Oil Price Fluctuations and their Short/Long Run Impact on Algerian Economic Growth: The ARDL Model

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Abstract:

   This paper investigates the linear asymmetric impacts of oil price shocks on the Algerian economic growth during the period (1990-2015), using the ARDL approach. The results show that there is insignificant positive effect of oil price fluctuations on the Algerian economic growth in the long run and the short run. finally the study recommends that the Algerian government, and in order to reduce its dependency on the petroleum sector, should adopt a prudent fiscal policy toward oil prices, further more it should use its oil revenues and the financial Surpluses to develop the other economic sectors.

Keywords: Oil prices, Economic Growth, ARDL Model.
(JEL) Classification : Q41,O4

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I. Introduction:

Energy is a vital ingredient in achieving sustained growth of every nation, and Algeria is   not an exception. Algeria is considered one of oil producing countries, it participate in global production of oil through its company SONATRACK and its foreign partners about 11898 barrels per day (in2010), exporting about 709 barrels per day and estimated oil reserves of 12.2 billion barrels. In 2014, the Algerian economy expanded by 4%,up from 2.8% in 2013,growth was driven mainly by the recovering oil and gas sector and further economic expansion of 3.9% in forecast in 2015,and 4% in 2016(**African Economic Outlook,2015).**

The objective of this paper is to investigate the impact (long and short) of oil price fluctuations on Algerian Economic Growth rate over the period 1990-2015 using seven variables: GDP Per Capita(as measure of economic growth),oil prices, government expenditures, money supply, exchange rate, capital stock, and labor force, using the ARDL approach (co-integration mechanism and error correction mechanism ECM).

1. Literature Reviews:

Several studies have been carried out to examine the effect of oil price distortions on economic variables, most of them have focused on studying this relation mainly within developed net oil importing countries. Earlier works, as **(Darby,1982) (Burbidge and Harrison,1984)** obtained statistically significant empirical evidence of the relationship between oil prices and aggregate economic performances. Recently, in 2004**, (Rebeca Jimenez and Marcelo Sanchez,2004)** examine the effect of oil price shocks on real economic activities using a sample of seven OECD countries over 1972:Q2-2001:Q4(using quarterly data)using multivariate VAR analysis (linear and non linear model),the results show a nonlinear impact of oil prices on real GDP and a negative effect of oil prices on economic activities in all countries except Japan. In 2008, using VEC model by **(Katsuya,2008)** to investigate the effect of oil prices and monetary shocks on the Russian economy over the period 1997:Q1-2007:Q4,he find that an increase in oil prices contributes to real GDP growth ,and the monetary shocks (through interest rate   channel)affect real GDP and inflation as predicted by theory. More recently, the study conducted by **(Akin Iwayemi and Zabajide Fowowe,2011)** to analyze the effects of oil price shocks on developing oil –exporting country (Nigeria case) ,found that oil price-shocks don't have a major impact on most economic variables over the period 1985:Q1-2007:Q4(using quarterly data).

2.oil price fluctuations in Algeria:

Oil sector contributes significantly to the gross domestic product (GDP) in Algeria, in the year 2010, the oil sector form 34.7% of the GDP compared to 59.2% for other various sectors(public administration services, services outside of public administrations , construction works sector, industry and Agriculture) , 6.1% for the rights and import duties, like shown in the figure1.

Algeria saw the fluctuation in oil prices during the period (1980-2000), the period(1992-1994) saw a decline in output in turn to a decrease in real oil prices, from1996 the GDP saw a marked improvement which is the result to increasing in non-oil exports.

Generally the GDP has taking an ascending curve form , starting from the year 1999 due to high oil prices as a result of actions taken by the oil-producing countries, where the period (2004-2011) record a high oil prices which has resulted in a rise in GDP.

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II. Research Methodology:

1. Data Collection: time series data from 1990-2015 of the related variables were collected from world bank data indicators(2014),and Organization Arab Petroleum Exporting Countries(OAPEC):Annual Statistical Report. The variables are: GDP Per Capita as indicator of economic growth, oil prices, government expenditures, money supply, exchange rate capital stock, and labor force.

2. Model Specification: since the objective of this study is to examine the oil price effects on Algerian Economic Growth, the study adopts the **"Solow model"** [*] ,which is defined as:

$$Y_t = A K^{\alpha}{}_t\, L^{\beta}{}_t\, e^{\varepsilon} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: Y_t:Output, **A**: Total factor productivity, **K**:Capital stock, **L**:labor force.

