Oil Price Shocks and Algerian Economy

"Evidence from the New Economic Model"

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Abstract:

This study aims at investigating the existence of a clear relationship between 2014 oil shock and the orientation of Algeria towards implementing more sustainable development programs. To explore this relationship, four sustainable development indicators were used, namely: gross domestic product, CO2 emissions, energy depletion, and unemployment as dependent variables. In addition to, crude oil prices as independent variable. We employ an autoregressive distributor lag (ARDL) approach to test both long and short run relationship between the study variables during the period of 1987 to 2017. The results of the study reveal the existence of an interaction between all variables. These findings can be interpreted as tangible efforts of Algerian government to integrate sustainable development programs to break total dependency to oil revenues.

Keywords: oil shocks ; volatility ; sustainable development indicators ; Algeria ; ARDL

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I. Introduction:

Almost all studies that have discussed oil price behavior, agree on the fact that understanding, oil market determinants, is important to explain volatile oil prices, and to predict future oil shocks. Understanding oil market is even more important for oil-rich countries and especially, those with a heavy dependence on hydrocarbons. The Algerian economy is an example of oil-rich countries, which is still struggling to break the 'resource curse', and to manage effectively, its oil revenues to promote the non-oil sector. Starting from mid- 2014, Algeria is living a difficult economic situation following the collapse of oil prices. This oil shock invokes again the negative impacts of the over reliance on hydrocarbons as the main source of economic revenues. The Algerian government responded by taking gradual austerity measures such as spending cuts, imports restrictions, with great efforts to maintain a stable social climate. To face this crisis, Algeria adopted a new strategy aiming to address its economic vulnerabilities, and to break its economic dependency to oil revenues instead of taking rapid actions (shock therapy). This strategy includes a continuous interest in implementing sustainable development plans. In reality, the interest in sustainable development started since 2000, and Algeria was always trying to stay in accordance with international efforts seeking to reach sustainability in all its dimensions. Whether Algeria's interest in this strategy was a planned action or only a way to use oil reserves accumulated during the period of booming oil prices; Algerian government is more aware today that the key to economic launch is breaking dependence with hydrocarbons, and focusing more on sustainable development. Thus, the main question of this study is **"whether the last oil shock has affected Algerian economic orientation towards integrating sustainable development objectives into the economic model ?"**

A growing interest in understanding the dynamics behind the rapid changes of oil prices is clearly observed in the last two decades. Studies have attempted to explain the driving factors of oil price behavior, whether by focusing on the supply side or the demand side. Moreover, researches are giving more importance to understand oil price volatility rather than concentrating solely on price behavior. Oil price volatility is a dominant feature of oil market, and it was the main responsible of oil price shocks through the history.

1. Volatility in oil market

Understanding oil price behavior has received much attention, especially after the series of crises episodes caused mainly by shocks in oil market. To explain the abrupt fluctuations in oil market, different studies have focused on analyzing oil price movements using different approaches and models. Explaining theories range from exhaustible resources theory initiated by Hotelling (1931) to the supply-demand framework (Bacon 1991 and Dees et al.2007), and finally the informal approach (Fattouh, 2007). Hamilton (Hamilton, 2009) attempts to explain the main drivers of oil prices by highlighting the three main approaches widely used in the related literature. These approaches are respectively: statistical investigation of the basic correlations in the historical data, the predictions of economic theory as to how oil prices should behave over time, and the examination of the fundamental determinants and prospects of demand and supply (Hamilton, Understanding Crude Oil Prices, 2009). Almost all studies agree on the fact that oil price volatility is increasing over time (especially since 1980s), and this volatility can have a more significant effect on economic activity than the changes in oil prices themselves (Sauter & Awerbuch, 2003). Oil price volatility negatively affects macroeconomic fundamentals, since it slows down economic growth, creates uncertainties that discourage foreign investment, and can cause inflationary pressures and global imbalances (Fattouh, 2007), (Hamilton, 2008), (Baumeister & Peersman, 2010).

The evolution of oil prices has witnessed different variations in the last two decades (since 1990) with key events shown in the following table: table 1.

This table shows that oil prices has exhibited significant volatility during this period (since 1990) with no obvious long run trend (upward or downward). Oil price volatility is attributed to different factors: geopolitical events namely the Gulf War in 1990, during which oil prices recorded the most significant increase by 53% in the three following months, along to other political events like the 2002-03 Venezuelan crisis, Iraq War and the Arab Uprisings starting from 2011. Other oil price shocks are mainly caused by underlying supply and demand conditions such as the great commodities surge (2003-08) and the Global financial crisis (the Subprime crisis) in 2008 (Economou, 2016).

The increasing oil price volatility tends to become much higher in times of shocks. This phenomenon (oil shock) often refers to moments when oil prices record sudden surges. As shown above, several shocks have marked the history of oil prices. The last and recent variations of oil prices took place in 2008, where oil prices rose, just in few months between January and July 2008, from 96$ per barrel for Brent oil to 144$. However, just after this rise, oil prices experienced a major drop from 130$ to 40$ between July and December of the same year. Around 2010, a recovery in economic growth and a significant rise in demand for oil, along with geopolitical problems that affected the Arab world in 2011, all these factors caused oil prices to attain a peak of 128$ per barrel. In 2013, the price per barrel stabilized at 100$; and in 2014, oil prices recorded a major collapse to below 50$ threshold, and prices continued their descending trend to attain their lowest level since 2003 by 30$ per barrel in 2016.

