



Revisiting effects of Sahara blend crude oil price on economic growth in Algeria: Fresh evidence from ARDL approach

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Abstract

The purpose of this paper is to analyze the effects of oil price fluctuations on Algeria's economic growth in both short and long term, over the period extending from 1983 to 2022. To achieve this objective, we adopted an econometric model based on five variables. This model was estimated using the ARDL (autoregressive distributed lags) approach. The results show that the impacts of oil prices fluctuations on the evolution of Algeria's GDP are positive and significant. In the long term, a minor increase in oil prices does little to stimulate investment and capital creation. The effects of higher oil prices are insufficient to create sustainable growth. The findings highlight the Algerian economy dependence on oil exports, Indeed

Keywords : Oil prices, Economic growth, ARDL, dependence on hydrocarbons, Algeria.

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1. INTRODUCTION

The price of oil has undoubtedly been a key element in the transformation of the world economy since the end of the Second World War. Fluctuations in oil prices have been decisive to achieve economic development in both industrialized and developing countries. The recent years oil shocks have highlighted proved the fragility of this market and its ability to cope with recurring crises in the sector. Actually, the stabilization of oil prices continues to be disrupted by large-scale cyclical or exogenous events, such as wars.

Hydrocarbons as a whole, and oil in particular, are major sources of wealth. More than a source of energy, oil constitutes a core raw material on which many industries' business models are built, nowadays. Some economies dependency on this commodity positive price fluctuations asserts it. The oil shocks of 1973 (Yom Kippur War), 1979 (Iranian Revolution) and 1980 (Iraq War), for instance, had deeply affected the world economy. The US economy, as well, underwent a severe stagflation during the 1970s. The oil prices recovery only began in the 2000s, topping an average of \$105 a barrel as a result of industrialized countries increasing demand, particularly China.

The volatility of oil prices impacts global economic stability. Non-diversified and oil-producing economies as a sharp drop in world crude oil prices would have a dramatic consequence on their economic development. This is illustrated by oil prices drop witnessed in June 2014 induced by a combination of various factors among which a change in the Organization of Petroleum Exporting Countries (OPEC) orientations, a slowdown in geopolitical hazards and a significant revaluation of the US dollar (Baffes and others, 2015), Added to this, the diminishing developed countries demand and the high production in exporting countries.

Determining the relationship between oil price variations and economic growth has generated a rich debate within the scientific community. Many researchers have investigated the oil price-economic growth link in recent years. Some of them have attempted to shed light on the origin of oil shocks that occurred in world economy history. In the United States, for example, Hamilton (1983) estimated that seven of the eight post-war American recessions were preceded by a sharp drop in crude oil prices. In a second study, Hamilton (2003) demonstrated the role played by wars or military conflicts in creating uncertainty about energy prices and supply.

Algeria's economy is also exposed to this risk. being dependent on the oil and

gas sector which accounts for over 90% of Algeria's exports (World Bank, 2022). Its oil revenues reached \$30 billion in 2018, up 25% on 2017 (Kutlu, Gedikoglu, 2019). The latter are used to import various commodities, mainly food products that local production does not satisfy the demand. and to finance economic and social measures taken by the public authorities to reduce unemployment and improve the living standard of Algerians people.

This paper aims to investigate the effects of changes in crude oil prices on Algeria's economic growth. To achieve this objective, we conducted an empirical study based on an econometric model based on one dependent variable, represented by gross domestic product (GDP), and four exploratory variables, represented by oil price, investment, trade openness and inflation. The reference period used in our case extends from 1983 to 2022.

To achieve this purpose, we have organized our work into three main parts. The first part will present an empirical review describing the link between oil price fluctuations and economic growth. The second part will highlight the methodological approach used and specify the econometric model adopted to examine the relationship between oil price variations and growth in the Algerian economy. The third and final section will focus on our study's empirical results. In conclusion, a summary of our findings and their implications will be presented.

2. The relationship between oil price fluctuations and economic growth

This first section of our study will concentrate on a review of the findings of many global research on the correlation between changes in oil prices and economic growth. There will be a discussion of two study methodologies: panel data research and individual country-specific data research.

Papapetrou (2001) attempted to test the influence of oil prices on the country's economic activity and employment as part of a study of the Greek economy using time series from January 1989 to June 1999. An econometric model based on four variables - oil prices, real share prices, interest rates, industrial production and employment - was defined. This was estimated using a multivariate vector autoregression combined with cointegration tests, impulse response functions and variance decomposition. Through his analysis, the author found that fluctuations in real crude oil prices directly affect Greek economic activity and employment. Oil shocks have a negative effect on industrial production and job creation, then.

The crude oil needs of Pacific island countries depend on imports and the world oil market. Jayaraman and Choong (2009) attempted to analyze the relationship between imported oil prices and economic growth in four Pacific island countries: Samoa, Solomon Islands, Tonga and Vanuatu. The time series used vary as follows: 1982-2007 for Samoa, 1980 to 2007 for Solomon Islands and Vanuatu, 1981-2007 for Tonga. Using an autoregressive distributed lag (ARDL) approach, the results highlight the negative impact of oil prices on economic growth in the four sample island countries.

