

Factors Influencing Economic Growth in Algeria: Analysis of the Impact of Private Sector Credit, Government Spending, and Trade Openness Using the ARDL Model.

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Summary: This study examines the factors of economic growth in Algeria, and highlights the impact of Private Credit, government spending, and trade openness on the Algerian economy. The research aims to analyze and estimate the impact of the mentioned factors on the economic growth in Algeria using the ARDL model. Annual data were collected for the period from [1980] to [2022], and analyzed using the ARDL model to estimate the relationship between private credit, government spending, trade openness, and economic growth. The results indicate that the negative impact of credit provided to the private sector on economic growth due to the failure of the Algerian banking system to support the private sector, while the increase in liquid liabilities indicates the inefficiency of channeling financial resources and the reluctance of banks to provide loans. While government spending negatively affects economic growth despite increased spending, finally, the opening of trade promotes growth but makes the Algerian economy hostage to fluctuations in oil prices. Based on these results, it is recommended to strengthening the economic environment: improving laws for property rights and anti-corruption, promoting investment in education and information technology, developing banks and financial infrastructure to promote financial inclusion and enhance confidence in the banking system.

Keywords: ARDL Model, Economic Growth, Government Spending, Private Credit Provided to the Private Sector, Trade Openness.

Jel Classification Codes : C22 ; O40; H50 ; G21 ; F13

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I- Introduction :

Algeria is a prominent example of a country that has an abundance of hydrocarbon resources and relies heavily on its export revenues, especially with regard to oil and gas, as it is considered one of the main exporters in Africa, as it ranks fourteenth globally in oil exports and sixth in gas production. Despite the fact that the Algerian government's revenues have increased significantly in recent years as a result of the constant rise in oil prices, it has failed to diversify its economic base (Chekouri et al., 2017, p. 2). The analysis of the factors of economic growth in Algeria is of great importance for understanding the challenges facing the Algerian economy and for determining effective economic policies to promote growth. In this context, the direct factors of the growth of the economy in Algeria are still unclear, empirical studies focus on institutional changes and economic policies conducive to growth. Growth performance is tied to social and political variables as the ultimate sources of economic growth. A wide range of multidimensional determinants associated with long-term economic growth exist, however, there is no consensus on the appropriate theory yet, nor an empirical framework guiding policy makers. Country-specific determinants are important for maintaining economic growth nowadays (Haouas et al., 2021, p. 2).

Algeria is witnessing important economic transformations, ranging from political fluctuations to structural changes in the global economy. Among the factors influencing economic growth in Algeria, private sector credit, government spending, and trade openness are the most important variables that need to be studied to understand the causes of growth or slowdown in the Algerian economy. In fact, according to (Mallick, 2008, p. 5) government spending as an instrument of fiscal policy can profoundly affect economic stability and growth, depending on how it is used and managed by the government. Although the standard assumption is that government spending supports economic growth, evidence suggests that it has a variety of effects that can be positive or negative on the economy. While (Raghutla, 2020, p. 1) that trade openness enhances export and import opportunities and increases employment and economic growth. Economists emphasize that trade is the main driver of growth, and there is a strong correlation between them. Countries, both developed and developing, are focusing on increasing their production, and emerging market economies are expected to become the "main engine of new demand and purchasing power growth" in the world. Moreover, (Osman, 2014, p. 1) noted that in the modern economy, an important role of Finance lies in promoting economic growth. The main idea is the necessity of a financial intermediary that connects borrowers and lenders and efficiently directs resources. This opinion emphasizes the importance of financial development in driving growth, as banks play the role of a financial intermediary that directs financial flows from parties with excess liquidity to parties in need of financing, contributing to enhanced capital formation and promoting trade.

On the basis of the above, the following main question is included: what is the impact of private sector credit, government spending and trade openness on the growth of the Algerian economy? To answer the question, hypotheses were constructed with the aim of testing their validity, namely:

- The first hypothesis suggests that an increase in private credit provided to the private sector can contribute to the strengthening of economic activity through the financing of private projects and investments. In the case of Algeria, there is a statistically significant positive relationship between increased private credit provided to the private sector and economic growth.
- It is assumed that an increase in government spending on infrastructure and public services can boost internal demand and stimulate economic growth. Hence, there is a statistically significant positive relationship between increased government spending and economic growth.
- While it is assumed that trade openness may contribute to the transfer of technology and increase foreign direct investment, leading to improved productivity and economic growth. Then, there is a statistically significant positive relationship between increased trade openness and economic growth.

For this purpose, the Autoregressive Distributed Lag (ARDL) model has been employed to analyze the impact of private sector credit, government expenditure, and trade openness on the growth of the Algerian economy. Time-series economic data available for the relevant period will be used to estimate the relationships between the various variables.

