The impact of oil prices on economic growth in Algeria for the period between (1970-2020) – an econometric analytical study using the Autoregressive Distributed Lag Model (ARDL)

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Abstract:

Oil has imposed itself as a strategic commodity since the First World War, being the main source of crude GDP. It has been confirmed that this commodity plays a significant role in improving the economic growth rate. Therefore, this study aimed to clarify the extent to which oil price fluctuations affect economic growth, given the economic dependency of the hydrocarbon sector as the main engine of the Algerian economy, which influences the size of macroeconomic variables. The relationship between oil prices and economic growth in Algeria for the period (1970-2020) was studied using the cointegration model according to the ARDL bounds approach. The study concluded that there is a direct and significant relationship between oil prices and economic growth, and that oil prices affect economic growth in both the short and long term.

Keywords: oil, oil prices, economic growth, petroleum, Algerian economy

JEL Classification: F43, Q3, P28

Introduction:

Oil is one of the most important energy sources, ranking highly since its discovery due to the significant role it plays in international relations and driving economic growth, serving as a monetary indicator that determines the exchange value of goods and services in the market. Its prices are subject to fluctuations in international markets, which can cause a balance of payments deficit on one hand and increasing debt service burdens on the other. Amid structural reforms imposed on Algeria by international financial institutions, and due to rising global oil prices as a major determinant of national income, Algeria adopted a savings policy aimed at accumulating as much foreign exchange reserves as possible, which plays an important role in building a balanced economy through the external assets held by monetary authorities to meet balance of payments needs and intervene in exchange markets as a key indicator of a country's economic and financial strength.

The hydrocarbon sector represents the core engine for driving the economy and financing economic development in Algeria, providing substantial revenues that support the

implementation of development plans and thus economic growth. Algeria is among the leading oil-exporting countries. Since the concept of growth and development is closely linked to the hydrocarbon sector, Algeria relies heavily on this sensitive sector, as it accounts for more than 97% of public revenues. However, the global oil market has experienced successive crises, influenced positively and negatively by multiple factors, resulting in price fluctuations and instability.

Research Problem:

In light of the above, the main research question is:

To what extent do oil prices affect economic growth in Algeria for the period (1970-2020)?

Sub-questions:

From the main question, the following sub-questions arise:

- What are the measures of economic growth?
- What are the types of oil prices?
- Do oil prices affect economic growth in the short term, long term, or both?

Research Hypotheses:

To answer the sub-questions, the following hypotheses are proposed:

- Measures of economic growth are represented by monetary and real growth rates, as well as the comparison of equivalent purchasing power.
- Types of oil prices include: announced price, realized price, benchmark price, tax-inclusive cost price, spot price.
- Oil prices affect economic growth in both the long and short term.

Importance and Objectives of the Study:

The importance of this study lies in the impact of oil prices and economic growth on international economies, influencing the global economic cycle, which underscores the relevance of economic studies by researchers. This study examines the effect of oil prices on economic growth using econometric tools and software for a more precise analysis. The study aims to:

- Understand key concepts related to oil prices and economic growth;
- Identify the main types of oil prices;
- Clarify the extent of oil price fluctuations' impact on economic growth in Algeria.

Methodology and Tools:

To address the study comprehensively and answer the research question, the study uses:

- The descriptive-analytical approach, focusing on describing and analyzing phenomena, especially in the first section;

- The inductive approach, particularly in field studies analyzing quantitative data, models, and statistical relationships;
- Data sources include OAPEC, the Arab Monetary Fund, and the World Bank;
- Analytical tools include EViews9 and Excel2010.

Previous Studies:

The literature review is divided into six studies:

1. Alkoun Nadia, Makhlouf Asma, "Oil Price Fluctuations and Their Impact on Economic Growth in Algeria – An Econometric Analytical Study for the period (1986-2017)," Al-Hadath Journal of Financial and Economic Studies, Issue 01, pp. 148-170, University of Mohamed Cherif Messaadia, Souk Ahras, Algeria, 2018.

Research problem: What is the impact of oil price fluctuations on Algeria's economic growth?

Findings: Using the VECM error correction model, there is cointegration between GDP, oil prices, and money supply, showing long-term equilibrium and a positive relationship between oil prices and economic growth.