Chuku and others (2010) investigated global oil price effects on imbalances on Nigeria's macroeconomic performance over the period from 1970 to 2008 applying the Vector Error Correction Model (VECM) approach. The results confirm that Nigeria's economic situation has no influence on global oil prices. They also assert that oil price distortions cannot be considered as an important element in Nigeria's economic activity. While world prices appear to have had a very strong impact on inflation, their impact on the Nigerian economy remains asymmetrical.

In Western Europe, Norway's oil production is the most distinctive in the global oil industry. Al-Mulali (2010), however, examined the effects of oil prices on Norway's exchange rate and economic growth over the period 1975-2008. Based on vector-error-correction modeling, the results confirm that higher oil prices benefited Norway's gross domestic product over the reference period. and played an important role in the depreciation of the country's exchange rate.

Using an AutoRegressive Distributed Lag (ARDL), Tang and others (2010) conducted a study on the impact of oil shocks on China's economy. The number of observations considered in the study sample was 123 (from June 1998 to August 2008). The authors of this study highlighted the exercise of a negative effect of the upward shift in oil prices on the growth of the Chinese economy, measured here by real output and investment. These results also showed the positive impact of rising crude oil prices on the country's interest and inflation rates. In the short term, the importance of the effects induced by sudden drops in crude oil prices on Chinese growth is only observed in the first or second year. In the long term, however, it would appear that the importance of this impact only becomes dominant after the twenty-ninth period.

Nigeria is considered one of Africa's largest crude oil producers. Its oil reserves rank it as a major player in the global oil industry. In a research, Ani and others (2014) tried to examine the influence of oil prices on some macroeconomic indicators. Annual

time series from 1980 to 2010 were chosen by the authors for the application of their model. Estimated using Granger causality and ordinary least squares techniques, the causal relationships studied did not reveal any evidence of a relationship between oil prices and the macroeconomic indices used (inflation rate, interest rate, exchange rate and GDP).

Unlike Algeria and Nigeria, Libya has significant oil reserves in Africa. Aimer (2016) investigated the possible relationship between oil price fluctuations and Libyan economic growth (between 2000 and 2015), using cointegration in the sense of Johansen (1988, 1990). The findings refute the existence of a significant relationship between oil prices and Libyan economic growth during the reference period. However, on the basis of the impulse responses generated, a positive short-term effect of the oil price shock on Libyan gross domestic product was observed.

The price of imported oil is a key variable for many developing countries that are not oil producers. Huang and Hieu (2018) studied the relationship between imported oil prices and Vietnam's consumer price index. Analysis of this relationship enabled the two authors to determine the level of impact of globally fixed oil prices on Vietnamese economic growth over the period from 2000 to 2006. The results obtained using regression and correlation methods revealed a number of findings. Thus, from the data in this study, it is clear that fluctuations in the world price of imported oil have a significant impact on the evolution of the inflation rate over the period studied. The country's economy is thus directly impacted.

In the Middle East, Iraq is a benchmark in the hydrocarbon market. This has made the country a key player on the global energy scene, as the natural resources it possesses are among the most important in the world. Aktug and others (2019) investigated the impact of oil prices on the growth of the Iraqi economy over the period 1995-2017. The statistical analysis conducted by the authors of this study was based on the growth rates of the variables observed and the correlations that exist between them. The conclusions that emerge validate the significant and positive relationship that exists between crude oil prices and Iraqi gross domestic product over the period studied.

Empirical studies attempting to investigate the effects of fluctuating oil prices on algerian economic growth (Refafa, Adouka, 2017; Benramdane, 2017) have overall found similar results. Indeed, for Benramdane (2017), who conducted his investigation over the period 1970-2012 using a VAR model associated with impulse response functions and variance decomposition, the negative effects of oil price volatility

neutralized the positive impact that these prices could have had on the algerian economy growth. For Refafa and Adouka (2017), who also addressed this same issue using a VAR model but only annual data from 1980 to 2014, a positive link exists between oil prices and economic growth in Algeria.

To distinguish ourselves from the latter two studies, we propose in our case to investigate the question of the relationship between oil price fluctuations and Algerian economic growth using an autoregressive model with distributed lags (ARDL) over a longer period, i.e. from 1970 to 2017. Introduced by Pesaran and Shin (1999) and Pesaran and others (2001), the ARDL approach is a cointegration technique whose emergence has addressed the shortcomings generated by other cointegration methods (notably that of Johansen and Juselius, 1990) (Nkoro, Uko, 2016). This technique is relatively simple to develop and offers a number of advantages. Mainly, it can be applied if the variables in the study are cointegrated at level I (0) or first difference I (1) or both, and it can also be used even for small samples. Finally, estimation using the ARDL approach enables us to estimate both short- and long-term dynamics.

3. Methodology description

We present the main characteristics of the methodology carried out to demonstrate the relationship between oil price fluctuations and the algerian economic growth.

3.1. Data sources

The purpose of this research is to study the effects of oil price changes on Algerian production growth using an autoregressive distributed lags model. This empirical study was conducted using annual time series data from 1983 to 2022. The latter were drawn from two main sources, namely the World Bank (World Development Indicators) compilation database and OPEC statistical data. This period choice was motivated by Algeria's membership of in the Organization of Petroleum Exporting Countries (OPEC), since 1969. Table (1) details the sources used for each variable.