α, β: Elasticities.

Economic studies indicate that there are multi-variables that can affect the total factor productivity (A) in equation 1,so the current study examine the following variables of interest as:

$$A_t = f(\ OP_t,\ G_t\ MS_t,\ EXR_t)\ \ldots\ldots\ldots\ldots(2)$$

Where: **OP**: oil price: Government Expenditures, **MS**:Money Supply ,EXR: Exchange Rate

By substituting equation (2) in (1),the equation became:

$$Y_t = OP^{\gamma 1}{}_t\, G^{\gamma 2}{}_t\, MS^{\gamma 3}{}_t\, EXR^{\gamma 4}{}_t\, K^{\alpha}{}_t\, L^{\beta}{}_t\, e^{\varepsilon} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

By taking the natural logarithm (Ln) and by noting Y_t=GDPPC$_t$,so equation3 became:

$$\mathbf{Ln}GDPPC_t = \gamma_0 + \gamma_1 \ln OP_t + \gamma_2 \ln G_t + \gamma_3 \ln MS_t + \gamma_4 \ln EXR_t + \alpha \ln K_t + \beta \ln L_t + \varepsilon_t.. (4)$$

Since the objective of this study is to investigate the impact (long/short run) of oil price on Algerian economic growth ,we have used the Error Correction Mechanism(ECM)and co-integration analysis, so we have employed Auto-Regressive Distribution Lag(ARDL)approach[*].

The ARDL representation of equation 4 is specified as:

$$\Delta Ln GDPPC_t = \gamma_0 + \lambda Ln GDPPC_{t-1} + \gamma_1 \ln OP_t + \gamma_2 \ln G_t + \gamma_3 \ln MS_t + \gamma_4 \ln EXR_t + \alpha \ln K_t + \beta \ln L_t$$

$$+ \sum_{i=1}^{p} \phi_{1i} \Delta Ln GDPPC_{t-i} + \sum_{i=1}^{p} \phi_{2i} \Delta Ln OP_{t-i} + \sum_{i=1}^{p} \phi_{3i} \Delta Ln G_{t-i}$$

$$+ \sum_{i=1}^{p} \phi_{4i} \Delta Ln MS_{t-i} + \sum_{i=1}^{p} \phi_{5i} \Delta Ln EXR_{t-i} + \sum_{i=1}^{p} \phi_{6i} \Delta Ln K_{t-i} + \sum_{i=1}^{p} \phi_{7i} \Delta Ln L_{t-i}$$

$$+ \mu_t \ldots\ldots\ldots\ldots\ldots\ldots. (5)$$

where: Δ:the first difference operator: lag order selected by criterions, γ_0:drift parameters, υ_t: error term, ϕ_{ji}:short run parameters, $\lambda, \alpha, \beta, \gamma_i$: long run multipliers.

The first procedure in ARDL approach ,is to estimate equation 5 using OLS method, then we have used the F-test to test the presence of long run relationship among the variables in equation 5 ,this test test the null hypotheses of "no long run relationship among variables" as:

$$\begin{cases} \mathbf{H_0: \alpha = \beta = \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0} & \text{\textbf{no-co-integration}} \\ \mathbf{H_1: \alpha \neq \beta \neq \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq 0} & \text{\textbf{presence of co-integration}} \end{cases}$$

So, if calculated f-statistic is more than critical values, the null hypotheses is rejected, and if F calculated is less than critical, the null hypotheses is accepted.

The ARDL error correction representation of the series is specified as:

$$\Delta LnGDPPC_t = \varphi_0 + \sum_{i=1}^{p} \phi_{1i}\Delta LnGDPPC_{t-i} + \sum_{i=1}^{p} \phi_{2i}\Delta LnOP_{t-i} + \sum_{i=1}^{p} \phi_{3i}\Delta LnG_{t-i}$$

$$+ \sum_{i=1}^{p} \phi_{4i}\Delta LnMS_{t-i} + \sum_{i=1}^{p} \phi_{5i}\Delta LnEXR_{t-i} + \sum_{i=1}^{p} \phi_{6i}\Delta LnK_{t-i} + \sum_{i=1}^{p} \phi_{7i}\Delta LnL_{t-i}$$

$$+ \varepsilon \, ECT_{t-1} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (6)$$

Where: ε:the speed of adjustment of parameters to long run equilibrium following a shock to system, ECT_{t-1}: residuals obtained from equation 6.