An oil price drop has both direct effects through trade and indirect effects through growth and investment and changes in inflation. Trade effects will eventually attain the whole economic system by affecting current accounts, fiscal position, stock markets, investment and inflation. The most obvious and direct effect of oil price fall is reducing the value of oil exports, and this can have devastating consequences for oil-exporting countries, especially those with a heavy reliance on oil revenues. Many oil-rich countries have not yet succeeded to manage oil revenues to launch their economic growth. This poor management in addition to volatile oil prices create economic imbalances generally called in the literature as the 'Dutch Disease Syndrome (DDS)' Such economies are generally characterized by an expanding oil sector that penalizes the non-oil sector, which reinforces sharp decline in economic growth rate when oil prices fall. It is a familiar situation in oil-rich countries that invokes again, what is described in the literature as a 'resource curse' (Alley & al., 2014).

When hit by oil shocks, countries with over reliance on hydrocarbons generally follow a standard menu of measures that starts first by using international reserves build up in years of booming oil prices. These reserves consist a considerable buffer that may work as a first line of defense. The following measures include respectively: active exchange rate policy, fiscal austerity and spending cuts, reducing social and energy subsidies, and finally, working on stimulating private sector and export diversification (Lopez-Calix and Touqeer, 2016).

2. Algerian economy and the 2014 oil shock

Oil-exporting countries especially with a heavy dependence on hydrocarbons were severely hit by the sharp decline in oil prices that began in mid-2014. Many studies investigated this effect on different countries, like sub Sharan African countries, or MENA region, and have concluded that this collapse had a major, and sometimes destabilizing impacts on these economies, and the Algerian economy is no exception (Escribano, 2016).

Algeria is an oil-rich county that is struggling until now to break the 'resource curse' by minimizing its dependence to hydrocarbons and to promoting other non-oil sectors. The Algerian economy is characterized by a heavy reliance on hydrocarbons that accounted for 25 percent of GDP, 94 percent of export earnings and 48 percent of budget revenues in 2015 (FMI 2016). It is the largest natural gas producer and the third-largest proved crude oil reserves in Africa. Algeria is Europe's second largest natural gas supplier and a key supplier of oil (Escribano, 2016). In the late of 1980's, Algeria knew a transition from state-socialism to a more market-oriented economy. It had experienced a long period of economic and social hardship (the 1986 shock, the black decade). By 1995, external debt had increased to 75 percent of GDP and inflation had reached 30 percent, unemployment rate stood to 28 percent (IMF, Country Report No. 17/141, 2017). Starting from 1999, Algeria knew an economic stability with steady but modest economic growth. During this period and thanks to booming oil prices, Algeria has accumulated substantial fiscal savings and international reserves that enable it to go smoothly through different international economic and political shocks, such as the unrest in the MENA region during the Arab Spring. By 2006, Algeria was able to repay nearly all its external debt to Paris Club after being restructuated twice and regained its economic sovereignty. The country succeeded in accumulating sizable buffers in international reserves and in fiscal stabilization fund (FRR (note1)[*]), that was originally created to face volatility in hydrocarbons prices (Lopez-Calix and Touqeer, 2016). In 2009, fiscal savings in FRR reached 43 percent of GDP, and international reserves rose to a peak of US$ 194 billion in 2013 (IMF, 2016). The Algerian economy is characterized by a large part of social subsidies and transfers. In 2015, direct subsidies cost was estimated of 13.6 percent of GDP, in addition to indirect energy subsidies in the form of low energy prices accounting for over half this amount. These subsidies carry a huge burden on fiscal account and economic growth. Energy subsidies for instance, reduce exports, and increase domestic energy consumption leading to a large scale smuggling to neighboring countries (IMF, Country Report No.16/128, 2016).

Since 2012, Bank of Algeria targeted price stability and external stability of the currency. The main monetary policy instruments are base money that has been the dominant tool since 2003, along with liquidity management (IMF, Country Report No.16/128, 2016). Interest rate instrument is inefficient and unresponsive to changes in monetary conditions, due to excess liquidity and the insufficient development of the financial system. During oil boom, liquidity in the banking system surged, and the government used it to implement social peace (note2)[**] through different mechanisms such as providing loans for young entrepreneurs and increasing subsidies. The Algerian economy is known by its high dependence on imports that led in 2012 to exchange rate depreciation and a rise in inflation rate following public sector wage increases. Inflation dynamics in Algeria are sensitive to administrative control and exchange rate changes, goods and services prices are administrated, including food items that account for over 43 percent of the CPI basket (FMI 2016).

Following the oil price collapse in 2014, the Algerian economy is experiencing a long-lived shock that plunges the country in a severe economic crisis. This crisis may worsen if oil shock persists, and if the government did not respond appropriately to this situation in the short term, in addition to addressing effectively hidden economic vulnerabilities (mainly breaking correlation with oil volatile prices) in a long run. During the 2008 mortgage crisis and the following decline in oil prices, the Algerian economy remained stable due to different factors: the 2008 oil shock was only a short-lived and did not persist. Moreover, the Algerian economy is not fully integrated with the international financial system, thus crisis contagion channels are limited. The country has also accumulated a significant fiscal savings and international reserves that work as buffers against external shocks. Furthermore, the government employed these reserves to absorb people frustrations during the 2011 uprising by ramping up spending on public wages, transfers, and social housing (Escribano, 2016). When oil prices drop in 2014, the government was reluctant to respond appropriately to face the crisis, and continued to use the build-up savings, which led to a rapid depletion of reserves.