Table 1. Data sources

Variables	Description	Indicators	Data sources
GDPC	Economic growth	Gross Domestic Product per	World Bank

		capita constant 2015 US\$)	
OILP	Oil prices	Price of Sahara blend crude oil (U.S. dollars per barrel)	OPEC statistical data
INV	Investment	Gross fixed capital formation (% of GDP)	World Bank
OPE	Trade openness	Ratio that measure the sum of country's exports and imports and GDP (% GDP)	World Bank
CPI	Inflation	Consumer price index (2010=100)	World Bank

Source: Author compilation

3.2. Model specification

To understand the relationship between oil price fluctuations and Algerian economic growth over the period 1983-2022, we adopted a model the five following variables: economic growth, oil price, investment, trade openness and inflation. The production function used in our study is a modified version of models proposed by Aimer (2016) and Salisu and others (2018). Our model is specified in the following mathematical formula:

$$GDPC_t = f(OILP_t, INV_t, OPE_t, CPI_t) \quad (1)$$

The transformation of this model into an econometric form will yield ensuing function:

$$LGDPC_t = a_0 + a_1 LOILP_t + a_2 LINV_t + a_3 LOPE_t + a_4 LCPI_t + \varepsilon_t \quad (2)$$

LGDPC: the logarithm of gross domestic product, LOILP: corresponds to the logarithm of oil prices, LINV: corresponds to the logarithm of investment, LOPE: Corresponds to the logarithm of trade openness, LCPI: corresponds to the logarithm of the inflation, a_0 : represents a constant term, a_1, a_2, a_3 et a_4 : represents four regression coefficients ε_t : corresponds to an error term.

3.3. Estimation approach

Once the model defined, the approach used to estimate it will be presented. The main steps that will characterize our empirical analysis will be referred to.

The first step in our methodological procedure consists on verifying the stationarity of our series. using unit root tests. The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test were developed by Dickey and Fuller (1981) and

Phillips and Perron (1981) respectively. The objective of this step will be to confirm that our variables are not cointegrated of order I(2), which is an essential condition for using the autoregressive distributed lag (ARDL) approach.

The relationship between oil price fluctuations and economic growth will be tested using the following ARDL modeling:

$$\begin{aligned} \Delta LGDPC_t = & \alpha_0 + \sum_{i=1}^p a_{1i} \Delta LGDPC_{t-i} + \sum_{i=0}^q a_{2i} \Delta LOILP_{t-i} + \\ & \sum_{i=0}^q a_{3i} \Delta LINV_{t-i} + \sum_{i=0}^q a_{4i} \Delta LOPE_{t-i} + \sum_{i=0}^q a_{5i} \Delta LCPI_{t-i} + \beta_1 LGDPC_{t-1} + \\ & \beta_2 LOILP_{t-1} + \beta_3 LINV_{t-1} + \beta_4 LOPE_{t-1} + \beta_5 LCPI_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

Where: $\beta_1, \beta_2, \beta_3, \beta_4$ et β_5 , are long-term coefficients, $a_{1i}, a_{2i}, a_{3i}, a_{4i}$ et a_{5i} are short-term dynamics. ε_t = An error term, α_0 = A constant term, Δ = the first difference operator, t = time period.

The second operation we'll be able to carry out at a later date concerns the estimation of an optimal ARDL model. This will be selected using the AIC (Akaike Information Criteria) test. This criterion is used to determine the number of delays or lags required for our best-performing model, out of twenty possible models.

The third step in the empirical analysis is conceived to verify the existence of cointegrating relationships between the variables defined in our model. A bounds test is, then, developed on purpose. Boundary cointegration will enable us to determine whether, in the first instance, the relationship between changes in oil prices and GDP is valid over the long term. The bounds test is based on the calculation of the Fisher F-statistic, which that will be compared with the critical significance values of the two estimated lower bounds I(0) and upper bounds I(1).

Finally, if we confirm the existence of cointegrating relationships between the defined variables we will estimate the long- and short-term dynamics. The last procedure to be initiated here will be reserved for calculating the long-run coefficients and specifying an error-correction model (ECM).

4. RESULTS AND DISCUSSION

This final section will focus on the estimation of our predefined ARDL model.

In order to examine the relationship between oil price fluctuations and Algerian economic growth over the period 1983-2022, a studying of the stationarity of the series defined in the model is required.

4.1. Stationarity study

Studying time series stationarity is the first step in any time series analysis. It aims to find out how time series react to shocks (Butler, Kazakov, 2011). For these authors, stationary series tend to have temporary shocks, whereas for non-stationary ones, they become constant.

Checking stationarity helps prevent the occurrence of spurious regression problems, and plays an essential role in predicting time series (Hong and others, 2017). Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are two methods commonly employed by researchers in series unit root analysis.

The ADF approach has been proposed as an alternative to the error autocorrelation problems appearing in the Dickey and Fuller (1979) test, especially by allowing the number of lags to be increased (El Bouhadi, Ouahid, 2014). The Phillips-Perron (PP) test was proposed by Phillips and Perron (1988) as a variant of the ADF test. The PP test, which is a non-parametric test, corrects for standard errors of heteroscedasticity and autocorrelation that may arise (Dasgupta, 2018). The results of our series stationarity study are given in Table (2).