III. Results and Discussion:

1. **Stationary of time series (Unit Root Test):**

In order to examine the stationary of time series, we have used the Augmented Ducky Fuller (ADF) and Fillips Peron) PP) test.

The results show that all variables under study are integrated at same order) at first difference: **I(1))** which means that there is a long run relationship between them, so we can apply the co-integration techniques.

2. Lag Selection of ARDL:

after determining the stationary level of all variables, the ARDL co-integration system[*] is implemented for Algeria using annual time series over 1900-2015.

  ▪ **Step 1**:

    We have to determine the lag length order obtained through Unrestricted Vector Autoregressive (VAR) via: Schwartz Criteria **(SC)**, Akaike Information Criteria**(AIC)**,and Hunan Quinn Criteria(HQ),as show in table 2, Through the criterion values, the lag length order is (1)

  ▪ **Step2:**

Is to test if there is a long relationship between variables under study through the unrestricted error correction model (UECM) using equation 5.To ensure that there is a relationship, we have determined F-Statistic through "Wald Test", which test the null hypotheses **H₀**:"there is no co-integration test between variables", which means the absence of long run relationship .the F calculated was compared with the lower/upper critical values(**pesaran and pesaran,2009**) as show in table (03).

As show table above, F calculated is bigger than F critical value for high bound at 1%,5%,10% ,so we reject **(H₀)**,which means the presence of long run relationship between variables under study.

  ▪ **Step 3:**

After ensuring that there is a long run relationship between variables under study, the next step is to estimate this long run relationship coefficients using ARDL as show in table (04):

The results show:

  ◆ the presence of insignificant positive effect between GDPPC and Oil Prices.
  ◆ the presence of significant negative effect between GDPPC and government expenditures and insignificant negative effect with exchange rate.
  ◆ the presence of insignificant positive effect between GDPPC and money supply, and labor force ,and significant positive effect with capital stock.

- **Step4:**

For measuring the short run relationship, we have using the error correction model (ECM)[*] as show in table (05).

As show the results in table above (table5), the error correction estimator is significant at 1%, which support the presence of short run relationship between variables ($EC_{T-1}=0.90$), this means that when economic growth (Measuring with GDP per capita) deviate from his equilibrium value in the short period (t-1), it correct which was equivalent to (90.8%) of this deviation in the period (t), the results also show the sign of estimators which where compatible with long run period.

IV. Conclusion:

In this study, we have investigate the long/short run effect of oil price fluctuations on Algerian economic growth rate over 1990-2015.

1. Results:

We can summarize the econometrics results below:

- ◆ the presence of insignificant long run relationship between growth rate and oil prices in Algeria during period under study(1990-2015)
- ◆ the presence of significant long run relationship between growth rate and capital stock in Algeria during period under study(1990-2015).
- ◆ the presence of insignificant long run relationship between growth rate and government expenditure, money supply and labor force in Algeria during period under study(1990-2015).
- ◆The oil prices have a positive effect on economic growth, but this effect is insignificant in the long run.

2. Recommendations:

Through the results obtained from econometric study, we can give some recommendation:

- ◆ Algerian government should uses its oil revenues and the financial Surpluses to develop the other economic sectors in order to reduce its dependency on the petroleum sector.
- ◆ Use a basket of currencies to do their foreign trading transaction; so as to avoid losses resulting from the depreciation of the dollar; and diversification of sources of imported goods; especially from the regions of dollar because it will be less expensive than the imported from euro region; must applied of more flexible exchange rates to achieve a real independence of the monetary authorities for help to face external shocks.
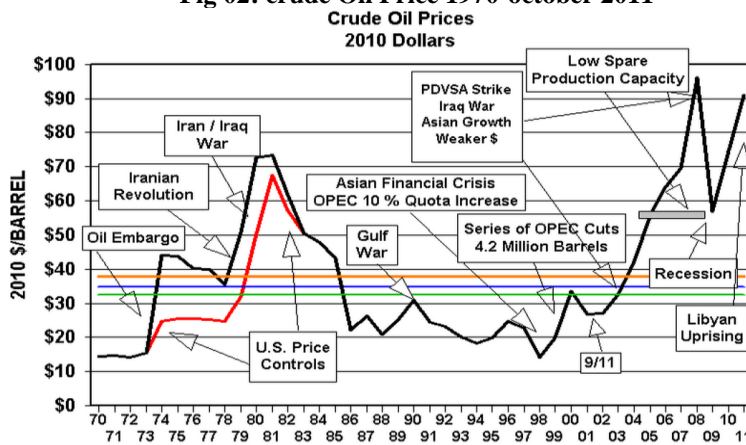- ◆ The government should adopt a prudent fiscal policy in relation to oil prices.

