

Determinants of Economic Growth in Algeria during the Period 1990-2022

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Abstract:

This study aims to highlight the key determinants of economic growth in Algeria during the period from 1990 to 2022. Several independent variables were used, including public expenditure (PE), oil prices (OIL), and trade openness (TO), which affect economic growth (Gross Domestic Product, GDP, as the dependent variable). The study employs the Autoregressive Distributed Lag (ARDL) model and tests for the existence of both short-term and long-term equilibrium relationships between these variables.

The study found that the most significant variables positively influencing long-term economic growth in Algeria are public expenditure (PE) and trade openness (TO), while oil prices (OIL) have a significant negative impact on long-term economic growth in Algeria.

Keywords: Economic Growth, Gross Domestic Product, Public Expenditure, Oil Prices, Trade Openness, ARDL.

I- Introduction :

Achieving economic growth constitutes one of the primary objectives pursued by all countries, regardless of their economic system or the level of economic advancement they have reached. Economic growth is characterized as the outcome of a complex and intertwined process that reflects the efforts of the entire society. Economic literature has devoted intense efforts to studying and analyzing numerous economic models at both theoretical and applied levels, aiming to identify the factors influencing economic growth. This research aims to develop strong models with high explanatory power that reveal the nature and direction of the relationship between economic growth and other influencing variables.

Due to the failure to achieve the desired levels and efficiency of economic growth in Algeria, this is partly attributed to the continued oscillation and instability, which are influenced by many internal and external variables. The importance of research in this context is highlighted as it aims to understand and analyze the factors and causes contributing to this economic fluctuation.

It appears that the Algerian economy is influenced by complex internal variables, which may be linked to government policies, investment, and the efficiency of various sectors. Additionally, it is affected by fluctuations in global markets and changes in global economic conditions, making it susceptible to oscillation. To improve the situation, economic policies need to comprehensively address these factors, focusing on enhancing stability and improving conditions that affect economic growth. This requires a precise analysis of the determinants of growth and the implementation of effective measures to address the challenges and variables negatively impacting the Algerian economy.

Therefore, the main problem statement for the study can be formulated as follows:

To What extent does the contribution of determinants of economic growth in Algeria to achieving high growth rates during the period 1990-2022?

Sub-Problems:

Derived from the main problem statement, the sub-problems can be formulated as follows:

- Is there a statistically significant impact of public expenditure on economic growth in Algeria?
- Is there a statistically significant impact of trade openness on economic growth in Algeria?
- Is there a statistically significant impact of oil prices on economic growth in Algeria?

Hypotheses:

Based on the sub-problems, the following hypotheses, which serve as initial answers to these questions, can be formulated as follows:

- There is a statistically significant impact of public expenditure on economic growth in Algeria.
- There is a statistically significant impact of trade openness on economic growth in Algeria.
- There is a statistically significant impact of oil prices on economic growth in Algeria.

1.1. Previous Studies:

Haouas, A., Ochi, A., & Labidi, M. A. (2024)¹: This paper examines the sources of economic growth in Algeria, studying the key drivers of their slow and weak economic performance, during the period of 1979–2019 from the perspective of the augmented growth accounting framework and the growth regression method. More specifically, the paper uses the augmented growth accounting framework to decompose the aggregate growth of an individual economy to determine the contribution of various inputs and the total factor productivity. The growth regression method, then, links the growth performance of a given country to a set of economic, social, and institutional variables to identify the deep drivers of its economic growth. Results of the accounting framework show that Algeria's growth performance has been weak and modest for decades. This is due, mainly, to labor growth with weak gain in capital accumulation and to sharp losses in the total factor productivity growth. Furthermore, results of the econometrics study stress the importance of the political, institutional, and economic variables and the macroeconomic stability as potential factors that may affect growth in Algeria. These findings highlight the need for policymakers to identify and to target these determinants to improve the long-run economic growth in Algeria.