The stationary study results show that with the Augmented Dickey-Fuller test, the null hypothesis of unit root was rejected for the LGDPC, LOILP, LINV, LOPE and LCPI series. The same findings were observed in the estimates returned by the Phillips-Perron test. Our results indicate a combination of two distinct integration orders for our series. The LOILP, LINV and LOPE series are stationary in first difference (I(1)), while the LGDPC and LCPI series are stationary in level (I(0)), meaning that none of our series is integrated in second difference (I(2)). These results satisfy the conditions for applying the ARDL approach.

Table 2. Unit root tests

		ADF		PP		Decision
		Level	First difference	Level	First difference	
LGDPC	Constant	-1.3074 (0.6156)	-3.8355 (0.0056)***	-0.7050 (0.8337)	-3.9367 (0.0043)***	I(0)
	Constant and trend	-3.9245 (0.0225)**	-3.9341 (0.0201)**	-1.8975 (0.6367)	-4.1103 (0.0131)**	
LOILP	Constant	-0.8554 (0.7882)	-5.0522 (0.0003)***	-0.8103 (0.8026)	-4.7207 (0.0007)***	I(1)
	Constant and trend	-3.0311 (0,1440)	-4.9453 (0.0021)***	-2.0710 (0.5416)	-4.6244 (0.0044)***	
LINV	Constant	-1.2490 (0.6406)	-4.1713 (0.0028)***	-1.3839 (0.5777)	-4.0028 (0.0043)***	I(1)
	Constant and trend	-2.1546 (0,4968)	-4.0825 (0.0160)**	-1.9260 (0.6178)	-3.9065 (0.0238)**	
LOPE	Constant	-1.9075 (0.3241)	-1.3011 (0.6141)	-1.8059 (0.3710)	-4.3397 (0.0018)***	I(1)
	Constant and trend	-1.4589 (0.8188)	-5.4464 (0.0006)***	-1.5853 (0.7764)	-4.4944 (0.0061)***	
LCPI	Constant	-6.7323 (0,0000)***	-3.0222 (0,0442)**	-4.2560 (0.0022)***	-2.1547 (0.2260)	I(0)
	Constant and trend	-6.3577 (0.0000)***	-2.1222 (0.5133)	-5.0186 (0.0016)***	-1.5317 (0.7963)	

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author calculation.

4.2. Cointegration analysis

Having confirmed the applicability of the ARDL approach, we can now proceed to the verification of the existence of cointegrating relationships between oil prices, investment, trade openness, inflation and economic growth. Confirmation of the cointegrating relationships involves testing the null hypothesis $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ against the alternative hypothesis $H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$. This task will be carried out using the bounds test.

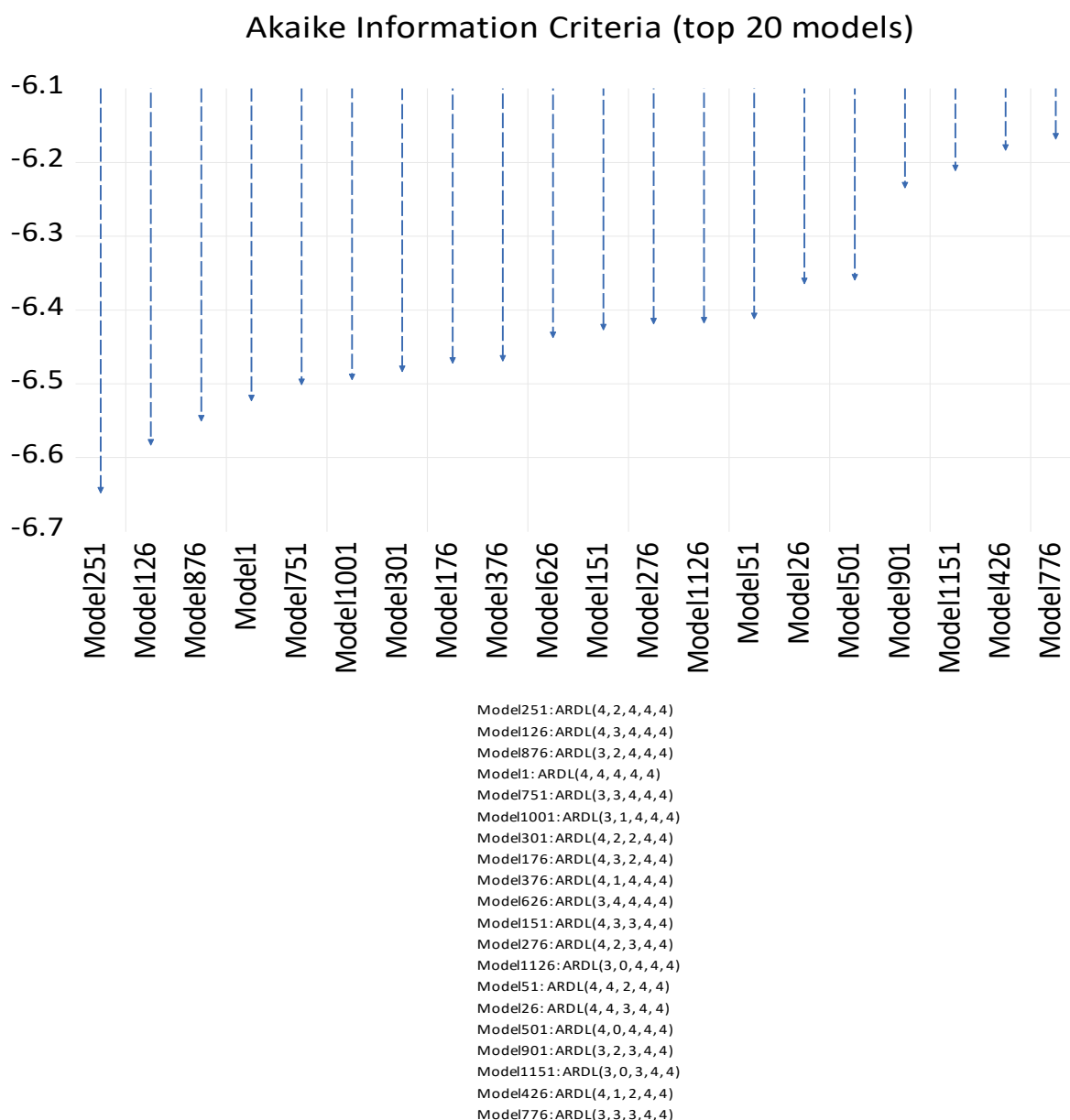
Also known as cointegration at the bounds, this test is based on Fisher's F-statistic. Once calculated, the value of the F-statistic is compared with the critical significance values of each of the two upper I(1) and lower I(0) bounds. There are three possible scenarios.

