variable (Y_t) if the lagged values of X_t can predict Y_t and vice-versa.

3. Analysis of results:

Figure 1 illustrates the monthly GDP , oil price-domestic as well as international from February, 1990 to March, 2015.The trend in GDP suggests that GDP growth was expected to be higher when international price slows down and GDP growth are found to higher when domestic oil price increases which was beyond our expectation.

Fig:1



Source: Authors' own estimate

3.1. Descriptive Statistics:

Sample mean, standard deviation, skewness and kurtosis, and the Jacque-Bera statistics and the p-value have been reported.

Table 1: Descriptive statistics for India's stock market returns and other macro-economic variables

	LnGDP	LnIOIL	LnDOIL
Mean	7.569488	3.592039	7.290314
Median	7.467462	3.350255	7.177531
Maximum	9.272003	4.897093	8.870804
Minimum	5.941355	2.282382	5.598578
Standard Deviation	0.937944	0.738307	0.931923
Skewness	0.206766	0.287015	0.156169
Kurtosis	1.827896	1.632864	1.654450
Jarque-Bera	19.50355	27.75696	24.08923
Probability	0.000058	0.000001	0.000006
Observations	303	303	303

Source: Authors' own estimate

Note: The standard value of the kurtosis for normal distribution is equal to 3,
Skewness value for the normal distribution is equal to zero.
Jarque-Bera is used to test the hypothesis of normality.

Table 1 presents descriptive statistics for the variables used in our estimate. Summary statistics in table 1 include the mean and the standard deviation, minimum and maximum value for the period from February, 1990 to March, 2015.The mean, median, maximum, minimum and standard deviation can determine the statistical behaviour of the variables. The relatively lower figure of standard deviation indicates that the data dispersion in the series is quite small. This finding suggests that almost all the years included in the sample were having smaller dispersion level of different variables under our study across time series. All the variables are asymmetrical. More specifically, skewness is positive for all series, indicating the flat tails on the right-hand side of the distribution comparably with the left-hand side. On the whole, the distribution shows positive skewness which indicates flatter tails than the normal distribution. Kurtosis value of all variables also shows data is not normally distributed because values of kurtosis are deviated from 3. Variables show platykurtic distribution (kurtosis<3). The Jarque-Bera test, a type of Lagrange multiplier test, was developed to test normality of regression residuals. The Jarque-Bera statistic is computed from skewness and kurtosis and asymptotically follows the chi-squared distribution with two degrees of freedom. While testing for normality, it was found that Jarque-Bera statistics where p values for variables like GDP, IOIL,DOIL are lower than 0.05 which implies that variables under our consideration are not normally distributed.

Table 2: Regression results

Dependent Variable: LNGDP				
Method: Least Squares				
Sample: 1990:01 2015:03				
Included observations: 303				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.635831	0.228305	-2.785005	0.0057
LnIOIL	-0.644845	0.092569	-6.966122	0.0000
LnDOIL	1.443234	0.073337	19.67957	0.0000
R-squared	0.903134	Mean dependent var		7.569488
Adjusted R-squared	0.902488	S.D. dependent var		0.937944
S.E. of regression	0.292891	Akaike info criterion		0.391819
Sum squared resid	25.73553	Schwarz criterion		0.428588
Log likelihood	-56.36052	F-statistic		1398.526
Durbin-Watson stat	0.115442	Prob(F-statistic)		0.000000

Source: Authors' own estimate

Explanatory power of the models as indicated by R^2 (multiple coefficient of determination) and adjusted R^2 is fairly good. The model explains around 90% of the variation in the dependent variable.We examine the effects of international as well as domestic oil prices on the economic growth in India. Result suggests that international crude oil price increase has significant negative impact on economic growth of India which is at par our expectation. We know that the Indian economy imports about 80% of its oil requirements from international markets. This makes the economy vulnerable to any increases in oil prices in the international markets. In other words, increasing oil prices generate a current account surplus for oil exporters (like OPEC) and current account deficits for oil importers like India causing reallocation of wealth that may impact exchange rates. Empirically, there is clearly an inverse correlation between oil prices and exchange rates. In oil importing country like India, with oil price increase in international market, cost of importing oil in India enhances in rupee terms thus depreciating real exchange rate. A currency depreciation means the currency buys less foreign exchange, therefore, imports are more expensive and exports are cheaper. Therefore, the price of imported goods will go up because they are more expensive to buy from abroad. If there is depreciation in the exchange rate, this depreciation should cause cost-push inflation to increase. Eventually, there is an inverse relationship between the inflation and economic growth. This is because inflation in the economy will cause production to slow down since products are produced at higher prices. Inflation also increases the welfare cost to society, reduces international competitiveness of a country because of more expensive exports, thereby reducing economic growth in the long-run (Khan and Senhadji, 2001). In a nut shell, given our increasing dependence on imports effects to the Indian economy, by the increase in the price of crude oil, the inflation increases, government have to spend too much on subsidy, our exports become weaker, investment decreases and GDP is also affected.