Fadila Melouah, Mekkid alli (2020)²: This study aims to analyze the relationship between certain economic variables and economic growth in Algeria during the period (1990-2018). It begins by discussing the conceptual framework of economic growth and the explanatory theories thereof. Subsequently, an attempt is made to construct a standard model of economic growth based on the economic variables that explain it. The study concludes that public expenditure, physical capital, human capital, money supply, and trade openness are among the most influential variables affecting economic growth, as expressed by the Gross Domestic Product (GDP) in Algeria during the study period.

Zakaria Massoudi, Khalifa Azzi (2019)³: This study aims to highlight the main determinants of economic growth in Algeria during the period (1980-2017). To achieve this goal, several independent variables that impact economic growth according to economic theories were used. The model was formulated using the Fully Modified Ordinary Least Squares (FMOLS) method for the long term and the Error Correction Model (ECM) for the short term. The study concluded that the most important determinants of economic growth in Algeria, with statistically significant positive relationships in the long term, are investment expenditure, operating expenses, exports, imports, loans directed to the private sector, and oil prices. Additionally, the study found that the determinants of economic growth in the short term include investment expenditure, exports, imports, loans directed to the private sector, and oil prices.

NAOUM, A. (2017)⁴: This research endeavors to develop an econometric framework that delineates the key factors influencing economic growth in Algeria (TCGDP) from 1970 to 2013. Additionally, it seeks to examine the long-term equilibrium relationship using the Autoregressive Distributed Lag (ARDL) method. Utilizing data from the World Bank and EViews 9 software, the analysis reveals a statistically significant correlation between these determinants and economic growth. The findings indicate that factors such as monetary stock (money supply), consumption, exports, oil prices, and local investment, assessed across various time intervals, have consistently bolstered economic growth throughout the study period. These outcomes align with established economic principles and corroborate similar research findings.

Malik Mahmoudi (2016)⁵: This study aims to analyze the nature of the relationship between economic growth and certain economic variables in Algeria for the period from 1990 to 2014. To address this issue, the conceptual framework of economic growth and the explanatory theories thereof were discussed. Additionally, the study analyzed the reality of the phenomenon in Algeria, attempting to construct a standard model of economic growth based on the economic variables that explain it. The study concluded that total population, total investment volume, total exports, and final consumption are among the most influential variables affecting economic growth, expressed by per capita Gross Domestic Product (GDP) in Algeria during this period. However, the other variables did not appear in the model. Finally, per capita GDP for the period (2015-2018) was forecasted.

Attou charaf ,Adjri Khira (2015)⁶: This research aims to study and analyze the determinants of economic growth in Algeria during the period 1970-2011. A set of determinants was used in line with the reality of the Algerian economy, based on modern growth theory and empirical studies. In this study, the first model relied on estimating the neoclassical production function to determine the contribution ratio of production factors to economic growth, while the second model estimated the total production function and investigated the explanatory variables for it. The study found that economic growth in Algeria is primarily a result of the contribution of capital followed by labor. Additionally, there is a positive impact of government expenditure, foreign direct investment, and real exchange rates on total productivity in the long run. As for the error correction model, the results showed a positive impact of money supply, foreign direct investment, and human capital on total productivity of production factors in the short term, with varying effects between the short and long term.

I. 2. Literature Review:

Economic Growth Concept: Economic growth is defined as the increase in the value of goods and services produced by a specific economy over a certain period of time. Economic growth is an indicator of the development and strength of the economy, usually measured by the annual growth rate of the Gross Domestic Product (GDP), which is the total cash value of all goods and services produced by a country over a specified period.

It is also defined⁷ as the expansion of production over a period preceding both in the short and medium terms. It reflects the expansion of a country's capabilities in producing goods and services desired by society, or by the continuous increase in the total GDP, which achieves an increase in the average individual's share of real national income.