In the first case, the calculated Fisher statistic could be lower than the values contained in the I(0) boundary. In this case, we'll accept the hypothesis of the absence

of cointegrating relationships between our five variables. In the second case, the F-statistic obtained could be higher than the significance values presented in bound I (1). In this case, we would refute the hypothesis of the absence of cointegrating relationships between our variables. In the last case considered, the estimated Fisher statistic could lie between the values of the lower bound I (0) and the values of the upper bound I (1).

The decision would then be inconclusive. But before carrying out these checks, it will first be necessary to select the optimal ARDL model from a list of twenty best models obtained using the Akaike Information Criterion (AIC). The results of this operation are shown in the following figure.

Fig .1. ARDL model selection using the AIC criterion



Source: Author calculation

The results obtained using the AIC criterion showed that the optimal model selected from the twenty best models was the ARDL model (4, 2, 4, 4, 4). It provides three lags for all variables (LGDPC, LINV, LOPE and LCPI), except for the LOILP variable, which had only two lags. This model had the lowest AIC value. The results relating to the verification of the cointegrating relationships between our five variables will come after the estimation of the selected ARDL model. The estimation of the ARDL model (4, 2, 4, 4, 4) is given in table (3).

The results presented in the table (3) show that oil price fluctuations have a significant positive impact on the evolution of CBIP. However, for the other

exploratory variables (investment and inflation), their influence on economic growth appears positive. The effect of trade openness on GDP is both negative and significant. To observe the relationships between our variables in more detail, we will examine them in the short and long term.

Table 3. ARDL model estimation (4, 2, 4, 4, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LGDPC(-1)	1.855442	0.339423	5.466461	0.0016
LGDPC(-2)	0.170700	0.341336	0.500092	0.6348
LGDPC(-3)	-1.349069	0.318543	-4.235126	0.0055
LGDPC(-4)	-0.335527	0.321853	-1.042483	0.3374
LOILP	0.139676	0.034837	4.009354	0.0070
LOILP(-1)	0.056211	0.031483	1.785418	0.1244
LOILP(-2)	-0.027802	0.021407	-1.298752	0.2417
LINV	0.103187	0.058828	1.754051	0.1300
LINV(-1)	0.367973	0.075982	4.842870	0.0029
LINV(-2)	-0.312907	0.071382	-4.383551	0.0047
LINV(-3)	0.093729	0.076586	1.223840	0.2669
LINV(-4)	-0.096821	0.067051	-1.444006	0.1989
LOPE	-0.300517	0.107835	-2.786809	0.0317
LOPE(-1)	0.148959	0.063459	2.347346	0.0573
LOPE(-2)	-0.300015	0.102137	-2.937373	0.0260
LOPE(-3)	0.205785	0.063431	3.244214	0.0176
LOPE(-4)	-0.346746	0.085293	-4.065324	0.0066
LCPI	0.430757	0.204906	2.102218	0.0802
LCPI(-1)	-0.335996	0.275483	-1.219661	0.2684
LCPI(-2)	-0.619228	0.251933	-2.457905	0.0493
LCPI(-3)	0.829908	0.242422	3.423397	0.0141
LCPI(-4)	-0.291190	0.121583	-2.394990	0.0537
C	6.533581	1.102363	5.926889	0.0010
R-squared	0.999135	Mean dependent var		8.199270
Adjusted R-squared	0.995962	S.D. dependent var		0.136675
S.E. of regression	0.008685	Akaike info criterion		-6.643654
Sum squared resid	0.000453	Schwarz criterion		-5.559247
Log likelihood	119.3330	Hannan-Quinn criter.		-6.304031
F-statistic	314.8840	Durbin-Watson stat		2.594277
Prob(F-statistic)	0.000000			

*Note: p-values and any subsequent tests do not account for model selection.