In 2016, with oil prices still declining, authorities announced a series of spending cuts measures in the form of what was called then a 'rationalization of spending (note3)***. After a clear reluctance, the government adopted a more restrictive budget for 2016; public spending dropped by 9 percent, and current expenditures were cut by more than 3 percent without affecting the main subsidies (food, housing and energy). The implications of lower oil prices were seen in the following macroeconomic indicators.

Table 2 shows that economic growth has slowed since 2015. However, GDP remains positive and still higher than the levels recorded in 1986 (-0.2 percent) and in 1988 (-1.9 percent). Fiscal deficit has deteriorated significantly since 2014 after consecutive deficit recorded from 2009 to 2013, when government's spending surged following the global crisis and the Arab awakening. External balance, as well, has deteriorated rapidly, and the current account deficit reached records levels in 2015 (Escribano, 2016). Since June 2014, foreign reserves have plunged by more than US$35 billion, and the oil fund stabilization (FRR) dropped by more than 30 percent, while the Algerian dinar has fallen against the US dollar by more than 30 percent.

3. Policy measures and the 'new economic model': is sustainable development included?

Oil prices continued their declining pattern since 2016, and the Algerian authorities were forced to acknowledge, at last, that the country is facing a serious economic crisis. The official discourse started to use 'austerity', when talking about necessary solutions, instead of 'spending rationalization'. In 2016, a series of gradual and incremental austerity measures have been introduced to prevent a sudden deterioration of social climate. The adopted approach to this oil shock can be considered as an adjustment between economic activity slowdown, and an acceptable social and political climate to prevent any uprising (note4)****. Austerity measures included trimming state budget by 9 percent at the start of 2016, gradual increases in the prices of subsided gasoline, import restriction in 2017, and a controlled depreciation of the Algeria dinars (IMF, Country Report No. 17/141, 2017). In March 2016, the government issued a national public debt remunerated at a 5 percent, and in 2017, it resorted to 'quantitative easing' that is the increase of money supply by the central bank (Bank of Algeria) through issuing government bonds to stimulate the economy. This unconventional financing was supposed to be directed to investment budget and not to government spending, and it is considered by the authorities a better alternative than resorting again to external debt.

In 2016, former Prime Minister ‘Abdelmalek Sellal’ introduced a new economic vision for the period of 2016-2019. This vision was called the ‘new economic model’ that was supposed to not only face the actual oil price shock, but to address hidden economic vulnerabilities and to lead eventually, to a sustainable and efficient economic system. This ’new model’ is an overall strategy for economic reform, rather than a superficial response to an urgent crisis. It focuses on sustainable development that includes several objectives such as diversifying the economy and promoting non-oil sector. In reality, the government’s interest in sustainable development appeared since 2000 after the establishment of ministry of territory planning and environment. This ministry put sustainable development as one of its main objectives through a work plan of environment and sustainable development (PNAE-DD 2000-2011) (MATE, 2002). A report about the environment is issued every two years (MATE, Rapport sur d’état et l’avenir de l’environnement, 2007). Similarly, sustainable development objectives were included in almost all programs and previsions related to strategic fields such as: territory development program(SNAT 2010-2030) (renouvelables, 2010), fighting climate change program (PNC2025) and (PNA-EREE), the government action plan for resources and renewable energies and energy efficiency...etc. all these objectives were grouped into four main axes with sixteen (16) priority objectives (MATE, Rapport sur d’état et l’avenir de l’environnement, 2007).

II– Data and methodology:

In this section, we try to explore the existence of a real relationship between oil price variations and sustainable development indicators. The existence of such relationship, especially after 2014, may indicate an increasing interest of Algerian government towards sustainable development. The vision of the ‘new economic model’ focuses on sustainability instead of rapid solutions to form an economic buffer –in the medium and long term- against future oil prices shocks.

Sustainable development goals recommended in the 21st century agenda were interpreted in a group of measurable indicators such as Sustainable Development Indicators (SDI) suggested by United Nation for Sustainable Development (UNSD) (United Nations, 2017). These indicators measure the capacity to meet present and future needs, and globe more than 230 indicators covering the 17th goals of sustainable development. (United Nations, 2017) Similarly, the Blue Plan indicators prepared and adopted by Mediterranean Countries including 130 indicators for sustainable development. In addition to sustainable Development Indicators adopted by Arab League States, as a way to achieve the requirements of sustainable development.

In this work, we chose four indicators of sustainable development namely: gross domestic product per capita (GDPPC) that is an economic indicator, carbon dioxide emissions per capita (CO2PC) and energy depletion (ENRG), that are both environmental indicators, and finally unemployment (UEM) that is a social indicator. In addition to these four variables, we take average annual crude oil prices (PP) as the main oil shock indicator. Annual data from 1987 to 2017 were obtained from the World Development Indicators (The World Bank, 2019) for the four sustainable development indicators, and from OPEC database (OPEC, 2019) for the last variable.

