Sectoral Output Response to Fluctuations of Oil Exports in Algeria

Abdusalam F. Yahia

***Abstract*—The aim of this paper is to econometrically examine the impact of fluctuations of oil exports and its expansion on Algerian economic growth. The model of "an export as an engine of growth" is applied to total output as well as sectoral outputs. The technique of a Koyck distributed lag scheme was used and the main results can be illustrated as following: The growth rates of all Algerian sectors were much higher during the periods of rise in oil prices than during the period of oil recession. The regression results suggest that the coefficient of oil exports is highly significant in all periods except in the recession period (1986-1998). There are spread effects from oil exports to the rest of the economy during the periods that enjoyed high oil prices (1973-1985 and 1999-2010). When the component effects are excluded, the results of sectoral output investigation indicate that there is no evidence of spread effects of oil exports to the rest of the economy. The coefficient of the dummy variables in the equations of trade sector and manufacturing sector are statistically significant, which suggest that the intercept of these sectors have risen during periods of increase in export prices.**

***Index Terms*—Oil exports, sectoral output, economic growth, Algeria.**

I. Introduction

The Algeria is an oil producer country which located in the North Africa and a member of the organization of petroleum exporting countries (OPEC). Algeria has been exporting oil for more than forty years. In 2011, Algerians' oil production was approximately 1.2 million barrel per day and the share of Algeria oil exports in OPEC is approximately 6 percent in the same year. Available data also shows that Algerians' a proved reserve of crude oil was 12.2 billion in 2011 [1].

Table I reveals the significance of oil exports in Algeria over the past four decades. On one hand, oil exports amounted to about 80.6 and 71 percent of total exports of goods and services in 1973 and 1985 respectively. On the other hand, these percentages were reduced slightly over the following 13 years due to fluctuations in oil prices. They amounted to 51 percent in 1998. However, these percentages were significantly increased to 70 percent in 2011.

The data in Table I also indicates that in 1973 oil exports were responsible for over 18 percent of GDP. This percentage changed significantly over the following three decades due to changes in oil prices. The distinguished increases in the percentage of oil exports to GDP was approximately 24 percent in 1974, due to the oil embargo. At the end of the oil boom in 1985, the percentage of oil exports to GDP was reduced to 16 percent .it is clearly from the data in Table I that the share of oil exports to GDP went to its lowest level (12 percent) in 1998, when oil prices (nominal price) were very low (less than US$13 per barrel). The sharp rise in oil prices during the period of 1999-2011 pushed this percentage to its highest level (26 percent in 2011).

Finally, Table I shows that oil exports per capita was the highest in 1999 and 2011.however the picture was opposite during the period of 1986 to 1998 that the lowest oil exports per capita was (less than US$1000) in 1986.

TABLE I: Significance of Oil Exports in the Algerian Economy

	1973	1985	1998	2011
Value of oil export (in billion US dollars)	1,522	9,669	5,691	51,400
Imports as % of oil export	146	122	184	190
Oil exports as % of total exports of goods and services	80	71	51	70
Oil exports as % of GDP	18	16	12	26
Oil exports per capita (US dollars)	540	950	1597	1389

Source: Calculated by the author and based on [1]

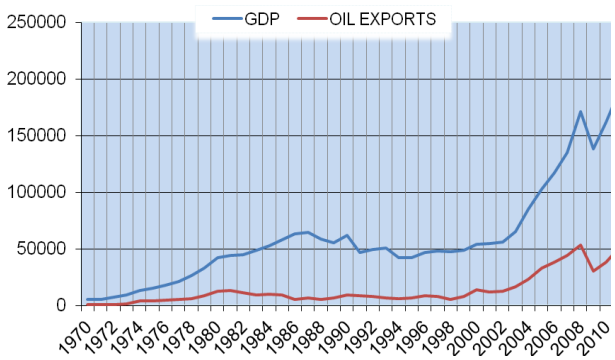

Fig. 1. Relationship between Algerian GDP and its oil exports.