On the contrary, it is evidently observed that crude domestic oil price increase has unexpectedly significant positive impact on economic growth of India. A remarkable point in the results that there exists significant relationship between domestic oil price and economic growth. The effect of domestic oil price on economic growth is statistically significant but with the wrong sign indicating that increase in domestic oil price enables economic growth to move upward which may not be possibly true. We have found in a study(Ray, Sarbapriya and Saha, Malayendu (2015)) that changes in international oil prices have more critical effects on the price indices than changes in domestic oil prices in India which supports the similar findings of Wen-Hsiu Huang , Ming-Che Chao,2012.It has been observed that international oil prices changes have substantial effects on the inflation in India and domestic oil prices do not affect the price indices significantly when oil price changes are substantially large. Consequently, the price indices are more sensitive to international than domestic oil prices. Keeping in mind the above research result, if domestic oil price change do not affect the price index or have less effect on price index, it will not affect GDP growth remarkably. Moreover, the domestic oil prices do not affect the economy homogenously. The services sector is far less dependent on oil than the industrial sector. In fact, as most of the growth in the economy is coming from the services sector, the economy and its performance is becoming less vulnerable to domestic oil price fluctuations. Another reason for the oil-price shocks not being fully effective in India is the governments administered pricing policies of oil that diffused the hikes by raising subsidy etc.

Table:3: Unit Root Test: The Results of the Augmented Dickey Fuller (ADF) Test

Variables	Level/First difference	Calculated ADF	ADF critical value (at 5%)	Included in test equation	Inference
LnGDP	Level	-2.52	-3.426	Intercept and trend	Non stationery
	First difference	-17.81	-2.871	Intercept	Stationery
LnIOIL	Level	-2.93	-3.426	Intercept & Trend	Non-stationery
	First difference	-13.15	-2.871	Intercept	Stationery
LnDOIL	Level	-3.23	-3.426	Intercept & Trend	Non-stationery
	First difference	-13.62	-2.871	Intercept	Stationery

Ho: series has unit root; H_1: series is trend stationary

Source: Authors' own estimate

Table 3 presents the results of the unit root test. The results indicate that the null hypothesis of a unit root can not be rejected for the given variable as none of the ADF value and PP value is smaller than the critical t-value at 5% level of significance for all variables and, hence, one can conclude that the variables are not stationary at their levels. The results show that variable of our interest- namely GDP (LnGDP), international oil price(LnIOIL) , domestic oil price(LnDOIL) have also attained stationary after first differencing I(1) signifying that they are integrated of order one, I (1). The results show consistency with different lag structures and to the presence of the intercept or intercept and trend.

Table 4: Johansen Co-integration Tests

Sample: 1990:01 2015:03,
Included observations: 298,
Test assumption: No deterministic trend in the data,
Series: Series: DLNGDP DLNIOIL DLNDOIL,
Lag Interval: 1 to 4

Hypothesized No. of CE (s)	Eigen value	Likelihood Ratio	5% critical value	1% critical value
None **	0.079586	32.53577	24.31	29.75
At most 1	0.023644	7.822238	12.53	16.31
At most 2	0.002318	0.691660	3.84	6.51

Software used: e.views

Ho: has no co-integration; H_1: has co-integration.

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.

L.R. test indicates 1 cointegrating equation(s) at 5% significance level.

Source: Author's own estimate

The co-integration is done to test the presence of long-run relation among two or more variables. Subsequently, a co-integration test is carried out to examine the long-run relationship among selected macroeconomic variables. The results in table-4 show that there exists long-run co-integrating relationship among different Macroeconomic variables.