To investigate the relationship between sustainable development variables and oil prices, we use Autoregressive Distributor Lag (ARDL) approach suggested by Pesaran et al. (2001) among other existing approaches such as the residual based approach by Engle and Granger (1987); maximum likelihood based approach by Johansen and Juselius (1990). We choose ARDL approach because it is more suitable in small samples. Furthermore, this method avoids the problems of endogeneity, and helps to estimate the coefficients in the long run. The assessment of both short and long run effects between independent and dependent variables takes place simultaneously and does not require an order of integration.

ARDL approach is executed in four steps. The first step is stationarity test in which we apply both augmented Dickey–Fuller (ADF) (DA & WA., 1979) test, and Phillips– Perron (PP) (Phillips & Perron, 1988) test . The second step is to test for co-integration using bounds test to check for the existence of long run relationships. This test is based on the comparison of calculated F-statistic with the asymptotic bound values of (Pesaran, Shin, & Smith, 2001) . The next step is to estimate the short and long run relationship, and finally, we assess the validity of the estimated models using diagnostic tests.

The model is presented in the following equation:

$$Y_{it} = f(PP_{it}, Z_{it})$$

Where Y_{it} denotes sustainable development indicators; PP_{it} is oil prices, and Z englobes other explanatory variables that may influence sustainable development such as economic, social and environmental indicators. ARDL approach is applied through four different models. The first model is presented in Eq. (2) which is an estimation of CO2PC as a function of the other variables. Oil price is expected to affect CO2 emissions through energy production and consumption, which in turn increases or decreases CO2 emissions. The construction of the second model, where the dependent variable is GDP per capita, starts usually from the production function. This function includes oil price in addition to other sustainable development indicators (CO2 emissions per capita, Enrg. Depletion, and Unemployment). This function is presented as follows:

$$\Delta(CO2PC)_t = \beta_{10} + \sum_{i=1}^{p1} \beta_{11}\,\Delta(CO2PC)_{t-i} + \sum_{i=1}^{p1} \beta_{12}\,\Delta(ENRG)_{t-i} + \sum_{i=1}^{p1} \beta_{13}\,\Delta(GDPPC)_{t-i}$$
$$+ \sum_{i=1}^{p1} \beta_{14}\,\Delta(PP)_{t-i} + \sum_{i=1}^{p1} \beta_{15}\,\Delta(UEM)_{t-i} + \delta_{11}(CO2PC)_{t-1} + \delta_{12}(ENRG)_{t-1}$$
$$+ \delta_{13}(GDPPC)_{t-1} + \delta_{14}(PP)_{t-1} + \delta_{15}(UEM)_{t-1} + \varepsilon_{1t} \dots\dots\dots\dots\dots..(2)$$

$$\Delta(ENRG)_t = \beta_{20} + \sum_{i=1}^{p1} \beta_{21}\,\Delta(ENRG)_{t-i} + \sum_{i=1}^{p1} \beta_{22}\,\Delta(CO2PC)_{t-i} + \sum_{i=1}^{p1} \beta_{23}\,\Delta(GDPPC)_{t-i}$$
$$+ \sum_{i=1}^{p1} \beta_{24}\,\Delta(PP)_{t-i} + \sum_{i=1}^{p1} \beta_{25}\,\Delta(UEM)_{t-i} + \delta_{21}(ENRG)_{t-1} + \delta_{22}(CO2PC)_{t-1}$$
$$+ \delta_{23}(GDPPC)_{t-1} + \delta_{24}(PP)_{t-1} + \delta_{25}(UEM)_{t-1} + \varepsilon_{2t} \dots\dots\dots\dots\dots\dots.(3)$$

$$\Delta(GDPPC)_t = \beta_{30} + \sum_{i=1}^{p1} \beta_{31}\,\Delta(GDPPC)_{t-i} + \sum_{i=1}^{p1} \beta_{32}\,\Delta(CO2PC)_{t-i} + \sum_{i=1}^{p1} \beta_{33}\,\Delta(ENRG)_{t-i}$$
$$+ \sum_{i=1}^{p1} \beta_{34}\,\Delta(PP)_{t-i} + \sum_{i=1}^{p1} \beta_{35}\,\Delta(UEM)_{t-i} + \delta_{31}(GDPPC)_{t-1} + \delta_{32}(CO2PC)_{t-1}$$
$$+ \delta_{33}(ENRG)_{t-1} + \delta_{34}(PP)_{t-1} + \delta_{35}(UEM)_{t-1} + \varepsilon_{3t} \dots\dots\dots\dots\dots\dots\dots..(4)$$

$$\Delta(UEM)_t = \beta_{40} + \sum_{i=1}^{p1} \beta_{41}\,\Delta(EUM)_{t-i} + \sum_{i=1}^{p1} \beta_{42}\,\Delta(CO2PC)_{t-i} + \sum_{i=1}^{p1} \beta_{43}\,\Delta(ENRG)_{t-i} + \sum_{i=1}^{p1} \beta_{44}\,\Delta(GDPPC)_{t-i} + \sum_{i=1}^{p1} \beta_{45}\,\Delta(PP)_{t-i} + \delta_{41}(UEM)_{t-1} + \delta_{42}(CO2PC)_{t-1} + \delta_{43}(ENRG)_{t-1} + \delta_{44}(GDPPC)_{t-1} + \delta_{45}(PP)_{t-1} + \varepsilon_{4t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The following graphs show the variations (the dynamics) of the five series, and table (1) shows the main descriptive statistics.