Appendix:

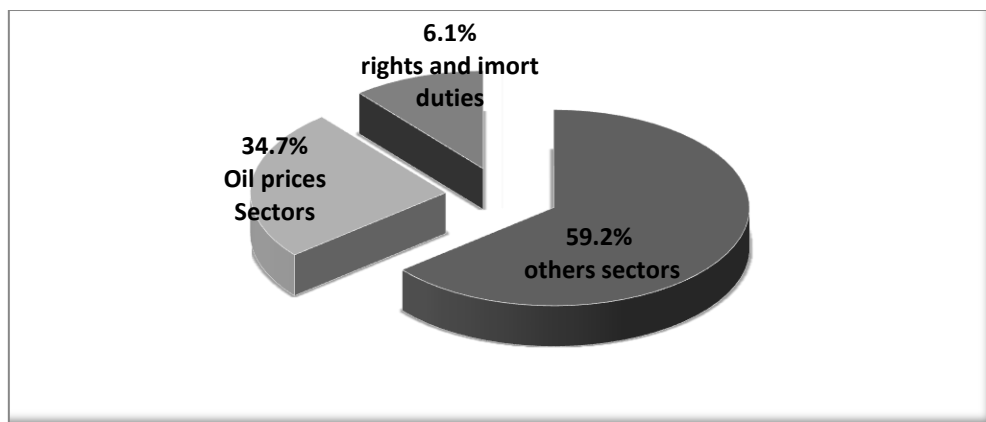**fig1: Spot Prices for OPEC Basket of Crudes، 2012-2015 (US Dollar / Barrel)**
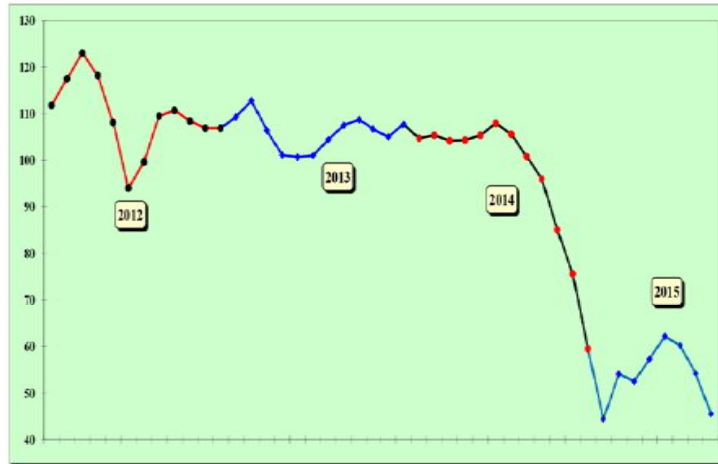
Source: Organization Arab Petroleum Exporting Countries (OAPEC): Annual Statistical Report,p113

Fig 02: crude Oil Price 1970-october 2011
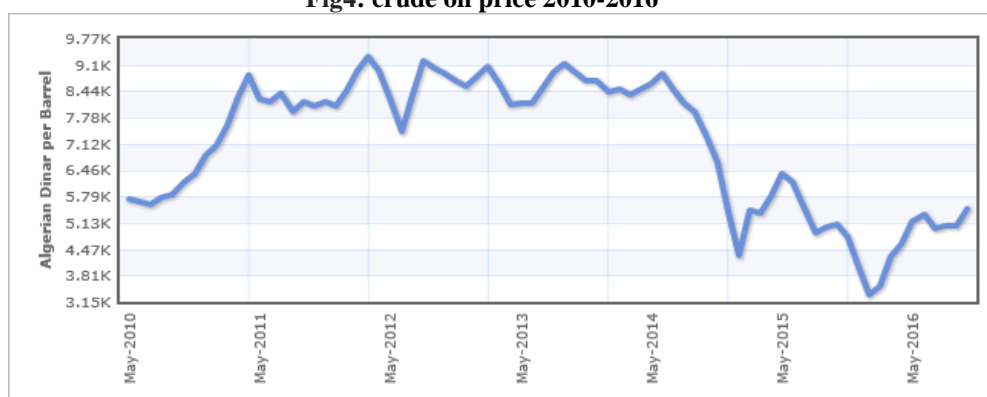

Source : http://www.wtrg.com/oil_graphs/oilprice1970.gif

Fig 3: The contribution of various sectors in GDP in Algeria in the year 2010

Source: prepared by researcher depending on central bank data.