In order to assess the preliminary relationship between Algerian GDP and its oil exports over the period 1973-2010, available data was illustrated in Fig. 1. This graph suggests that the remarkable raise in Algerian GDP has taken place after the oil embargo in 1973 and the consequent export price rises. It is also shows that the two variables drift too far apart from each other over time. However, fluctuations in GDP seem to be highly related with fluctuations in Algerian oil exports. This information is associated with other investigations related to trade relationship between oil exports and GDP in the oil producer countries [2]-[6].

Generally, this paper tries to examine the impact of fluctuations in oil exports on economic growth and in particular to investigate the response of sectoral output to fluctuation and expansions in oil exports in Algeria. It is

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A. F. Yahia, is with the Department of economics, Faculty of Economics and Commerce, Almergib University, Al-Kumis, Libya (e-mail: asuprince2000@yahoo.com, afyahia@elmergib.edu.ly).

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divided into six sections. After the introduction, section two gives a brief review of literature and section three compares the rates of growth of Algerian oil exports and the rates of growth of Algerian non-oil sectors over the last four decades. Section four examines the relationship between exports and Economic Growth in the Algerian economy. The response of sectoral output to expansion in oil exports is examined in section five. The main findings of the paper is summarizes in section six.

II. A Brief Review of the Literature

The impact of fluctuations in oil exports on economic growth and performance of oil producers in the Middle East and north Africa region has been analyzed by a number of researchers [2], [3], [5], [7]-[9]. According to these researchers, two major oil shocks have affected the world in general and members of OPEC in particular. The first major oil shock was after the oil embargo of 1973. After 1973, the Middle East oil producers enjoyed high oil revenues that lasted for almost a decade. The second oil shock took place in 1986. As a result of this shock, the price of oil fell dramatically and the oil producers suffered huge losses in oil revenues. However, the oil prices started rising sharply in 1999 and reached their higher level in 2011. As result, oil demand returned to its normal levels in the period of 1999 and the members of OPEC enjoyed high level of oil revenue again.

III. Growth Rate of Oil Exports and Non-Oil Sectoral Output

The aim of this section is to test if there is relationship between Algerian oil exports and its Non-oil sectoral output. If such a relationship exists, this would suggest that the two variables do not drift too far apart from each other over time. This would imply that growth in Non-oil GDP in Algeria is simply a reflection of growth in its oil exports. However if there is no evidence of this relationship, the relative level of Algerian GDP may be increasing or decreasing over-time, compared with its oil exports [7]).

According to the information presented above, three periods that experienced fluctuations in Algerian oil exports since 1973 were distinguished as following:

1973 – 1985
1986 – 1998
1999 – 2010

The first and third periods represent substantial increases in oil exports, while the second period represents the years of relative lower levels of oil exports. The growth rates were calculated using the regression model:

$$\log(Y_{it}) = b_0 + b_1 t + u_t \quad (1)$$

where Y_{it} represents the output of the *i*th sector in period *t* (*assessed in current values and measured in US dollars.*) and *t* represents time. The coefficient b_1 represents the proportional (constant) rate of growth.

The results of the estimated model are given in Table II. It seems to suggest that the rates of growth of output of Algerian oil exports and output of total non-oil output were greater during the periods (1973-1985 and 1998-2011) when oil prices were very high than the period of 1986-1998 when oil prices were very low (less than US$13 per barrel)). The data in Table II also suggest that growth rates of all Algerian non-oil sectors were much higher during the periods of oil boom (1973- 1985 and 1999-2011) than during the period of oil recession (1986-1998). Actually, the values of non-oil sectoral output, had declined significantly over the period 1986- 1998. As a result, the growth rates of all sectors were negative during that period, despite the fact that oil exports during the same period, enjoyed a slightly positive high rate of growth. This suggests that the Algerian economy did not benefit from the growth in its oil exports during that period.