Source: Author calculation.

After estimating our ARDL model, we will proceed to present the cointegration relationships between our variables by calculating Fisher's F statistic. According to these calculations, the Fisher F-statistic obtained through the bounds test is 9.2266. This value is higher than the critical values of the four upper bounds (4.37, 3.87, 3.49 and 3.09) at the 1%, 2.5%, 5% and 10% significance levels respectively. As a result, we reject the hypothesis that there are no cointegration relationships between our variables. This confirms the existence of cointegrating relationships between economic growth and the other variables.

Table 4. ARDL bounds test results

F-statistic	K	Significance levels	I(0)	I(1)
9.2266	4	10%	2.2	3.09
		5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source : Author calculation.

To see in more detail the long-term and short-term dynamics of the effects of oil price fluctuations on GDP, it is necessary to carry out another operation. This is the subject of the following sections.

4.3. Estimation of long- and short-run dynamics

The estimation of long-run and short-run coefficients allows us to capture the relationships likely to exist between our predefined variables in our econometric model. The results of these estimates are reported in the Table (5). They lead to several conclusions, which we shall attempt to summarize in the following.

Thus, in the long term, the results obtained show that the coefficients of all the variables making up our model are different. Economic growth, represented by GDP, is positively influenced by oil price fluctuations. The impact exerted by the LOILP variable is significant. As a result, an increase of 1% in oil prices over this period will lead to an increase of almost 0.26% in Algerian economic growth. Investment is the second variable in our model which shows that it has a positive impact on the evolution of Algerian GDP. However, the influence of this variable on economic growth remains significant. An increase of 1% in this variable will lead to an increase of around 0.24% in Algeria's economic growth.

The connection between inflation and economic growth may be explained in the same way. On how the Algerian GDP has changed, the consumer price index has a positive influence. As a result, an increase in inflation of 1% will result in an increase in economic growth of more than 0.02% in Algeria. As for trade openness, their influence on economic growth appears negative and significant. An increase of 1% in this variable will lead to a fall of around 0.9% in Algerian GDP.

These results demonstrate the fragility of the Algerian economy. In the long term, a minor rise in oil prices does very little to boost investment and capital creation. Moreover, it cannot curb inflation. Consumers may therefore be directly affected by the effects of fluctuating oil prices over the long term. As a result, the purchasing power of Algerian consumers would be affected by higher prices for goods and services. The benefits of higher oil prices are insufficient to create sustainable growth. In fact, it does not encourage companies to recruit on a massive and lasting scale.

In the short run, we find that the effect of oil price fluctuations on gross domestic product is positive and significant. The short-run coefficient recorded by this variable is of the order of 0.14. This confirms that an increase of 1% in oil prices will accelerate Algerian economic growth by 0.14% in the short term.

As for the other explanatory variables (investment and inflation), their impact on economic growth is positive, with the exception of trade openness, which had a negative impact on GDP. An increase of 1% in investment and inflation leads to respective increases of 0.10% and 0.43% in Algeria's gross domestic product in the short term. for trade openness, an increase of 1% would cause GDP to fall by 0.30%. Furthermore, the speed of adjustment of our error correction model (ECM-1) is negative and significant. This shows that past imbalances will be corrected by 66% in the long-term equilibrium.

Table 5. Estimates of long-term and short-term coefficients

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Long-term results				
LOILP	0.255271	0.079754	3.200732	0.0186
LINV	0.235643	0.071613	3.290499	0.0166
LOPE	-0.899886	0.390895	-2.302119	0.0609
LCPI	0.021644	0.085894	0.251988	0.8095
C	9.922605	1.598166	6.208743	0.0008

Short-term results				
D(LGDPC(-1))	1.513896	0.120380	12.57601	0.0000
D(LGDPC(-2))	1.684596	0.171563	9.819107	0.0001
D(LGDPC(-3))	0.335527	0.137710	2.436473	0.0507
D(LOILP)	0.139676	0.013947	10.01498	0.0001
D(LOILP(-1))	0.027802	0.009105	3.053441	0.0224
D(LINV)	0.103187	0.029298	3.521933	0.0125
D(LINV(-1))	0.316000	0.029543	10.69624	0.0000
D(LINV(-2))	0.003092	0.025097	0.123209	0.9060
D(LINV(-3))	0.096821	0.020280	4.774159	0.0031
D(LOPE)	-0.300517	0.035408	-8.487287	0.0001
D(LOPE(-1))	0.440976	0.035928	12.27375	0.0000
D(LOPE(-2))	0.140961	0.035718	3.946448	0.0076
D(LOPE(-3))	0.346746	0.028938	11.98223	0.0000
D(LCPI)	0.430757	0.058857	7.318672	0.0003
D(LCPI(-1))	0.080509	0.063466	1.268545	0.2516
D(LCPI(-2))	-0.538718	0.069261	-7.778111	0.0002
D(LCPI(-3))	0.291190	0.042609	6.834006	0.0005
ECM(-1)*	-0.658454	0.065360	-10.07434	0.0001

*P-value incompatible with the t-Bounds distribution.