Simon Kuznets defined⁸ it as a long-term increase in a country's ability to provide a wide and diverse range of goods and services increasingly to its population. François Perroux defined it as the continuous increase in the total income of the country.

From the above definitions, economic growth can be defined as the increase in national income contributing to an increase in income or the individual's share of the total national income.

Achieving economic growth is a fundamental goal for many countries, as it can lead to increased employment opportunities and improved living standards for the population. The growth rate is influenced by several factors, such as the level of investment, labor efficiency, technological innovation, government economic policies, and global conditions such as international trade and global economic fluctuations.

Types of Economic Growth⁹:

Expansive Economic Growth: This type of growth occurs when the growth of income per capita aligns with the population growth rate, meaning that the individual's share of the Gross Domestic Product (GDP) remains relatively constant and stable.

Intensive Economic Growth: In this type, the individual's share of the GDP exceeds the population growth rate. This reflects the state's ability to achieve high growth rates through optimal utilization of resources.

Measuring Economic Growth: Can be measured by the following two indicators

Gross Domestic Product (GDP)¹⁰: GDP is defined as the total value of goods and services produced and marketed within the borders of a country during a specific period, whether three months or a year. This indicator reflects the economic status of the country. An increase in production in any country reflects an improvement in its economic situation and the ability of its economy to provide more employment opportunities, thereby increasing individuals' income, consumption, savings, and investments, leading to increased production once again.

This indicator was first developed by the economist Simon Kuznets in 1934 when he estimated US output of all goods and services. This indicator reflects the level of economic performance of the country, rising in times of prosperity and declining in times of recession.

Individual Income:

Measuring individual income growth is essential for assessing economic progress and the level of prosperity in countries. An increase in per capita income reflects an improvement in the standard of living and the individual's ability to spend. The relationship between production growth and population development plays a significant role in this context, as population growth leads to increased demand for goods and services, stimulating production and contributing to

economic growth. On the other hand, economic progress leads to improvements in living, educational, and health conditions. It's worth noting that measuring economic growth through the purchasing power of the currency reflects individuals' ability to purchase goods and services, contributing to assessing the extent of economic progress and improving the community's living standards.

Economic Growth Determinants¹¹:

Public expenditure: It is considered one of the most important tools of fiscal policy as it serves as a means to supply the economy with the revenues generated by the state. It contributes significantly to increasing the economic growth rates in the country, and its impact on gross domestic product (GDP) is expected to be positive.

Trade Openness¹²: Trade openness is obtained by the ratio of total exports and imports of goods and services to the total GDP. It reflects the degree of a country's economic interdependence and its openness to the external world. Naturally, the impact of this variable on economic growth is expected to be positive.

Oil Price: It plays an important role in financing the state's general revenues as oil prices increase public revenues, which in turn reflects an increase in public spending, thereby contributing positively to economic growth rates.

II– Methods and Materials:

Study Methodology: This research utilizes the descriptive-analytical approach, which describes the study variables and analyzes their evolution over time, in addition to the standard methodology for testing the equilibrium relationship between the explanatory determinants of growth in the long run. This is done by employing the AutoRegressive Distributed Lag (ARDL) method, following the test of cointegration and the autoregressive distributed lag approach for distributed lags.

The limits of the study : Studying the determinants of economic growth in Algeria necessitates the delineation of a set number of independent variables that explain it. This is based on economic theory and previous studies in this field, as well as preliminary empirical tests conducted in this study on the Algerian economy during the period 1990-2022.

Study variables: In this regard, a number of variables were chosen as follows:

The dependent variable: is the gross domestic product (GDP), which is considered the best indicator to measure economic growth.

Independent variables :

Public expenditure(PE), Trade Openness (TO), Oil Price (OP).