2. Abu Azoum Abu Bakr Abdelkader, "Oil Price Fluctuations and Their Impact on Economic Growth – An Econometric Study of the Libyan Economy from 1990 to 2010," Academic Research Journal, Issue 05, pp. 74-106, University of Sabha, Libya, 2016.

   Research problem: Do oil price fluctuations affect economic growth in Libya?

   Findings: Using descriptive-analytical and quantitative methods with R software, the study found a strong positive relationship between crude oil prices and GDP growth.

3. John M. Maheu, Yong Song, Qiao Yang, "Oil Price Shocks and Economic Growth: The Volatility Link," International Journal of Forecasting, Vol. 36, Issue 02, pp. 570-587, 2020.

   Research problem: Is there a relationship between oil price shocks and economic growth?

   Findings: Oil shocks primarily affect economic growth through conditional variance, showing strong linkage with economic growth volatility and asymmetrical responses.

4. Moawad Ahmed Sayed, "The Impact of Oil Prices on Economic Growth and Development in MENA Countries," MPRA Paper No. 89073, 15th International Conference, MEEA, Doha Institute for Graduate Studies, 2018.

   Research problem: Do oil prices affect economic growth and development in MENA countries?

   Findings: Oil price fluctuations significantly impact macroeconomic variables,

including production costs, consumption, and exchange rates, affecting both developed and developing countries.

5. Musa Foudeh, "The Long Run Effects of Oil Prices on Economic Growth: The Case of Saudi Arabia," International Journal of Energy Economics and Policy, Vol. 07, No. 06, pp. 171-192, Turkey, 2017.

    Research problem: Do oil prices affect long-term economic growth in Saudi Arabia?

    Findings: Oil dominates the Saudi economy; GDP and government spending closely follow oil price trends. ARDL model shows long-term direct and indirect effects of oil on growth.

6. María Dolores Gadea, Ana Gómez-Loscos, Antonio Montañés, "Oil Price and Economic Growth: A Long Story?", Econometrics, Vol. 04, No. 41, pp. 01-28, 2016.

    Research problem: Is there a long-term relationship between oil prices and economic growth?

    Findings: The relationship between GDP and oil prices is relatively unstable, with rising oil prices negatively affecting economic growth.

Position of Current Study:

While previous studies mainly focused on the period 1986-2017, this study investigates the impact of oil prices on Algeria's economic growth from 1970-2020 using the ARDL model.

Study Structure:

- **Chapter 1:** Conceptual framework of study variables (oil prices, economic growth);
- **Chapter 2:** Econometric analysis of the impact of oil prices on Algeria's economic growth (1970-2020).

Chapter 1: Conceptual Framework of Study Variables (Oil Prices, Economic Growth)

Oil has gained global importance not only as an energy source but also as a strategic economic resource. Its influence extends to all economic activities and international trade, making it a pivotal factor in economic growth, technological progress, and development. Algeria has relied heavily on the oil sector since independence, making it central to this study.

1. **Concept of Oil Prices:**

Oil prices are key indicators controlling the oil market and influencing the global economy, determining the exchange value of goods and services. Definitions include:

- "The value of oil expressed in a specific currency, influenced by economic, social, political factors and market forces." (Al-Douri, 1983, p. 194)
- "A monetary indicator determining the exchange value of goods and services, balancing supply and demand to allocate resources efficiently." (Said Al Otaiba, 1978, pp. 21-22)
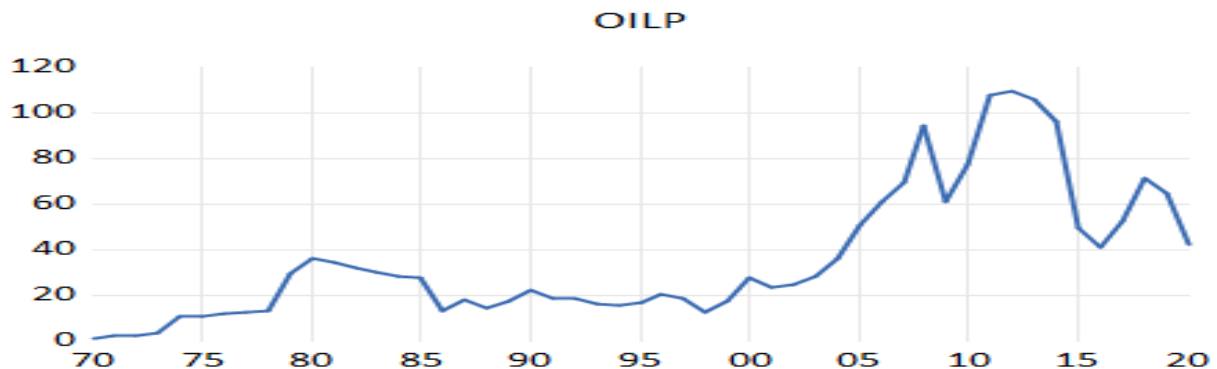
- "The monetary value of a barrel of crude oil according to the American barrel measurement." (Shaker Farih & Mohammed Ma'atsch Al-Anzi, 2018, p. 1577)