Source: Author calculation.

These results confirm previous long-term trends. In addition, the short-term rise in oil prices no longer has a significant effect on trade openness, and we find that the effects of oil prices on GDP are greater in the long term than in the short term. For higher oil prices to have a positive and significant impact, they need to last longer. In the event of a sudden oil shock, Algerian economic growth would be seriously weakened.

The Algerian economy remains highly dependent on hydrocarbons. Fluctuations in the price of oil and gas products generate market tensions and have an unwavering impact on Algerian exports. The budget revenues generated by this sector play an important role in the country's economic stability. The statistics published by the World Bank are eloquent. Over the period 2015-2020 alone, hydrocarbon exports accounted for almost 40% of the country's budget revenues (Serrano, 2022). It is therefore urgent for Algeria to accelerate the diversification of its economy in order to reduce this dependence on hydrocarbons.

4.4. Robustness checks

In order to verify the robustness of the results given by the previously estimated model, diagnostic tests will have to be carried out. This will involve checking the robustness and stability of the model through tests of autocorrelation, heteroscedasticity, normality and functional specification. These tests are shown in the table below:

Table 6. Diagnostic tests

Type of test	Verification	Stat	P-value
Breusch-Godfrey Serial Correlation LM test	Serial Correlation	2.900517	0.1666
Breusch-Pagan-Godfrey	heteroskedasticity	0.716892	0.7393
Jarque-Bera	Normality	2.467502	0.291198
Ramsey Reset test	functional specification	1.121122	0.3381

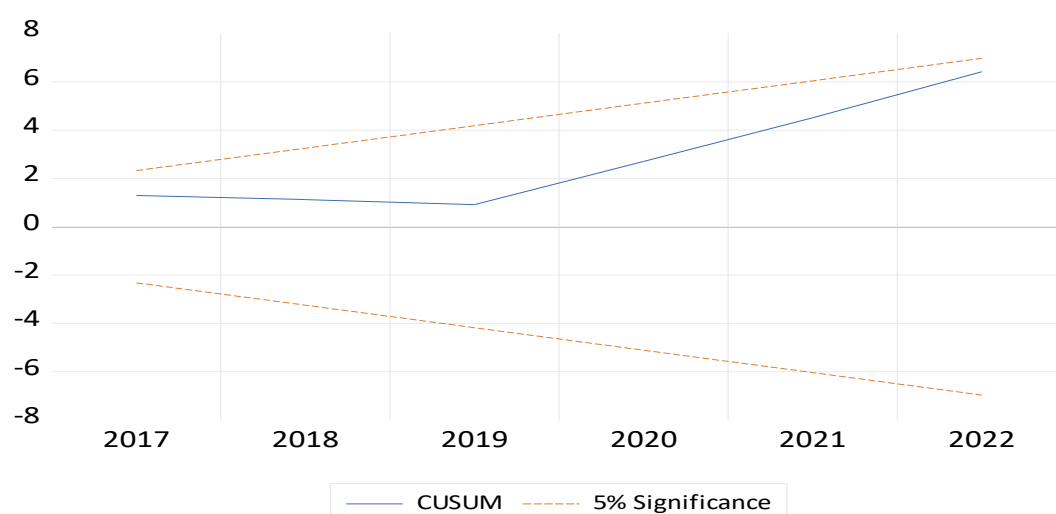
Source: Author calculation.

These tests demonstrate the absence of autocorrelation heteroscedasticity and the normal distribution of residuals. We also note that the functional specification of this model is approved. All probabilities exceed 5%. This confirms the perfect reliability of the model in explaining the effects of the explanatory variables on Algerian economic growth.

Having verified the reliability of our model, a final operation to check its stability is required. The results of this procedure are shown in Figures (2) and (3).