III- Results and discussion :

1. Descriptive statistical indicators of study variables

From Table 01 the following can be observed:

Table 01 : Descriptive statistical indicators of study

	GDP	PE	OIL	TO
Mean	10292.94	3710532.	51.80182	5.81E+08
Median	8501.640	2453014.	45.01000	5.87E+08
Maximum	27688.90	9660000.	112.9400	7.67E+08
Minimum	554.3880	136500.0	12.85000	3.23E+08
Std. Dev.	8303.818	3056628.	32.81256	1.00E+08
Skewness	0.585070	0.388116	0.543221	-0.295957
Kurtosis	2.158796	1.596064	1.970833	2.770955
Jarque-Bera	2.855673	3.538662	3.079369	0.553882
Probability	0.239827	0.170447	0.214449	0.758099
Sum	339666.9	1.22E+08	1709.460	1.92E+10
Sum Sq. Dev.	2.21E+09	2.99E+14	34453.26	3.20E+17
Observations	33	33	33	33

Algeria achieved growth in Gross Domestic Product (GDP) during the period from 1990 to 2022, with an annual output rate of 10,992.91 billion DZD. This figure exceeded 8,501.64 billion DZD during half of the study years, with GDP values ranging from 554.38 billion DZD to 27,688.9 billion DZD throughout the study period.

Meanwhile, Algeria's spending reached 3,710,532 million DZD on an annual basis, surpassing 2,453,014 million DZD during half of the study years, with public expenditure values ranging from 136,500 million DZD to 9,660,000 million DZD during the study period.

Additionally, oil prices averaged 51.80 USD annually, exceeding 45.01 USD during half of the study years, with prices ranging from 12.85 USD to 112.94 USD throughout the study period.

The trade openness rate averaged 5.81E+08% annually, not exceeding 5.87E+08% during half of the study years, with trade openness rates ranging from 3.23E+08% to 7.67E+08% throughout the study period.

It is also noted that the Jarque-Bera test statistic for normal distribution is greater than 0.05, indicating that we accept the hypothesis of normal distribution for the asset values during the study period. The descriptive statistical indicators of the study variables.

2. Measuring the linear correlation between the study variables.

Table 02 : Linear Correlation Matrix

Correlation				
Probabili ty	GDP	PE	OIL	TO
GDP	1.000000			

PE	0.963319	1.000000		
	0.0000	-----		
OIL	0.705365	0.747664	1.000000	
	0.0000	0.0000	-----	
TO	0.007534	0.111411	0.550393	1.000000
	0.9668	0.5371	0.0009	-----

The first column of Table 02 shows the statistical significance of the correlation coefficients between Gross Domestic Product (GDP) and both public expenditure (PE) and oil prices (OIL). The p-values were found to be 0.000, indicating a significant positive linear correlation between GDP and both PE and OIL, with correlation percentages of 96.3% and 70.53%, respectively. This highlights the importance of these two indicators in determining economic growth over the last three decades. Conversely, there was no statistical significance in the correlation between GDP and trade openness (TO), as the p-value was 0.9668.

3. Time Series Stability Test

Table 03 : PP Test

UNIT ROOT TEST RESULTS TABLE (PP)					
Null Hypothesis: the variable has a unit root					
	<u>At Level</u>				
		GDP	PE	OIL	TO
With Constant	t-Statistic	3.8763	0.9845	-1.1738	-1.9161
	Prob.	1.0000	0.9954	0.6734	0.3210
		n0	n0	n0	n0
With Constant & Trend	t-Statistic	-1.1090	-2.3767	-2.1740	-1.8170
	Prob.	0.9117	0.3839	0.4872	0.6729
		n0	n0	n0	n0