2. Types of Oil Prices:

- **Announced price:** Theoretical price set by companies for tax purposes.
- **Realized price:** Actual purchase price, agreed in contracts.
- **Benchmark price:** Average of announced and realized prices over several years.
- **Tax-inclusive cost price:** Minimum price covering production cost plus government tax.
- **Spot price:** Immediate market transaction price.

3.Evolution of Oil Prices in Algeria:

Figure 01 summarizes oil price evolution in Algeria from 1970-2020.

OILP

Source: Prepared by the researchers based on data from the National Office of Statistics, the Organization of Arab Petroleum Exporting Countries (OAPEC), the Arab Monetary Fund, and outputs from EViews9

Second: Theoretical Framework of Economic Growth

Improving individuals' living standards and increasing their welfare within society is one of the main objectives that macroeconomic policies in different countries aim to achieve. This can only be realized through enhanced economic performance, reflected in higher growth rates and the optimal utilization of available resources, which are considered a source of economic growth. This leads to increases in national and per capita income and production by stimulating the economy at all levels. Accordingly, this section addresses the concept and measures of economic growth as follows:

1. Concept of Economic Growth:

From a theoretical perspective, economic growth is one of the most important topics related to economic development. All countries strive to achieve high growth rates by providing sufficient resources and financial means. It represents the relative change in Gross Domestic Product

(GDP), reflecting the quantity of goods and services produced by a given economy in a specific period. Various definitions of economic growth exist, of which the following were selected:

- Defined as "the increase in the country's total domestic income along with any increase in the real per capita income." (Ben Kaddour, 2012, p. 63)
- Also defined as "a process whereby growth in real output occurs through the allocation, generation, and stabilization of resources that contribute to productivity." (Awili, 2015, p. 03)
- Additionally defined as "the per capita share of real GDP." (Hlalefang & Siyasanga, 2017, p. 03)

From the above, it can be concluded that economic growth refers to an increase in total GDP or total national income, resulting in an increase in real per capita income.

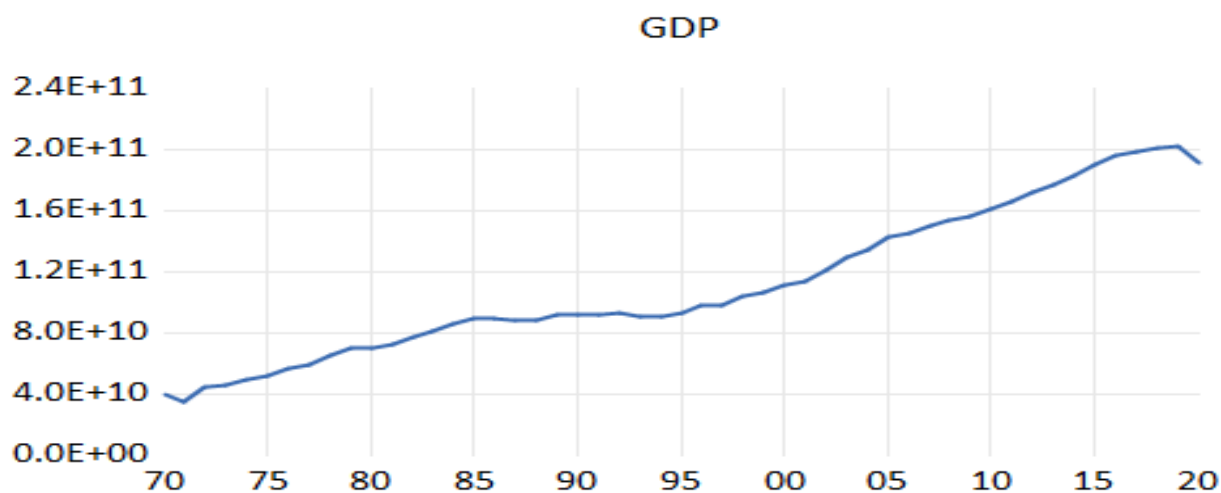## 2. Measures of Economic Growth:

Among the main indicators of national economic performance that reflect changes in the level of national activity and economic growth are:

a. **Monetary growth rates:** Growth rates are measured by converting goods and services into their monetary equivalents. These rates are calculated using various types of prices, including current, constant, and international prices. (Mustafa Mohamed & Abdelzaher, 1999, p. 118)

b. **Real growth rates:** Growth rates per capita of total output, national output, and national income are key indicators of economic growth and its relationship to population growth. This is particularly relevant given the substantial population growth rates in developing countries, which approximate the growth rates of output. In the services sector, due to the inaccuracy of monetary measures, alternative measures are used, such as the number of doctors per thousand people. (Sayad, 2012/2013, p. 35)

c. **Comparison of equivalent purchasing power:** Price changes in two different countries are the main determinant of their currency exchange rate in the long term. On the other hand, the exchange rate reflects the relative purchasing power of the two currencies in the respective countries. (Mordechai, 2007, p. 264)

3. Economic Growth Trends in Algeria:

The following figure summarizes the evolution of economic growth, as measured by GDP, in Algeria for the period (1970-2020):

Figure 02: Economic growth rates in Algeria for the period (1970-2020)

GDP

Source: Prepared by the researchers based on data from the World Bank and outputs from EViews9

Chapter Two: Econometric Analytical Study of the Impact of Oil Prices on Economic Growth in Algeria for the Period (1970-2020)

The study addressed the problem using annual time series data for all the mentioned variables, totaling 50 observations for the period (1970-2020). The data on economic growth were collected from published statistics in the World Bank database, while oil price data were collected from the National Office of Statistics, the Organization of Arab Petroleum Exporting Countries (OAPEC), and the Arab Monetary Fund.

First: Statistical Tools and Standard Tests Used in Data Processing

The data were processed using **Excel 2010** and analyzed using the econometric software **EViews9**, in order to determine the long- and short-term relationship between the variables. The study relied on the **ARDL (Autoregressive Distributed Lag) bounds approach**, as this model does not require all variables under study to be integrated of the same order.

Several approaches and tests were used to determine the precise effect of the relationship between oil prices and economic growth, as follows:

> **1. Time Series Stationarity Test:**

Economic measurement literature requires checking the stationarity of time series before estimating any relationship. Granger (1983) demonstrated that estimating models via ordinary least squares with non-stationary series can lead to misleading results, known as spurious regression (Granger, 1974, pp. 111-120). Given the availability of several tests to ensure the stationarity of the study variables, the **Augmented Dickey-Fuller (ADF) test** was used after determining the appropriate lag periods using the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SC).

The ADF test for stationarity estimates the following models (Ben Khatem, 2015/2016, p. 134):

- **Model 4:** Contains a constant term, given as:
- **Model 5:** Contains neither a constant nor a trend term, given as:
- **Model 6:** Contains both a constant and a trend term, given as:

Where:

- Δ: first difference of the series
- X_t: the variable whose time series is being tested
- P: lag order
- ε_t: random variable (Salem Hussein & Taleb Moussa, p. 05)

2. ARDL Model Test:

The **ARDL methodology** is one of the modern econometric approaches used to identify the cointegration relationship between the dependent variable and explanatory variables in both the long and short term, in addition to determining the effect size of each explanatory variable on the dependent variable. This methodology is distinguished within the framework of cointegration compared to other conventional methods like Engel-Granger (1987), Johansen's method, and the Cointegration Test within a VAR model.