TABLE II: Rates of Growth of Sectoral Output (Percentage)

Sector	1973-85	1986- 98	1999-2011	1973-2011
Oil Exports	12	10	15	5
Total Non-Oil Output	15	-37	9.5	4
Agriculture & fishing.	15	-3.0	10.	5.5
Manufacturing	19	-8.2	7.2	1.9
Construction	16	-6.8	9.8	2.9
Wholesale, Retail Trade	16	-2.6	8.5	4.4
Transport, Communication	15	-1.1	1.5	6.9
Other activities	13	-1.4	6.3	3.6

Source: Calculated by the author and based on data from [1], [10]

IV. The Relationship between Exports and Economic Growth

The philosophy of exports could act as an 'engine of growth' (or major sector) and the impact of an export motivation on the economy have been well investigated in the literature [2], [3], [11]-[18]. These researchers argued that, Exports contribute to economic growth directly (through direct contributions to GDP) and indirectly through contributions to GDP per medium of spread effects. The indirect contribution to growth holds Hirschman-type linkages and can broadly be measured as a sequence of multiplier-accelerator impact [19].

Export growth models suggest that the hypothesized relationship between export growth and GDP over time is central to the 'exports as an engine of growth' model, [2], [3], [13]. The question of determining time lags between export growth and economic growth must then be central to empirical examination of exports and economic growth. However, it is expected that the current period will provides the most important weight and geometrically declining weights will be imposed from the current period to assess the if there is a spread effect to the rest of the economy (that is a Koyck distributed lag scheme [20]).

It is important to indicate that all variables were calculated in the natural logarithm and the type of first difference (that is: $\log_e X_t$-$\log_e X_{t-1}$), which is basically a percentage change was used in order to estimate all equations. The hypothetical reasons for this can be illustrated as following: Firstly, the spread effects include acceleration effects. An appropriate

specification suggests that the equations include the notion of change. Secondly, since the constant impact of export on the economy is not expected over time. Therefore, simple linear relationships would seem to be incorrect method of examination. Hence, it is suitable to use the natural log differences technique in order to deal with these difficulties [7].

V. Specification of the Model and Empirical Results

Drawing upon the existing literature and following, [2], [7], [18], we consider the following models in order to examine the interaction between oil exports and economic growth in Algeria.

$$\ln(Y_t / Y_{t-1}) = b_0 + b_1 \ln(\mathrm{OX_t} / OX_{t-1}) + b_2 \ln(\mathrm{Y_{t-1}} / Y_{t-2}) + u_t \quad (2)$$

$$\ln(Y_{it} / Y_{it-1}) = B_0 + B_1 \ln(\mathrm{OX_{it}} / OX_{it-1}) + B_2 \ln(\mathrm{Y_{it-1}} / Y_{it-2}) + B_3 D_t + u_t \quad (3)$$

where

$\ln Y_{i_t}$ = Natural logarithm of GDP

$\ln OX_t$ = Natural logarithm of Oil Exports

$\ln Y_{i_t}$ = Natural logarithm of output in *i*th sectoral.

D_t = A dummy variable where:

D_t = 0: 1986-1998

D_t = 1: 1973-1985; 1999 - 2010

The assumptions of homoscedasticity and multicollinearity have been tested in all equations as suggested in [21] and found no crucial concern in this respect. The estimated Durbin's h (for long periods) statistic support the view that the residuals about the fitted equations were significant [22], [23].

The data in this paper covers the period of 1973–2011, and has been collected from [1], [10]. All Computations were performed using software package called Eviews version 5.1, 2005).

Table III provides the econometric results of the investigations into the relationship between export growth and GDP (in current prices) for the three periods that exhibit fluctuations in oil prices. The following regression model was used:

$$\ln(Y_t / Y_{t-1}) = b_0 + b_1 \ln(\mathrm{OX_t} / OX_{t-1}) + b_2 \ln(\mathrm{Y_{t-1}} / Y_{t-2}) + u_t \quad (4)$$

where:

$\ln Y_{i_t}$ = GDP and $\ln OX_t$ = Oil Exports

The regression results suggest that the current period export coefficient is highly significant in all periods except in the recession period (1986-1998). In addition, the lagged GDP variable (representing all lagged exports via the Koyck mechanism) is significant at least at the 10% level only in the periods that enjoyed high oil prices (1973-1985 and 1999-2010). As this part of the outcome may be explained as representing the spread effects 'proper', the results obviously imply that the Algerian GDP has benefited from opportunities generated by raise in oil exports However, the lagged effects are outweighed by the current period contributions which could recommend that the investment opportunities generated are not fully exploited.