Without Constant & Trend	t-Statistic	5.6082	2.2347	0.1788	0.1503
	Prob.	1.0000	0.9925	0.7315	0.7229
		n0	n0	n0	n0
		At First Difference			
		d(GDP)	d(PE)	d(OIL)	d(TO)
With Constant	t-Statistic	-5.5854	-5.3600	-4.6640	-4.3173
	Prob.	0.0001	0.0001	0.0008	0.0019
		***	***	***	***
With Constant & Trend	t-Statistic	-7.2192	-5.3665	-4.5780	-4.3747
	Prob.	0.0000	0.0007	0.0050	0.0081
		***	***	***	***
Without Constant & Trend	t-Statistic	-3.9116	-4.3512	-4.6543	-4.4391
	Prob.	0.0003	0.0001	0.0000	0.0001
		***	***	***	***

From Table 03, the p-values indicate the acceptance of the null hypothesis of the presence of a unit root at the original level for the four time series GDPt, Pet, OILt, and TOt, meaning that these series are not stationary at this level. However, after applying the first difference, we reject the unit root hypothesis as the p-values in the four well-known forms are less than 0.05 for the time series GDPt, Pet, OILt, and TOt. Therefore, they are integrated of order 1 I(1).

4. Estimation of the ARDL Model for Economic Growth in Algeria

The ARDL model explains the Gross Domestic Product (GDP) in year t as a function of its past values in previous years $GDP_{t-1}, GDP_{t-2}, \dots, GDP_{t-p}$, the current and past values of public expenditure $PE_t, PE_{t-1}, \dots, PE_{t-q_1}$, the current and past values of oil prices $OIL_t, OIL_{t-1}, \dots, OIL_{t-q_2}$, and the current and past values of trade openness $TO_t, TO_{t-1}, \dots, TO_{t-q_3}$. Thus, the ARDL equation takes the following form:

$$GDP_t = c + \sum_{i=1}^p \alpha_i GDP_{t-i} + \sum_{j1=0}^{q1} \beta_{j1} PE_{t-j1} + \sum_{j2=0}^{q2} \gamma_{j2} OIL_{t-j2} + \sum_{j3=0}^{q3} \theta_{j3} TO_{t-j3} + \epsilon_t$$

The model can be represented as follows:

$$ARDL(p, q_1, q_2, q_3)$$

The lag orders p, q_1, q_2, q_3 are determined by selecting the best models for estimation based on HQ, BIC, AIC, and the corrected coefficient of determination. Table 04 shows the best estimated models for the relationship, where the best ARDL model is of the form:

$$ARDL(4, 3, 4, 0)$$

Table 04 : The best estimated ARDL formulas for the studied relationship

Model Selection Criteria Table						
Dependent Variable: GDP						
Date: 02/11/24 Time: 14:23						
Sample: 1990 2022						
Included observations: 29						
Model	LogL	AIC*	BIC	HQ	Adj. R-sq	Specification
30	-204.411078	15.131798	15.839020	15.353292	0.997508	ARDL(4, 3, 4, 0)
29	-204.296706	15.192876	15.947246	15.429136	0.997338	ARDL(4, 3, 4, 1)

5	-204.403548	15.200245	15.954615	15.436504	0.997318	ARDL(4, 4, 4, 0)
26	-201.784488	15.226516	16.122331	15.507074	0.997089	ARDL(4, 3, 4, 4)
28	-204.267099	15.259800	16.061318	15.510825	0.997122	ARDL(4, 3, 4, 2)
4	-204.291560	15.261487	16.063005	15.512512	0.997117	ARDL(4, 4, 4, 1)
1	-201.745424	15.292788	16.235750	15.588112	0.996775	ARDL(4, 4, 4, 4)
27	-204.054224	15.314084	16.162751	15.579876	0.996906	ARDL(4, 3, 4, 3)
3	-204.266786	15.328744	16.177410	15.594536	0.996860	ARDL(4, 4, 4, 2)
2	-204.051674	15.382874	16.278689	15.663432	0.996597	ARDL(4, 4, 4, 3)
55	-212.095190	15.592772	16.252846	15.799499	0.996049	ARDL(4, 2, 4, 0)
105	-214.155816	15.596953	16.162730	15.774147	0.995981	ARDL(4, 0, 4, 0)
51	-208.383722	15.612670	16.461337	15.878462	0.995829	ARDL(4, 2, 4, 4)
101	-210.847036	15.644623	16.398993	15.880883	0.995817	ARDL(4, 0, 4, 4)
104	-213.849393	15.644786	16.257711	15.836746	0.995820	ARDL(4, 0, 4, 1)