Key features of ARDL methodology:

- ARDL does not require all study variables to be integrated of the same order. It can be applied when variables are integrated of order zero, order one, or a mix, but not of higher order.
- ARDL is suitable for small samples, given its efficiency.
- ARDL allows for unbiased estimates in long-term models.

The ARDL methodology follows these steps:

- Test the stationarity of time series;
- Test cointegration using the **Bounds Test**;
- Estimate the long-term model using the ARDL model;
- Estimate the short-term model, i.e., the Error Correction Model (ECM);
- Test the structural stability of the estimated model. (Ramdani & Othmani, 2019, p. 63)

Second: Results and Discussion

After studying stationarity, it was found that both series are stationary at first difference, which is why the ARDL model was chosen. Stationarity results according to the ADF test are as follows:

Table 01: ADF Test for Oil Prices and Economic Growth Series

Economic Growth	T-Statistic	ADF Test (GDP)	Oil Prices	T-Statistic	ADF Test (POIL)
0.8070	-0.8113	Model 01	0.4056	-1.7396	Model 01
0.8383	-1.4336	Model 02	0.5773	-2.0182	Model 02
0.9851	1.9000	Model 03	0.3943	-0.7324	Model 03

Source: Prepared by the researchers based on EViews9 outputs

Table 02: ADF Test for First Difference of Oil Prices and Economic Growth Series

Economic Growth	T-Statistic	ADF Test d(GDP)	Oil Prices	T-Statistic	ADF Test d(POIL)
0.0013	-4.2822	Model 01	0.0000	-5.9422	Model 01
0.0181	-3.9284	Model 02	0.0001	-5.9052	Model 02
0.0077	-2.7087	Model 03	0.0000	-5.9898	Model 03

Source: Prepared by the researchers based on EViews9 outputs

From Table 01, the economic growth series is non-stationary at level, as shown by p-values greater than 5% across all three models. Similarly, the oil price series is non-stationary at level with p-values above 5%. Table 02 shows that both series become stationary at first difference, with p-values less than 5% for all three models, indicating that the two series are integrated of order 1.

1. ARDL Model Estimation:
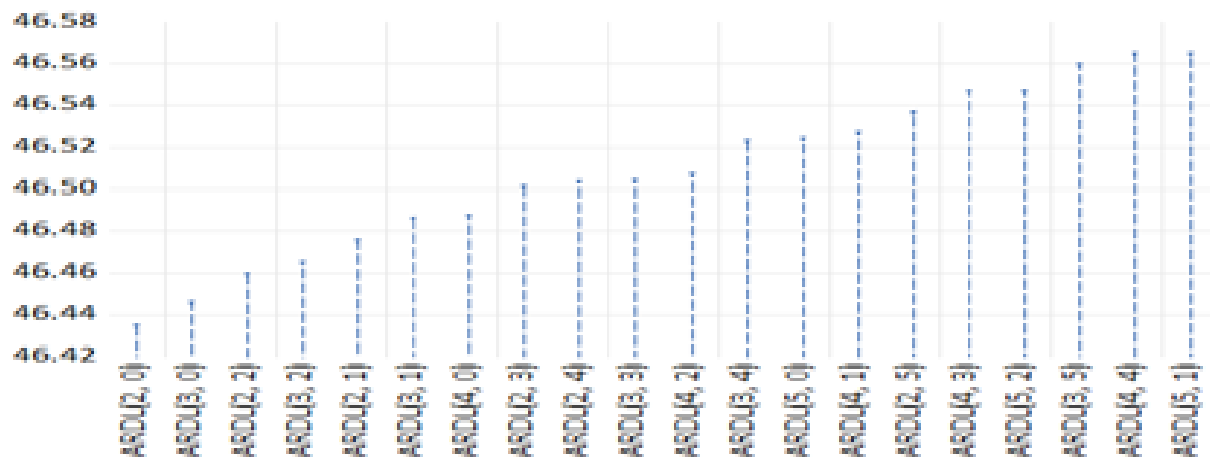
Table 03: ARDL Model Estimation

Source: Prepared by the researchers based on EViews9 outputs

From the table above, the ARDL results show that the model is statistically acceptable, as indicated by the F-statistic, which confirms the model's significance, in addition to its explanatory power, as reflected by the R-squared of 0.99.