This study aims to: a) provide a comprehensive assessment of the impact of private sector credit on economic growth in Algeria. b) analyze the impact of government spending on

economic growth in Algeria and identify effective government policies. And, c) examine the impact of trade openness on economic growth in Algeria and identify relevant economic policies. In summary, this study aims to provide a good understanding of the impact of selected factors on economic growth in Algeria and to make recommendations that can contribute to promoting sustainable growth in the country.

II- Literature Review:

In the context of our review of the literature related to analyzing the impact of private sector credit, government spending, and trade openness on economic growth, we have summarized some of that literature as follows:

1. (Member et al., 2024, pp. 23–33) employed a methodology integrating the Global Development Index for data gathering and financial theory for mediation, employing the moment Generalized System method within a dynamic panel data model. Key findings reveal a positive correlation between bank credit to the private sector and economic growth in sub-Saharan Africa, both in short and long terms, albeit with mixed results in the latter. Based on these insights, recommendations advocate for the relaxation of legal reserve requirements for banks to facilitate increased credit allocation to the private sector. Additionally, it proposes the implementation of monetary policies aimed at fostering private sector financing to bolster overall economic growth in the region.
2. (Kamara et al., 2024, pp. 151–163) utilized regression analysis to examine the correlation between bank credit and economic growth specifically within Sierra Leone. It uncovered a positive association between bank credit to the private sector and economic growth in the country. Additionally, the findings highlighted the potential negative effects of high interest rates and inflation on real economic growth. To address these challenges, the study recommends the implementation of incentive policies aimed at stabilizing interest rates to foster economic growth. Furthermore, it suggests bolstering initiatives to enhance the availability of credit to the private sector as a means to further stimulate economic development in Sierra Leone.
3. (Javed & Husain, 2024, pp. 208–219) utilized the Auto-Regressive Distributed Lag (ARDL) method to explore the relationship between government spending and economic growth in Oman. It uncovered that government expenditure, personal consumption expenditure, and public debt exert negative influences on long-term economic growth in the country, while gross domestic investment showed no significant impact on long-term growth. In light of these findings, the study offers valuable insights for policymakers, suggesting the need for sustainable growth-focused policies. These recommendations could entail measures to reevaluate government spending patterns, encourage responsible consumption, and address public debt concerns, all aimed at fostering sustainable economic growth in Oman.
4. (Salifu et al., 2024, pp. 1–13) employed World Bank data to analyze Ghana's economy and assess the consequences of openness policies on financial development. It concluded that financial and trade openness exert significant long-term impacts on financial development in Ghana. Furthermore, it found that foreign investment has minimal effects, particularly in less volatile environments. In light of these findings, the study recommends prioritizing the enhancement of trade agreements and the liberalization of capital movement to foster long-term financial development. However, it advises policymakers to manage short-term effects cautiously. This approach aims to strike a balance between reaping the long-term benefits of openness policies and mitigating potential short-term risks, thereby promoting sustainable financial development in Ghana.
5. (Patel, 2022, pp. 1–10) employed unit root tests, cointegration analysis, and Granger causality tests to investigate the correlation between economic growth and financial development in India. It revealed a long-term relationship between GDP, private sector domestic credit, and government spending in the country. Furthermore, the study identified a unidirectional causal relationship from private sector domestic credit to GDP. In light of these findings, the study underscores the importance of promoting financial development as a means to bolster economic growth in India. Additionally, it recommends directing credit towards sectors that have a demonstrably positive impact on economic growth. By prioritizing these measures, policymakers can foster a conducive environment for sustained economic development in India.
6. (Keho, 2017, pp. 1–14) employed a multivariate model to investigate the influence of trade openness on economic growth specifically within Cote d'Ivoire. It revealed a positive relationship between trade openness and economic growth in both the short and long terms, particularly when coupled with capital formation. Based on these findings, the study