4.1. Estimation of the Optimal ARDL Model for Economic Growth in Algeria

Table 05 shows the estimation results of the ARDL(4,3,4,0) model, which explains the GDP during the period 1990-2022.

Table 04 : ARDL model estimation results

Dependent Variable: GDP				
Method: ARDL				
Date: 02/11/24 Time: 14:36				
Sample (adjusted): 1994 2022				
Included observations: 29 after adjustments				
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): PE OIL TO				
Fixed regressors: C				
Number of models evaluated: 500				
Selected Model: ARDL(4, 3, 4, 0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.180302	0.114614	1.573129	0.1380
GDP(-2)	-0.264912	0.134150	-1.974741	0.0684
GDP(-3)	-1.168313	0.493938	-2.365304	0.0330
GDP(-4)	2.615669	0.427676	6.116004	0.0000
PE	-0.001828	0.000279	-6.558941	0.0000
PE(-1)	0.000352	0.000263	1.336104	0.2028
PE(-2)	-0.000712	0.000259	-2.749199	0.0157
PE(-3)	0.001450	0.000464	3.127874	0.0074
OIL	86.49609	7.742792	11.17118	0.0000
OIL(-1)	13.01567	10.52908	1.236163	0.2367
OIL(-2)	27.18056	10.71838	2.535883	0.0238
OIL(-3)	46.46785	19.34021	2.402654	0.0307
OIL(-4)	-87.00166	22.13755	-3.930049	0.0015
TO	-8.95E-06	1.71E-06	-5.244199	0.0001
C	5373.489	848.6370	6.331905	0.0000
R-squared	0.998754	Mean dependent var		11585.72
Adjusted R-squared	0.997508	S.D. dependent var		8032.117
S.E. of regression	400.9507	Akaike info criterion		15.13180
Sum squared resid	2250661.	Schwarz criterion		15.83902

Log likelihood	-204.4111	Hannan-Quinn criter.	15.35329
F-statistic	801.6163	Durbin-Watson stat	2.178164
Prob(F-statistic)	0.000000		

The ARDL model can be written in the following form:

$$\text{GDP} = 0.180302477703 \cdot \text{GDP}(-1) - 0.264912472358 \cdot \text{GDP}(-2) - 1.16831303271 \cdot \text{GDP}(-3) + 2.61566922642 \cdot \text{GDP}(-4) \\ - 0.00182843380947 \cdot \text{PE} + 0.00035179727331 \cdot \text{PE}(-1) - 0.000711566545473 \cdot \text{PE}(-2) + 0.00145021827685 \cdot \text{PE}(-3) + \\ 86.496090269 \cdot \text{OIL} + 13.0156658053 \cdot \text{OIL}(-1) + 27.1805615472 \cdot \text{OIL}(-2) + 46.467850811 \cdot \text{OIL}(-3) - \\ 87.0016638389 \cdot \text{OIL}(-4) - 8.95165948817 \cdot 10^{-6} \cdot \text{TO} + 5373.4888363$$

From the equation, we can interpret the following:

- The current GDP in Algeria is related to its levels in the previous four years. When these levels increase by 1 billion Algerian dinars (DZD), the GDP changes by 0.180324, -0.26491, -1.168313, and 2.61566, respectively.
- The current level of public expenditure and the levels from the previous three years show that when public expenditure increases by 1 million DZD, the GDP changes by -0.001828, 0.0003517, 0.00071156, and 0.001502, respectively.
- The current oil price and its levels in the previous four years indicate that when the price increases by 1 billion USD per barrel, the GDP is affected by 13.01567, 27.18056, 46.46785, and -87.00166, respectively.
- The current level of trade openness shows that when trade openness increases by one unit, the GDP decreases by -8.00166 E-06 billion DZD.