2. Optimal Lag Length:

Figure 03: Optimal Lag Length

From the figure above and according to the criteria (Akaike, Schwarz criterion, Hannan-Quinn criterion), we conclude that the optimal lag length is (2, 0).

3. Cointegration Test:

Table 04: Cointegration Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	5.284206	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual Sample Size	49	Finite Sample: n=50		
		10%	3.177	3.653
		5%	3.86	4.44
		1%	5.503	6.24
		Finite Sample: n=45		
		10%	3.19	3.73
		5%	3.877	4.46
		1%	5.607	6.193

From Table (04), it is evident that the Fisher statistic is 5.28, which is greater than the upper critical value (4.16) at a 5% significance level, indicating the existence of a cointegration relationship between oil prices and economic growth.

4. Estimation of the Error Correction Model (ECM): This involves estimating both the short- and long-term relationships to demonstrate the existence of a long-term relationship and the ability to correct deviations from the short term to the long term, as follows:

a. Estimation of the Short-Term Relationship:

Table 05: Estimation of the Short-Term Relationship

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.93E+09	1.23E+09	0.000000	0.0000
GDP(-1)*	-0.031952	0.014766	-2.163952	0.0358
OILP**	52736702	24361674	0.000000	0.0000
D(GDP(-1))	0.261761	0.173536	1.508390	0.1384

Source: Prepared by the researchers based on EViews9 outputs

From the table above, it is clear that the error correction coefficient appears negative (-0.032) and significant at 5%, which confirms the existence of a long-term equilibrium relationship. Consequently, there is the possibility of error correction and a return to equilibrium at a speed of 3.2% per time unit, which is one year.

b. Estimation of the Long-Term Relationship:

Table 06: Estimation of the Long-Term Relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OILP	1.65E+09	5.26E+08	3.136424	0.0030
C	1.23E+11	6.51E+10	1.890360	0.0652

Source: Prepared by the researchers based on EViews9 outputs

From Table (06), we observe that the coefficient of oil prices is positive and significant, from which we conclude that there is a direct relationship between oil prices and economic growth.

Third: Model Validity Tests for the Relationship between Oil Prices and Economic Growth

In this section, we address the econometric issues that may reduce the quality, accuracy, and validity of the chosen model for the study, through testing for autocorrelation, heteroscedasticity, and model stability.

1- Autocorrelation Test:

Autocorrelation between variables is tested using the following hypotheses:
H0: No autocorrelation problem exists;
H1: An autocorrelation problem exists.

Table 07: Autocorrelation Model

F-statistic	1.986149	Prob. F(1,44)	0.1658
Obs*R-squared	2.116318	Prob. Chi-Square(1)	0.1457

Source: Prepared by the researchers based on EViews9 outputs

From the table above, it is evident that neither the Fisher statistic nor the Chi-Square statistic is significant. Therefore, we accept the null hypothesis, meaning that the model does not suffer from an autocorrelation problem.

2- Heteroscedasticity Test:

Heteroscedasticity between the variables is tested using the following hypotheses:

H0: No heteroscedasticity problem exists;

H1: A heteroscedasticity problem exists.

Table 08: Heteroscedasticity

Heteroskedasticity Test: ARCH

F-statistic	0.010172	Prob. F(1,46)	0.9201
Obs*R-squared	0.010612	Prob. Chi-Square(1)	0.9180

Source: Prepared by the students based on EViews9 outputs

From the table above, it is evident that neither the Fisher statistic nor the Chi-Square statistic is significant. Therefore, we accept the null hypothesis, meaning that the model does not suffer from heteroscedasticity.
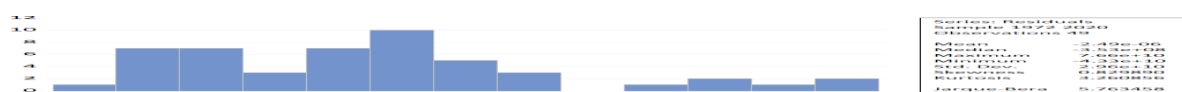
3- Normality Test:

The normality of the residuals between the variables is tested using the following hypotheses:

H0: The model residuals are normally distributed;