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Fig4: crude oil price 2010-2016

Source: http://www.indexmundi.com/commodities/?commodity=crude-oil-brent&months=240&currency=dzd(review: 30/11/2016)

Table01: Unit Root Test Results

variables	ADF(intercept & trend)		PP(intercept &trend)		result
	level	1st diff	level	1st diff	
LnGDPPC	-2.4765	-5.1413*	-3.0321	-7.6905*	I(1)*
LnOP	-3.1067	-5.4623*	-4.7218*	-9.6211*	I(1)*
LnG	-1.9772	-3.2835***	-1.7384	-3.8915**	I(1)**
LnMS	-1.6271	-3.9303**	-1.5721	-4.4092**	I(1)**
LnEXR	-2.2828	-9.3505*	-5.3363	-8.7478*	I(1)*
LnK	-2.9569	-3.3900***	-3.3476	-4.4729*	I(1)***
LnL	-0.0773	-3.7948**	0.2546	-7.5440*	I(1)**

Source: prepared by researcher depending on the statistical package EVIEWS7
Notes: *, **, *** significant level at 1%,5%,10%.

Table2: Lag Length Selection

	Growth Equation		
order lags	AIC	SC	HQ
0	-4.7888	-4.4434	-4.7019
1	-5.5544*	-5.1594*	-5.4550*
2	-5.5391	-5.0948	-5.4273

Source: prepared by researcher depending on the statistical package EVIEWS7
Notes: *:indicate the lag order selected by criterion.
AIC: Akaike Information Criteria, **SC**: Schwartz Criteria, **HQ**: Hunan Quinn Criteria.

Table3:co-integration test using Wald test

	F calculated	P value	Result
Growth model	08.5741	0.000	there is a equilibrium long run relationship.
critical value at K=6	lower bound I(0)	upper bound I(1)	**Notes:** **K**: number of independent variables
1% significance	1.96	03.08	
5% significance	02.27	03.44	
10% significance	02.84	04.12	

Source: Microfit(4) output

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Table04: Estimated long run relationship coefficient using ARDL

Dependent Variable: LnGDPPC	ARDL technique order		
Regressors	**Coefficients**	**SE**	**Low significant level**
LnOP	0.0038	0.0067	0.4215
LnG	-0.0313	0.0272	0.0006*
LnMS	0.0846	0.0468	0.4209
LnEXR	-0.0825	0.0522	0.6420
LnK	0.1091	0.0664	0.0000*
LnL	0.4054	0.3595	0.9430

Source: Microfit(4) output.

Note: * significant at 1%

Table05: Estimated short run coefficients using the (ECM)

Dependant Variable LnGDPPC	ARDL technique order	Lower significant level
Regressors:		
LnOP	1.3092	0.2012
LnG	-0.2910	0.0050*
LnMS	0.0265	0.3426
lnEXR	-0.1915	0.4507
LnK	0.3920	0.0004*
LnL	0.1988	0.8577
EC_{T-1}	0.908	0.0031*
R^2= 0.85 ,SE= 1.1344 ,DW=1.4208		

Source: Microfit(4) output.

References:

*: SOLOW model is a exogenous growth model, an economic model of long run economic growth ,it attempts to explain long run economic growth by looking at capital accumulation ,labor or population growth and increase in productivity.

*:ARDL model was introduced by Pesaran and al(2001)in order to incorporate I(0) and I(1) variables in some estimation ,so if your variables are stationary I(0) then OLS is appropriate and if all variables are no-stationary(1) then it is advisable to do VECM(Johansson approach).

* :ARDL properties: can be used with mixture of I(0) and I(1), it involves just a single –equation set-up making it simple to implement and interpret ,different variables can be assigned different lag-lengths as they enter the model.

*:ECM is useful for estimating both short-term and long-term effects of one time series on another .The term error –correction relate to the fact that last period deviation from a long run equilibrium ,the error influences its short –run dynamics. Thus ECM directly estimate the speed at which a dependent variable returns to equilibrium after a change in other variables.

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