Table 3 summarizes the descriptive statistics of estimated variables. According to the coefficient of variation (CV) values, oil prices, as the independent variable, was stable around an average of 20$ per barrel during the period of 1987-1999. It started to rise with an unprecedented (significant growth average) growth from 2000 to 2008, followed by a sharp decline in 2009. In 2012, oil prices reached their highest value as shown in Fig.1. Dependent variables show positive trends over the period of 2000 to 2017 for both CO2PC and GDPPC. While UEM shows a negative trend over the same period, declining from its highest average in 2000 to the lowest in 2013. The Enrg. Depletion recorded its lowest value in 1998 and reached its highest value in 2006, than it begins to decline from 2008 to 2017.

III- Results and discussion :

1. Unit root test

We test for the existence of unit root for the five variables using two models (with trend and intercept, and with intercept only). The results of ADF and PP unit root tests are presented in Table (04). The results of ADF and PP tests indicate that all variables were integrated in order one. Thus, the variables can be cointegrated.

2. ARDL co-integration test

The results of ARDL bounds test for cointegration are given in Table (03). (For null hypothesis)

Results of calculating F values for testing the existence of a long-run relationship are shown in Table (05). Since F-statistic is greater than the upper bound in all cases with the exception of model(3), co-integration exists amongst sustainable development indicators and their determinants. Estimated ARDL models are set to two (02) lags length. AIC-base suggests (1, 2, 2, 2, 2), (2, 2, 2, 2, 2), and (1, 1, 0, 2, 2) for Case 1, 2 and 4, respectively. While negative and significant ECT in Table (06) provides an extra evidence of long-run co-integration among variables. ECT indicates the adjustment speed of variables towards the long-run equilibrium.

In long-run models (Table 4), oil prices have a significant impact on sustainable development indicators in Algeria during the study period. Changes in variables are as follows:

Model (01): an increase in oil prices by 1% causes a decrease in CO2 emissions by 4.6%. This reverse relationship can be explained by investing in CO2 Capture and Storage technology. Algeria began to use this technology since 2004 after a partnership between Sonatrach and Stat Oil Hydro in order to improve the efficiency of energy exploitation. Where an increase by 1% in energy depletion, GDP per capita, and unemployment rate leads to : 7.2%, 0.1%, and 11.2% increase in CO2 emissions respectively. The positive effect of sustainable development indicators on CO2 emissions is a result of different factors: the increase of energy depletion is a result of using fossil fuels, which leads to an increase of greenhouse gases emissions in general, and CO2 emissions specifically. The positive effect of GDP per capita on CO2 emissions is explained within the Kuznets hypothesis framework. This hypothesis assumes that in first stages, economic growth is generally associated with environmental degradations in the form of CO2 emissions increase. Finally, the effect of unemployment rates on CO2 emissions is an indirect result of economic growth.

Model (02): an increase in both oil prices and CO2 emissions by 1% causes an increase in energy depletion respectively by 59.4% and 116%. A rise in oil prices leads to a more oil production, which eventually speeds the depletion of oil as the main source of energy. The increase in CO2 emissions stimulates investing more in clean or green energy. An increase in both GDP per capita and unemployment rates by 1% leads to a drop in energy depletion respectively by 2.1% and 150.2%. For GDP per capita, this effect is justified by a big reliance on energy production and consumption despite of the improvement in economic situations. However, the reverse effect between unemployment rates and CO2 emission is explained by GDP.

Model (04): an increase in oil prices by 1% causes an increase in unemployment rate by 69.1% due to the association between employment policy and oil sector. Working power will likely to wait a job opportunity in the industrial sector mainly in oil companies (EBRAHIM, INDERWILDI, & KING, 2014). An increase in both energy depletion and GDP per capita by 1% leads to a decrease in unemployment rate respectively by 78.4% and 2.3%. While for GDP per capita, this effect can be explained by a tendency of working power to prefer oil sector instead of other economic activities despite of the improvement of economic situation. For CO2 emissions, long run results show their effect on unemployment; however, their values were insignificant.

ECT parameters in estimated models show: Oil prices in the current and last year have no effect on the three sustainable development indicators. However, the interaction between variables is different according the three sustainable development models.

Model (01): both energy depletion and unemployment rates in the current and last year were significant. While energy depletion in the current year led to an increase in CO2 emissions by (0.030), the effect was negative in the last year by (-0.035). Unemployment rates in the current year led to an increase in CO2 emissions by (0.051), while for the last year, they led to a decrease by (-0.089). Other explanatory variables were statistically insignificant.

Model (02): both CO2 emissions in the current year, energy depletion in the last year, and unemployment rates in both current and last year were significant. CO2 emissions caused an increase in energy depletion by (3.08). Energy depletion in the last year caused an effect of (1.157). Unemployment rates in current year caused a decrease in energy depletion by (1.49), and unemployment rates in last year caused an increase of (2.88). Other explanatory variables were statistically insignificant.

Model (04): both CO2 emissions in the current and last year were significant. Current years values caused an increase of (7.83), while last years (lagged) values caused a decrease in unemployment rates by (-3.95). Other explanatory variables were statistically insignificant.

3. Diagnostic tests and parameter stability

The results of diagnostic tests, normality test, serial correlation and heteroskedasticity are reported in the lower part of Table 7. The diagnostic test statistics do not suggest the presence of any serial correlation and heteroskedasticity. The estimated model also passes the diagnostic tests of normality and functional form.