H1: The model residuals are not normally distributed.
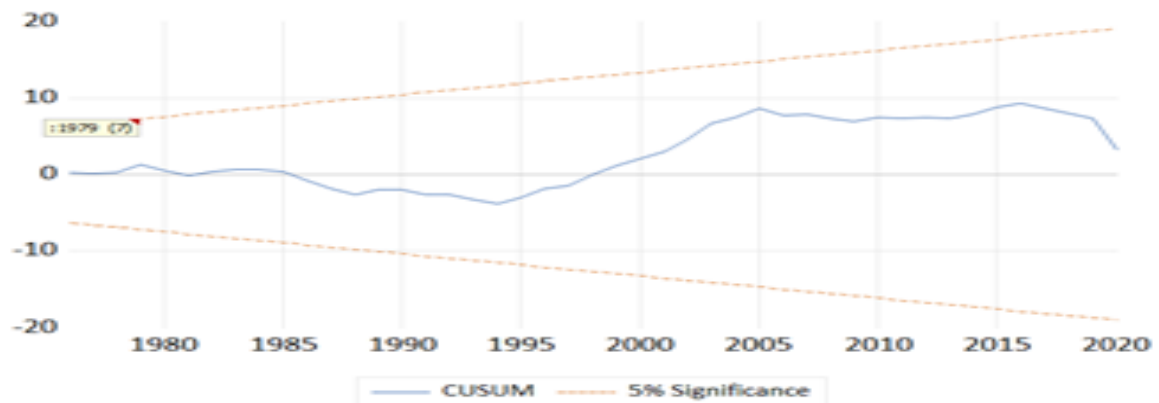
Figure 04: Normality Test

From the figure above, it is clear that the Jarque-Bera statistic is not significant. Therefore, we accept the null hypothesis, meaning that the model residuals are normally distributed.

4- Model Stability Test:

The model stability test was as follows:

Figure 05: Model Stability Test

Source: Prepared by the researchers based on Eviews9 outputs

From the figure above, which represents the CUSUM test—the cumulative sum of residuals— it is clear that the cumulative sum of all model residuals lies within the confidence bounds, indicating that the estimates are stable over time, and hence the model is stable.

Conclusion:

The importance of oil at the international level is highlighted as an energy source used in the most important economic sectors. This has made industrial countries, as the primary energy consumers, strive to secure oil supplies at reasonable prices, even establishing agencies to use as leverage over producing countries. Considering that the hydrocarbons sector in Algeria is the main driver of the overall economy, its revenues contribute to raising the national output and thus increasing economic growth rates. Through this, central banks retain foreign exchange reserves, which play an important role in protecting the economy from unexpected crises and shocks, while supporting the state's position in external dealings.

Study Results: The results obtained from this study are as follows:

- The hydrocarbons sector is the main driver of the Algerian economy, contributing to increased economic growth.
- Increases in oil prices lead the Algerian Central Bank to retain foreign exchange reserves, which protect the national economy from oil shocks and crises.

- Stability tests show that both the oil price and economic growth series are stable at first difference in all models.

- Cointegration tests indicate a significant positive relationship between oil prices and economic growth.

- The Fisher statistic of 5.28, which is higher than the maximum critical value (4.16) at 5% significance, confirms the existence of a long-term equilibrium relationship between oil prices and economic growth.

- The error correction model shows that the error correction term (-0.032) is negative and significant at 5%, confirming a long-term equilibrium relationship and the possibility of correcting deviations back to equilibrium at a speed of 3.2% per time unit, which is one year.

- Oil prices affect economic growth in both the long and short term.

Study Recommendations: The recommendations of this study are as follows:

- Given the challenges facing the Algerian economy, Algeria must pursue a diversification policy to reduce dependence on the hydrocarbons sector in order to achieve sustainable economic growth.

- Renewable energy is a real alternative to the hydrocarbons sector, especially oil, due to its role in advancing sustainable development as a clean energy source. Greater attention should be given to this field through research and development of working technologies, considering Algeria's vast solar and wind energy potential, which could position it as a leader in the field if optimally utilized.

- Algeria should increasingly focus on renewable energy to achieve multiple objectives, the most important being the expansion of renewable energy's role in diversifying the domestic economy and income sources.

- Algeria should leverage its renewable energy potential and integrate it as an important financial resource for achieving economic growth.

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