TABLE III: Algerian Oil Exports and Gross Domestic Product (Current Price)

The Model: $\ln(Y_t / Y_{t-1}) = b_0 + b_1 \ln(\mathrm{OX_t} / OX_{t-1}) + b_2 \ln(\mathrm{Y_{t-1}} / Y_{t-2}) + u_t$

Period	b_0	b_1	b_2	R^{-2}	F	"h"
1973-1985	0.057 (3.9)	0.26 (3.04)	0.16 (2.4)	0.59	8.24	
1986-1998	1.19 (3.3)	0.029 (.26)	-0.22 (-.17)	0.07	0.38	1.3
1999-2010	0.14 (.38)	0.32 (3.66)	0. 52 (1.6)	0.53	6.7	
1973-2010	0.47 (3.3)	0.21 (3.7)	0.32 (2.4)	0.34	9.9	1.24

To suppress the component effect the contribution of the oil (*i.e.* mining) sector from GDP has been excluded and the changes in the output of the remaining sectors (*i.e.* GDP minus oil) were regressed on changes in exports. The following model was tested:

$$\ln(Y_t / Y_{t-1}) = b_0 + b_1 \ln(\mathrm{OX_t} / OX_{t-1}) + b_2 \ln(\mathrm{Y_{t-1}} / Y_{t-2}) + u_t \quad (5)$$

where:

$\ln Y_{i_t}$ = (GDP – Oil) = **Non-oil output**

$\ln OX_t$ = Oil Exports

The results in Table IV show that the coefficients of the variable $(\mathrm{OX_t} / OX_{t-1})$ and $(\mathrm{Y_{t-1}} / Y_{t-2})$ which represent the changes in the oil exports and the changes in the non-oil sector are not significant at any period of oil export raise. These results suggest that when the component of oil sector is excluded from GDP there is no evidence of spread effects of oil exports to the rest of the economy (non-Oil GDP).

TABLE IV: Algerian Oil Exports and Non-Oil GDP

The Model: $\ln(Y_t / Y_{t-1}) = b_0 + b_1 \ln(\mathrm{OX_t} / OX_{t-1}) + b_2 \ln(\mathrm{Y_{t-1}} / Y_{t-2}) + u_t$

Period	b_0	b_1	b_2	R^{-2}	F	"h"
1973-1985	.0.61 **(1.5)**	0.03 (.10)	0.36 (.55)	0.17	.86	
1986-1998	1.3 (3,6)	-.09 (-.63)	-.22 (-.73)	.07	39	1.32
1999-2010	1.6 (3,17)	0 .09 (.63)	-.7 (-.1,4)	0.19	1.1	
1973-2010	0.8 (4.0)	0.06 (0.7)	0.13 (.69)	0.3	0,55	1.75

VI. The Relationship between Oil Exports and Sectoral Output

Eexport as an engine of growth models suggest that various sectors in any economy respond to fluctuation in the major source of income, such as oil exports in the oil producer countries [2], [13], [14], [17], [24]. Therefore, GDP by type of economic activity of Algeria was disaggregated into six sectors in order to examine the response of those sectors to fluctuations in oil exports. It is assumed that the expansion in oil exports would motivate the production of these sectors, through the mechanism of direct effects as well as through less direct spread effects, [2], [3], [7].

The following regression model for the period 1973-2010

was used:

$$\ln(Y_{it} / Y_{it-1}) = B_0 + B_1 \ln(\mathrm{OX_{it}} / OX_{it-1}) + B_2 \ln(\mathrm{Y_{it\text{-}1}} / Y_{it-2}) + B_3 D_t + u_t \quad (6)$$

where:

Y= Output of the ith sector

OX_i = Oil exports

D_t = A dummy variable where:

D_t = 0: 1986-1998

D_t = 1: 1973-1985; 1999 - 2010

The results of the sectoral analysis are illustrated in Table V. These results are strongly support, those of Table IV. Accordingly, it could conclude that in Algeria, output of all sectors, has not responded to growth in oil exports. In other words, the low level of significance of the coefficient b_2 confirms that there are no spread effects from export sector to the rest of the economy. However, the coefficient of the dummy variables of trade sector (wholesale and retail trade) and manufacturing are statistically significant at least at five percent level. It suggests that the intercept of these sectors have raised during periods of increase in export prices.