In order to assess the stability of long run relationships between sustainable development indicators and oil prices, In addition to the absence of any structural changes, we used two tests (adopted by Peasaran): cumulative sum of recursive residuals (CUSUM) test, and cumulative sum of squares of recursive residuals (CUSUMSQ) test suggested by Brown et al. (Brown, Durbin, & Evans, 1975). Tests results reveal the absence of structural changes, which indicates the stability of the model as a whole. Fig. 2 presents the plots of these tests. It implies that the estimated coefficients are stable across modes given that they fall inside the critical bounds of 5%, (with exception of model (3) CUSUM that takes unemployment as dependent variable).

All in all, study results reveal the existence of a significant effect of oil price changes on the selected sustainable development indicators in estimated models only in the long run : changes in oil prices affect negatively CO2 emissions, and positively both energy depletion and unemployment rates. These relationships are explained by the reliance of Algerian economy on oil revenues that enable specialized authorities to invest more resources in pollution reduction, mainly measured by CO2 emissions. However, changes in oil prices is still causing an increase in global oil production, which leads to more energy depletion, and this explains the positive effect between these variables. The positive relationship between oil prices and unemployment rates is a result of the connection between working policy and oil sector: working power avoid other economic sectors, and prefer to work in oil sector characterized by high remuneration.

Algeria did not achieve environmental balance due to the late in the application of an economic model, which integrates all sustainable development dimensions. Kuznets Curve is still in its early stages, where environmental degradation increases with economic growth, and it is expected to improve in the future. The negative relationship between economic growth and both energy depletion and unemployment rates is a result of the reliance of economic growth in Algeria on oil revenues. These revenues contribute to more than 50% of GDP and 97% of total exports and to change this situation, Algeria has to adopt a new economic strategy that integrates sustainable development dimensions in all national strategies and programs.

IV- Conclusion:

The repetition and intensity of oil shocks is forcing oil-rich countries and especially those with a total dependence to hydrocarbons to reconsider their economic system. Obvious solutions may include diversifying the economy and promoting non-oil sector, a serious reform of onerous subsidies and social transfer, in addition to attracting foreign private investors and a wise management of oil revenues reserves. Algeria as an example of hydrocarbons dependent countries, is struggling to break this dependency, especially since the last oil shock of 2014. We have explored in this study whether the 2014 oil prices collapse affected Algerian government orientation towards implementing more sustainable development programs. We used an ARDL approach to test both long and short run relationship between four (04) selected sustainable development indicators and oil prices during the period of 1987-2017. The results indicate the existence of an interaction between all variables. More specifically, the existence of a long run relationship between oil prices and CO2 emission, energy depletion and unemployment, however, this relationship was not observed in the short run. Additionally, the test results show a significant effect of GDP on the last three variables.

References:

Alley, I., & al. (2014). Oil Price Shocks and Nigerian Economic Growth. *European Scientific Journal, 10*(19), 375-391.

Baumeister, C., & Peersman, G. (2010). Sources of Volatility Puzzle in the Crude Oil Market. *http://wps-feb.ugent.be/Papers/wp_10_634.pdf*.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships overtime (with Discussion). *Journal of the Royal Statistical Society, 37*, 149–192.

Dickey DA,., & Fuller WA.. (1979). Distribution of the estimators for autoregressive time series with a unit root. *J Am Stat Assoc:74*, 427–31.

EBRAHIM, Z., INDERWILDI, O. R., & KING, D. A. (2014). Macroeconomic impacts of oil price volatility: mitigation and resilience. *Front. Energy*, 1-16. doi:DOI 10.1007/s11708-014-0300-3

Economou, A. (2016). Oil Price Shocks: A Measure of the Exogenous and Endogenous Supply Shocks of Crude Oil. *Economou, A. 2016. Oil Price Shocks: A Measure of the EOIES paper : WPM 68, The Oxford Institute For Energy Studies*, 1-48. doi:https://doi.org/10.2118/181542-MS

Escribano, G. (2016). The Impact of Low Oil Prices On Algeria. *Columbia Center on Global Energy Policy*, 5-21.

Fattouh, B. (2007). The Drivers of Oil Prices: The Usefulness and Limitations of Non-Structural Model, the Demand–Supply Framework and Informal Approaches. *EIB papers, 12*(01), 128-156.

Hamilton, J. (2009). Causes and Consequences of the Oil Shock of 2007-08. *NBER Working Paper, 40*(1), 215-283. doi:10.3386/w15002

Hamilton, J. (2008). Understanding Crude Oil Prices. (I. A. Economics, Éd.) *The Energy Journal, 30*(2), 179-206. doi:10.3386/w14492

IMF. (2016). *Country Report No.16/128.* Washington, D.C.: International Monetary Fund Publication Services.

IMF. (2017). *Country Report No. 17/141.* Washington, D.C.: International Monetary Fund Publication Services.

Lopez-Calix. J.R and Touqeer. I. (2016). Algeria: Comparing the Last Two Oil Shocks and Policy Responses. *Topics in Middle Eastern and African Economies, 18*(2), 117-129. Récupéré sur http://meea.sites.luc.edu/volume18/pdfs/26-Algeria Comparing the Last Two Oil Shocks and Policy Responses.pdf

MATE. (2002). *Plan national d'action pour l'environnement et le développement durable (PNAU-DD).* Alger: -.