4.2. Cointegration Test and the Existence of a Long-Run Equilibrium Relationship

As a prerequisite before applying the Bound Test, it is necessary to verify the assumptions related to the residuals estimated from the previous ARDL model.

4.2.1. Verification of Assumptions Related to the Residuals:

The p-value from the Jarque-Bera statistical test is 0.663, indicating the acceptance of the null hypothesis that the estimated residuals (errors) follow a normal distribution.

From the Breusch-Godfrey test, the p-values for both the Fisher statistic and the Lagrange Multiplier are 0.874 and 0.725, respectively, leading to the acceptance of the null hypothesis that there is no autocorrelation in the residuals.

Based on the ARDL test, we can accept the null hypothesis of homoscedasticity of the residuals.

4.2.2. The Bound Test (F-bounds test)

The Bound Test is used to test for the existence or absence of a long-run equilibrium relationship between economic growth, expressed as Gross Domestic Product (GDP), and the independent variables. We test the null hypothesis, which states that there is no long-run equilibrium relationship among the variables in the studied relationship.

Table 05 : F-bounds test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	30.48781	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	29		Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
			Finite Sample:	

			n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Table 6 shows that the calculated F-statistic value of 30.48 is greater than the upper critical value at the significance levels of 1%, 5%, and 10%. This allows us to reject the null hypothesis (H0) and accept the existence of a long-term equilibrium relationship.

The table above illustrates the calculated value for the F-statistic test, which is 30.48, exceeding the upper critical values at all three significance levels: 10%, 5%, and 1%. This enables us to reject the null hypothesis (H0) and accept the hypothesis of a long-term equilibrium relationship between GDP, public spending, oil prices, and trade openness.

4.3. Estimation of Cointegration Relationship

Table 06 : Estimation of the long-term relationship

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PE	0.002034	0.000429	4.747466	0.0003
OIL	-237.5173	121.2179	-1.959425	0.0703
TO	2.47E-05	1.19E-05	2.079782	0.0564
C	-14813.36	7667.123	-1.932062	0.0738
EC = GDP - (0.0020*PE -237.5173*OIL + 0.0000*TO - 14813.3567)				

Table 6 shows the long-term equilibrium relationship of GDP in relation to public spending, oil prices, and trade openness. It also explains that the relationship of GDP stabilizes in the long term. This is represented by the long-term equilibrium relationship of GDP in the following form:

$$GDP_t = 0.002034PE_t - 0237.5173OIL_t + 2.47 * 10^{-5}TO_t - 14813.36$$

According to the equation, public spending and trade openness have a positive effect on GDP, while oil prices have a negative effect.

4.4. Mechanism for correcting imbalances in order to achieve a balanced state of economic growth in Algeria

After estimating the long-term equilibrium relationship using the ARDL model of the first dimension and testing for the existence of a cointegration relationship using the Bound Test, we aim here to present an error correction model for the studied relationship to understand the speed of adjustment of the discrepancies between the previously estimated relationship. Table 8 illustrates the estimation of the error correction model.

Table 07 : Estimation of the Error Correction Model

ARDL Error Correction Regression				
Dependent Variable: D(GDP)				
Selected Model: ARDL(4, 3, 4, 0)				
Case 2: Restricted Constant and No Trend				
Date: 02/11/24 Time: 14:41				
Sample: 1990 2022				
Included observations: 29				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.182444	0.111476	-10.60719	0.0000
D(GDP(-2))	-1.447356	0.136125	-10.63254	0.0000
D(GDP(-3))	-2.615669	0.305605	-8.558989	0.0000
D(PE)	-0.001828	0.000153	-11.95719	0.0000