TABLE V: OIL EXPORTS AND OUTPUT OF VARIOUS SECTORS

THE MODEL: $\ln(Y_{it} / Y_{it-1}) = B_0 + B_1 \ln(\mathrm{OX_{it}} / OX_{it-1}) + B_2 \ln(\mathrm{Y_{it\text{-}1}} / Y_{it-2}) + B_3 D_t + u_t$

Period	B_0	B_1	B_2	B_3	R^{-2}	F	"h"
Agriculture & fishing	1.02 (4.5)	0.09 (.6)	-.03 (-.18)	012 (1.3)	0.54	0.61	2.26
Manufacturing	0.96 (4.75)	-.76 (-.80)	0.112 (.64)	0.16 (2.6)	0.26	3.7	1.48
Construction	1.4 (3.5)	-0.20 (-.17)	-0.029 (-. 2)	0.021 (1.86)	0.10	1.3	0 .76
Wholesale & Retail	0.91 (4.3)	0-.14 (-.13)	0 .09 (.51)	0.014 (2.2)	0.17	2.3	1.53
Transport & Communication	0.92 (4.05)	0.12 (.98)	-.05 (-.24)	12 (1.7)	0.15	11	1.32
Other Economic Activities	1.17 (4.8)	0.14 (.96)	-.31 (-1.4)	0.013 (1.2)	0.12	1.5	1.34

Note: the value between brackets shows the results of t test at 5 percent level of significance

The most essential conclusion from the sectoral output investigation is that all sectors output in Algeria economy does not seem to have responded to changes in oil exports with exception of manufacturing and trade sectors. This shows weak linkages between oil exports and aforementioned sectors. The statistically significant intercept term for those sectors in the Algerian economy obviously suggest that a good part of those sectors output grow independently of the growth in oil exports. It may also indicate that the expansion in oil exports is not fully exploited in stimulating the output of these sectors [24].

VII. CONCLUSION

This paper was motivated by the need of an econometric investigation of trade relationship between oil exports and economic growth in Algeria. The main results can be summarized as following:

1) The growth rates of all Algerian economic sectors were much higher during the periods of rise in oil prices than during the period of oil recession.
2) The regression results suggest that the current period of export coefficient is highly significant in all periods except in the recession period (1986-1998).
3) The relationship between GD and the lagged GDP variable (representing percentage change in GDP via the Koyck mechanism) is slightly significant at least at the 10% level only in the periods that enjoyed high oil prices (1973-1985 and 1999-2010).
4) When the component effects are excluded the sectoral output investigation indicates that all sectors output in Algeria economy confirm that there is no evidence of spread effects of oil exports to the rest of the economy. However, the coefficient of the dummy variables of trade sector (wholesale and retail trade) and manufacturing are statistically significant at least at five percent level. It suggests that the intercept of these sectors have raised during periods of increase in export prices.
5) Finally, the sectoral output analysis of Algeria support the conclusion reached by [24], that "the increase in oil exports in oil producer of Medill east and north Africa is not enough to give the required 'take off" or to generate adequate demand to justify the economic establishment of a good number of manufacturing industries.

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Abdusalam F. Yahia is with the Department of Economics, Faculty of Economics and Commerce, Almergib University, Al-Kumis, Libya. He completed his Ph.D. degree in economics at the University of Wollongong, Australia from 2005 to 2008.

He is currently the manager of Quality Assurance Office Almergib University, Al-Kumis, Libya.

He holds 10 years of experience in teaching undergraduate classes and 6 years in teaching postgraduate classes.

He has published in refereed international journals (e.g. IJTEF; Global Review of Business and Economic Research; The Middle East Business and Economic Review). He also has presented many papers in international conferences in different area of the worldwide (e.g. UAE, New Zealand, Malaysia, Australia and Sultanate of Oman).

His current research interests concentrate on the areas of applied economics, principle and advanced econometric methods, the issue of oil prices fluctuations, economic growth, and trade relationships (with emphasis on the Middle East and North Africa regions).