Table 5: Pairwise Granger Causality Tests

Sample: 1990:02 2015:03
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability	Accept /Reject
DLNIOIL does not Granger Cause DLNGDP	301	3.14717	0.04442	Reject
DLNGDP does not Granger Cause DLNIOIL		2.59919	0.07603	Accept
DLNDOIL does not Granger Cause DLNGDP	301	4.38562	0.01327	Reject
DLNGDP does not Granger Cause DLNDOIL		2.57314	0.07800	Accept

Source: Author's own estimate

To indicate the direction of causation, we have used granger causality test. The results of pairwise granger causality between growth in GDP (GDP) and different macro economic variables like international oil price (IOIL)and domestic oil price(DOIL) are contained in Table 5. There exist unidirectional causality between growth in GDP(GDP) and international oil price (IOIL), growth in GDP(GDP) domestic oil price(DOIL).The causality runs from international oil price (IOIL) to growth in GDP domestic oil price(DOIL)to growth in GDP respectively. This means that international oil price as well as domestic oil price granger causes economic growth but not vice versa.

4. Conclusion

Unit root test by Augmented Dickey Fuller test and Johansen cointegration test were used to examine stationarity and the existence long run relationship among the variables respectively. The result suggests that all variables like GDP growth, domestic oil price and international oil price attained stationery after first differencing I(1).Regression result suggests that international crude oil price increase has significant negative impact on economic growth of India which is at par our expectation. It is evidently observed that crude domestic oil price increase has unexpectedly significant positive impact on economic growth of India which is contrary to our expectation. Our long run analysis suggests that variables in the series are cointegrated and exhibits a stable long-run equilibrium relationship. There exist unidirectional causality between growth in GDP(GDP) and international oil price (IOIL), growth in GDP(GDP) domestic oil price(DOIL).The causality runs from international oil price (IOIL) to growth in GDP domestic oil price(DOIL)to growth in GDP respectively. This means that international oil price as well as domestic oil price granger causes economic growth but not vice versa so far as our study period and result are concerned. The study confirms that oil price is having long run relationship with economic growth by using Johansen Cointegration test and also does convey short term unidirectional causal relationship as empirically confirmed by Granger causality test.

References

Ray, Sarbapriya and Saha, Malayendu (2015), Does Oil Price Shock influence Inflation in India? , United States of America Research Journal, Vol. 5, No.1, pp.64-79, ISSN 2332-2160, USA).

Ray,Sarbapriya, Saha, Malayendu (2016), Dynamic Association between Macroeconomic Variables and Stock Return Volatility: Evidence from India, American Journal of Business, Economics and Management, Vol. 4, No. 4, pp. 40-56.

Granger C.W.J. (1969), Investigating causal relations by econometric models and cross spectral methods, Econometrica ,vol.37.

Hamilton,J.D(1983), Oil and the macro economy since World War,II,Journal of Political Economy, vol.91(2),pp228-48.

Carlton, A.B (2010), Oil Price and real time Output Growth, Working paper, Houston University.

Bruno,M and Sachs ,J(1982), Input price shock and slowdown in economic growth, The case of UK Manufacturing,NBER Working paper series, Working paper no.851.

Mork,K(1989), Oil and the macro economy when prices go up and down: An extension of Hamilton's results, Journal of political economy, vol.97(3),pp.740-44.

Hooker, M(1996), What happened to the oil price-Macro economy relationship? Journal of Monetary Economics, Vol.38, pp.195-213.

Granger, C. W. J. and Newbold, P. (1974),"Spurious regressions in econometrics", Journal of Econometrics, vol.2 (2): pp111–120.

Dickey, D.A and W.A.Fuller (1979), Distribution of estimators of Autoregressive Time series with a Unit Root, Journal of the American Statistical Association, vol.74,pp.427-31.

Sims, C. A. (1972): Money, Income and Causality, American Economic Review, vol. 4, pp. 540–542.

Phillips, Peter and Pierre Perron (1988),"Testing for a Unit Root in Time Series Regression." Biometrica, Vol. 75 (June). pp. 335-346.

Note:1:

International Energy Agency (2004), Analysis of the impact of high oil prices on the global economy,vol.2.