MATE. (2007). *Rapport sur d'état et l'avenir de l'environnement.* Alger: Dar Elhakaik.

United Nations (2017, March -). *Global indicator framework for the Sustainable Development Goalsand targets of the 2030 Agenda for Sustainable Development*. Récupéré sur Sustainable Development Goals: https://unstats.un.org/sdgs/indicators/indicators-list/

OPEC. (2019, march 01). *Annual Statistical Bulletin*. Récupéré sur OPEC publications: http://www.opec.org/opec_web/en/publications/202.htm

Pesaran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *J Appl Econom;16*, 289-326.

Phillips, P., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika;75*, 335–346.

Portail Algerien des energies renouvelables (2010). *SNAT 2030 : Schéma National d'Aménagement du Territoire Algérie.* Alger.

Sauter, S., & Awerbuch, S. (2003). Oil Price Volatility and Economic Activity: A Survey and Literature Review. *International Energy Agency Research Paper*, 1-18.

The World Bank. (2019, july 10). *Algeria*. Récupéré sur World Development Indicators: https://data.worldbank.org/country/algeria?view=chart

Zoheir, E., R., I. O., & A., K. D. (2014). Macroeconomic impacts of oil price volatility: mitigation and resilience. *Front. Energy*, -. doi:DOI 10.1007/s11708-014-0300-3

[*] 'Fond de Régularisation des Recettes' : FRR was created in 2000. Oil revenues are saved in FRR above the oil price threshold of US$37 per barrel (FMI, 2016).

[**] The post-Arab spring strategy of appeasing the population by increasing subsidies.

[***] By the government of Sellal that avoided confessing the hardship facing the Algerian economy.

[****] On the contrary of 'shock therapy' adopted after the 1986 shock, that contributed to complicated and destabilized social and political situation resulting in a black decade and political instability.

Appendix:

Table (1) : Summary of the key factors of historical oil price shocks

Oil price shock (chronology)	Key factors
53% (Aug90 – Oct90)	Gulf War, Supply shock and precautionary demand shock
-57% (Dec97 – Dec98)	Asian Financial Crisis; Demand Shock
77% (Jun99 – Sep00)	Strong global industrial growth; Supply cuts and strong demand
13% (Dec02 – Mar03)	Venezuelan crisis and Iraq War; Supply shock
145% (Jan03 – Jun08)	Commodities supercycle; Strong demand and stagnant supply, precautionary demand shock
-102% (Jul08 –Dec08)	Global Financial Crisis; Demand shock
35% (Dec10 – Apr11)	Arab Uprisings; Supply shock
-73% (Jul14 –Jan15)	Excess capacity; Strong supply and stagnant demand, precautionary demand shock

Source: Economou (2016), Oil Price Shocks: A measure of the Exogeneous and Endogeneous Supply Shocks and Crude Oil, p.04

Table (2) : a selected macroeconomic indicators (2015-2018)

	2015	2016	2017	2018
Real GDP growth Overall budget deficit Current account balance (percent of GDP)	3.8 -15.8 -16.6	3.3 -14.0 -16.9	5.9 -3.0 -11.9	0.7 -2.7 -9.7
Foreign reserves (months of imports)	24.5	19.4	-	-

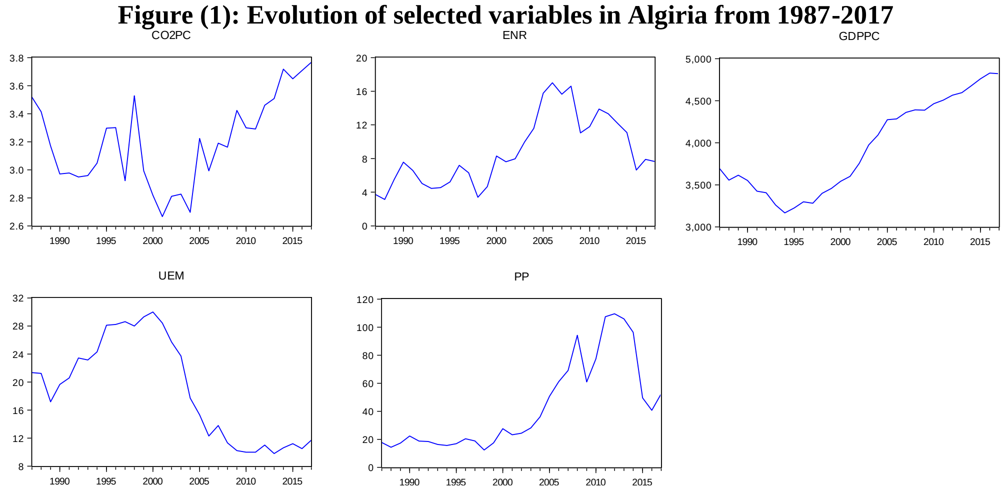
Source: by the authors based on FMI report (2017) and Escribanou (2016)

Table (3) : Descriptive statistics of variables

	CO2PC	ENR	GDPPC	PP	UEM
Mean	2.918752	8.555827	3737.913	34.05750	18.59313
Maximum	3.766415	22.16455	4827.724	109.4500	30.00000
Minimum	1.036083	0.020748	2321.350	1.210000	9.800000
Std. Dev.	0.626628	5.003344	592.8785	29.29923	6.270688