D(PE(-1))	-0.000739	0.000178	-4.156729	0.0010
D(PE(-2))	-0.001450	0.000193	-7.515977	0.0000
D(OIL)	86.49609	5.734004	15.08476	0.0000
D(OIL(-1))	13.35325	5.750330	2.322171	0.0358
D(OIL(-2))	40.53381	6.597030	6.144252	0.0000
D(OIL(-3))	87.00166	11.70031	7.435844	0.0000
CointEq(-1)*	-0.362746	0.025911	-13.99975	0.0000
R-squared	0.941294	Mean dependent var		913.7648
Adjusted R-squared	0.908680	S.D. dependent var		1170.133
S.E. of regression	353.6053	Akaike info criterion		14.85594
Sum squared resid	2250661.	Schwarz criterion		15.37457
Log likelihood	-204.4111	Hannan-Quinn criter.		15.01836
Durbin-Watson stat	2.178164			
* p-value incompatible with t-Bounds distribution.				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	30.48781	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

The error correction model explains the dynamics through which short-term imbalances can be corrected to reach the estimated equilibrium relationship. We refer to any discrepancy between the two sides of this equation as a balance error.

$$EC = GDP - (0.0020*PE - 237.5173*OIL + 0.0000*TO - 14813.3567)$$

The estimated error correction coefficient of -0.362746 implies that this imbalance is corrected after one period by 36.274%, according to the following cointegration equation:

$$D(GDP) = 0.362746199055*(GDP(-1) - (0.00203444*PE(-1) - 237.51731877*OIL(-1) + 0.00002468*TO - 14813.35669487))$$

This equation illustrates the mechanism for correcting the short-term imbalance in relation to the estimated equilibrium position in the subsequent period by 36.27%.

IV- Conclusion:

The GDP in Algeria in the current year is related to its levels in the previous four years. When these levels increase by 1 billion DZD, the GDP changes by: 0.180324, -0.26491, -1.168313, and 2.61566, respectively.

The level of public spending in the current year and the three previous years indicates that when public spending increases by 1 million DZD, the GDP changes by -0.001828, 0.0003517, 0.00071156, and 0.001502, respectively.

The level of current oil prices and the previous four years shows that when oil prices increase by 1 billion dollars per barrel, the GDP is affected by 13.01567, 27.18056, 46.46785, and -87.00166, respectively.

The current level of trade openness indicates that when the current level of openness increases by one unit, the GDP decreases by -8.00166 E-06 billion DZD.

There is a long-term equilibrium relationship between GDP and both public spending, oil prices, and trade openness.

Public spending and trade openness have a positive effect on GDP, while oil prices have a negative effect.

From the results of estimating the equilibrium relationship, we observe a statistically significant positive relationship between public spending and GDP in the long term, where the coefficient is 0.002034 at a significance level of 0.0003, which is less than 0.05. Therefore, we reject the null hypothesis and accept the alternative hypothesis, indicating that there is a statistically significant positive effect of public spending on economic growth, as expressed by GDP. Thus, we accept the first hypothesis.

From the results of estimating the equilibrium relationship, we also observe a statistically significant positive relationship between trade openness and GDP in the long term, where the coefficient is 2.47E-05 at a significance level of 0.0003, which is less than 0.05. Therefore, we reject the null hypothesis and accept the alternative hypothesis, indicating that

there is a statistically significant positive effect of trade openness on economic growth, as expressed by GDP. Thus, we accept the second hypothesis.

However, from the results of estimating the equilibrium relationship, we find no statistically significant negative relationship between oil prices and GDP in the long term, as the coefficient is -237.5173 at a significance level of 0.0703, which is greater than 0.05. Therefore, we accept the null hypothesis and reject the alternative hypothesis, indicating that there is no statistically significant positive effect of oil prices on economic growth, as expressed by GDP. Thus, we reject the third hypothesis.

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