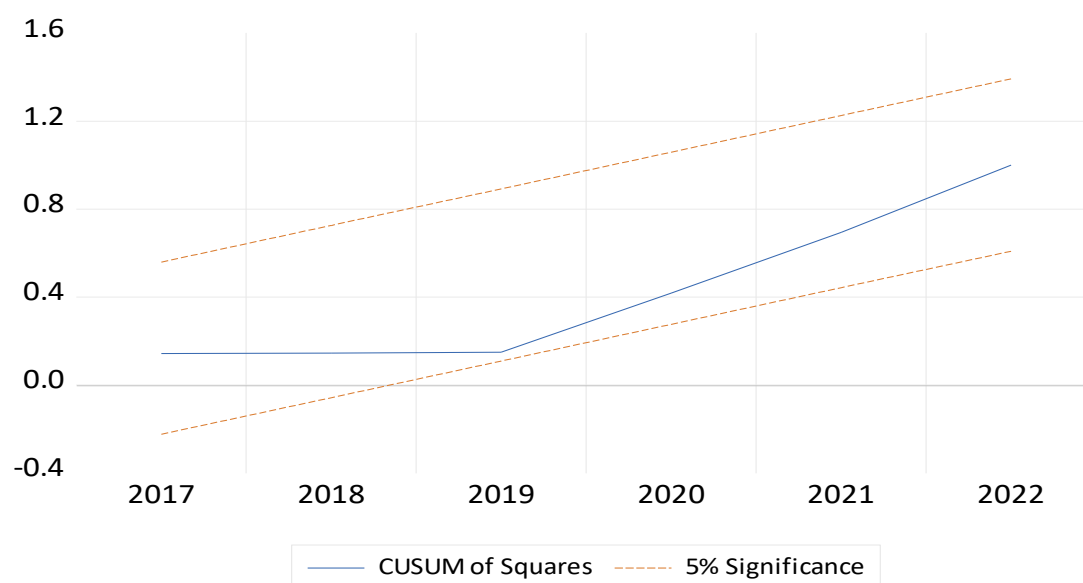
The use of CUSUM (cumulative sum of recursive residuals) and CUSUMSQ (cumulative sum of recursive residuals squared) tests confirms the stability of our ARDL model. The blue line characterizing the evolution of residuals adopts a normal trajectory and is contained between the two red lines at the 5% significance level.

Fig. 2. CUSUM test



Source: Author calculation.

Fig. 3. CUSUMSQ test



Source: Author calculation.

5. CONCLUSION

The aim of this study was to analyze the short- and long-term impacts of oil prices fluctuations on the evolution of Algerian economic growth. To do this, we used annual time-series data from 1983 to 2022. To achieve this objective, we adopted an econometric model based on five variables. An explained variable represented by GDP measuring Algeria's economic growth, and four explanatory variables represented by oil prices, gross fixed capital formation, trade openness and the consumer price index.

This model was estimated using the autoregressive distributed lags (ARDL) approach recommended by Pesaran and Shin (1999) and Pesaran and others (2001). This approach relies on bounds testing to verify the existence of cointegrating relationships. In our case, the use of the ARDL approach satisfies the main conditions for its application. Indeed, the stationarity of our series is not integrated in I (2) second difference. Also, the calculated F-statistic confirmed the existence of long-term cointegrating relationships.

The results of our analysis provide a number of findings. In the long term, the effects of oil prices, investment and inflation on economic growth are positive. However, oil prices and investment are the only ones whose effects are significant. An increase of 1% in oil prices generates an increase of 0.26% in GDP. While an increase of 1% in investment leads to an increase of 0.24% in GDP. On the other hand, the relationship between trade openness and economic growth is negative and not significant.

In the short term, the effects of oil prices on the evolution of Algerian GDP are considered positive and also significant, but to a lesser extent. A 1% increase in oil prices only leads to a 0.14% increase in GDP (versus 0.26% for the long term). Other interesting results indicate that, in the short term, investment, employment and inflation have a positive and significant impact on the growth of the algerian economy. It should also be noted that the trade openness-GDP link is still negative even in the short term. This result may be due to various reason. The fact that Algeria is dependent on oil exports and imports of foreign products makes its economy dependent on foreign trade. This creates a serious problem for Algerian companies which, in addition to fighting against all forms of administrative or bureaucratic obstacles and trying to evolve in a constraining business environment, have to offer products that are accessible and satisfy Algerian people needs.

In view of the results obtained, we note that the Algerian economy remains significantly dependent on the upward variation in world oil prices. Algeria is the world's tenth-largest recognized natural gas reserve, sixth-largest gas exporter and third-largest gas reserve. It ranks eighth in terms of known oil reserves (International Trade Administration, 2023). In terms of oil reserves, its production does not allow it to compete with today's biggest oil exporters such as Saudi Arabia, Russia or the United States, and its influence on world oil prices is therefore inconsequential. As we have seen in our literature review, oil price-setting is dependent on a number of variables

excluding Algeria. In addition to global conflicts such as wars, other exogenous or sudden events, such as the devaluation of the US dollar, jeopardize the stability of oil prices.

To counter the oil shocks affecting the petroleum industry, Algerian economy will have to become more robust, and basic industries will also have to be developed. It is imperative to move the country away from its dependence on oil and other hydrocarbons. Today, investment costs in hydrocarbon extraction are becoming exorbitant, as oil prices do not allow the companies involved to be profitable. An economic model that encourages other forms of green energy and meets global requirements needs to be devised. Oil shocks should not be used to reduce economic growth and limit the development of human capital, but should be seen as an opportunity to remind economic actors of the pressing need to diversify the country's economy.

Finally, this study addressed an important issue within the Algerian economy. In addition to focusing on the country's oil price (Saharan blend) sold / exchanged through OPEC, it examined recent data on oil prices. Our study differs from previous ones in that it uses the Brent crude oil price as a reference. The results show that oil prices are correlated with GDP growth in Algeria. However, further research using other econometric measurement techniques is required to confirm and extend these conclusions. The availability of statistical data shows that this is the main way of measuring the link between oil prices and economic growth. The effects of oil prices on the economic performance differ from one country to another. Carrying out a panel study would enable us to have a more detailed view of the effects of oil price variations on oil-exporting countries, particularly OPEC countries.

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