Source: by the authors based on eviews 09

Figure (1): Evolution of selected variables in Algiria from 1987-2017



Source: by the authors based on eviews 09

Table (4) : Unit root tests

Unit root tests	ADF		PP	
	Constant	Constant+ trend	Constant	Constant+ trend
PP	-3.527	-4.216	-3.080*	-2.781
CO2PC	-2.458	-4.368*	-2.397	-4.292*
LGDPPC	-1.206	-4.957*	-1.319	-1.865
UEM	-1.414	1.513	-1.247	-1.427
ENRG	-3.713*	-3.198	-4.643*	-3.543
DPP	-6.070*	-6.009*	-6.167*	-6.365*
DCO2PC	-9.825*	-9.831*	-11.331*	-11.779*
DLGDPPC	-6.122*	-6.072*	-6.153*	-6.105*
DENRG	-5.917*	-6.291*	-5.920*	-6.294*
DUEM	-4.974*	-4.908*	-4.974*	-4.908*

* denote that series is stationary at 5%.

Source: by the authors based on eviews 09

Table (5) : ARDL Bounds test for cointegration

ARDL Bounds Test				
Sample : 2000 2017				
Models	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**
F-statistic	9.544	9.735	3.163	6.10
Critical Value Bounds				
	10%	5%	2.5%	1%
I0 Bound	2.45	2.86	3.25	3.74
I1 Bound	3.52	4.01	4.49	5.06

Source: by the authors based on eviews 09

Table (6) : Short and long run cointegration

Dependent variables				
Independent Variable	**DCO2PC Model (1)**	**DENR Model (2)**	**DGDPPC Model (3)**	**DUEM Model (4)**
Selected model	**ARDL(1, 2, 2, 2, 2)**	**ARDL(2, 2, 2, 2, 2)**	**ARDL(2, 1, 1, 1, 1)**	**ARDL(1, 1, 0, 2, 2)**
Short run				
ECT	-0.830**	-1.981**	-6.551	-0.474**
D(CO2PC)		30.823**		7.835**
D(CO2PC(-1))		1.469		-3.955**
D(ENR)	0.030**			-0.372
D(ENR(-1))	-0.035**	1.157**		
D(GDPPC)	0.0001	-0.004		
D(GDPPC(-1))	-0.0002	0.008		
D(PP)	-0.002	0.091		0.045
D(PP(-1))	0.009	-0.305		0.031
D(UEM)	0.051**	-1.491**		
D(UEM(-1))	-0.089**	2.889**		
Long run				.
CO2PC		1.1686**		3.2862
ENR	0.072**			-0.784**
GDPPC	0.001**	-0.021**		-0.023**
PP	-0.046**	0.594**		0.691**
UEM	0.112**	-1.502**		
C	-2.754**	41.104**		-37.351

** denote that data series is stationary at 5%.

Source: by the authors based on eviews 09

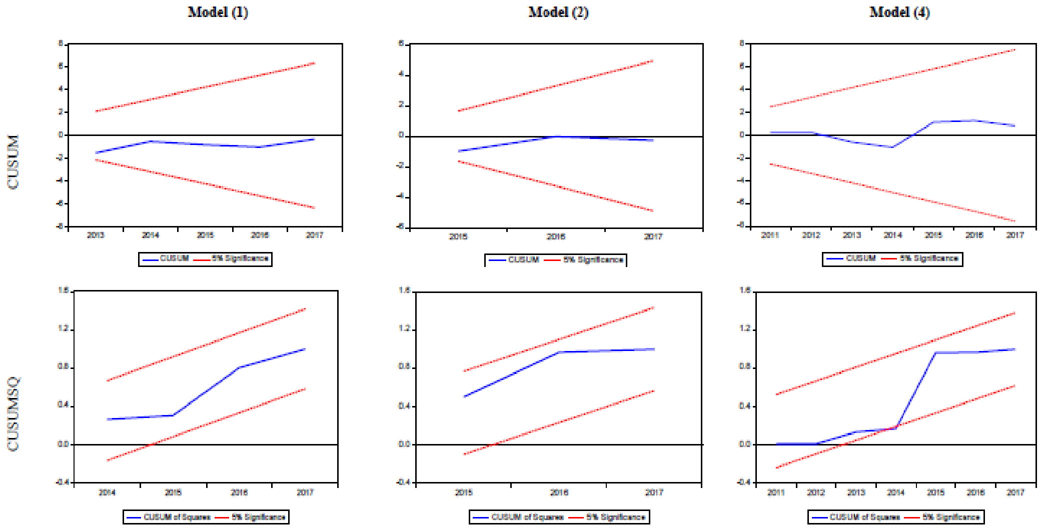
Table (6) : The diagnostic tests

	Model (1)	Model (2)	Model 4)
Normaity (Jarque- Bera)	χ^2 (2) = 1.148 (0.563)	χ^2 (2) = 0.184 (0.911)	χ^2 (2) = 0.778 (0.677)
Serial correlation LM test	χ^2 (2) = 0.634 (0.612)	χ^2 (2) = 0.830 (0.613)	χ^2 (2) = 5.393 (0.067)
Heteroscedasticity (ARCH-test)	χ^2 (1) = 0.062 (0.806)	χ^2 (1) = 0.269 (0.611)	χ^2 (1) = 0.996 (0.318)

The value between parentheses denote probabilities

source : by the authors based on eviews 09

Fig. 3. Plots of cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) of estimated models.



Source: by the authors based on eviews 09

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