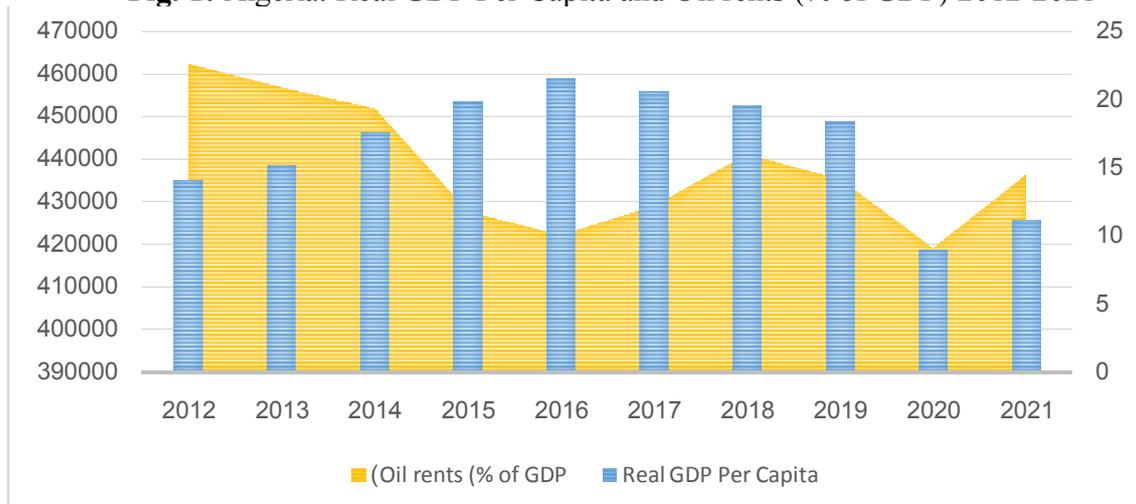
recommends the continuation of open economy policies, emphasizing the importance of expanding trade exchanges and enhancing capital formation as strategies to foster sustainable economic growth in Cote d'Ivoire.

7. (Hye et al., 2016, pp. 27–35) employed an internal economic growth model to examine the connection between trade openness and economic growth in China. It determined a positive correlation between trade openness and both short-term and long-term economic growth in the country, despite occasional negative impacts. In light of these findings, the study recommends the continuation of policies aimed at fostering trade exchange and openness in China. Additionally, it advises policymakers to design flexible policies capable of adapting to evolving economic conditions. By adopting this approach, China can sustain its economic growth momentum while effectively navigating potential challenges associated with trade openness.
8. (Ghali, 1997, pp. 165–171) employed the Barro model and vector autoregression analysis to explore the relationship between government spending and economic growth in Saudi Arabia. It found no substantial evidence supporting the notion that government spending contributes to per capita growth in the country. Consequently, the study suggests that fiscal policies should prioritize reducing the size and involvement of the government within the Saudi economy. Rather than relying on increased government spending to stimulate growth, the recommendations emphasize the importance of implementing fiscal measures aimed at diminishing the government's role. This strategic shift could foster a more efficient allocation of resources and promote sustainable economic development in Saudi Arabia.

III- Algeria: Economic Growth, Government Spending, Trade Openness, and Banking System Overview

Algeria's economy is heavily dependent on hydrocarbons for growth and revenues, and is suffering from the consequences of low oil prices, as this has led to a deterioration in the financial situation and the transformation of surpluses into a deep deficit, which significantly affects the non-hydrocarbon sector, which consists mainly of industry and services, which relies heavily on public spending financed from hydrocarbon revenues. According to the latest statistics and information on the trends of economic growth in Algeria (See [Erreur ! Argument de commutateur inconnu.](#)) from ([International Monetary Fund. Middle East and Central Asia Dept., 2023a](#); [World Bank, 2023](#)), which indicate that:

- The hydrocarbon sector accounts for 19% of GDP and 93% of product exports, contributing 38% to budget revenues between 2016 and 2021.
- Algeria aims to diversify its economy to improve employment opportunities, especially among young people, with an unemployment rate of 12.7% of the total workforce and 31.9% among young people.
- In 2021, the hydrocarbon sector experienced a growth of 3.4% as the GDP recovered from the covid-19 recession which led to a contraction of 5.1% in 2020.
- GDP growth declined during the first nine months of 2022 (+2.9% year-over-year) due to lower oil and natural gas production from the post-covid peak.
- Non-hydrocarbon GDP growth in the same period was +3.7%, supported by private consumption and reduced import volumes, as well as the recovery of agriculture, manufacturing and consumer-oriented service sectors.
- The Algerian economy is facing challenges from high inflation and the prospect of a global slowdown, with expectations of increasing policy trade-offs to achieve a balance between reducing inflation and supporting growth and purchasing power.
- Exposure to hydrocarbon price fluctuations is still high and poses an additional challenge to the Algerian economy and its future economic policy.

Fig. 1: Algeria: Real GDP Per Capita and Oil rents (% of GDP) 2012-2021

Source: <https://data.albankaldawli.org/country/algeria>

Looking at [Erreur ! Argument de commutateur inconnu.](#), we find that there has been a slight increase in GDP per capita over the years, reflecting positive economic growth. However, oil revenues gradually declined due to falling oil prices. This decline shows the importance of economic transformation from heavy dependence on Natural Resources. Thus, the situation requires strengthening the non-oil sectors to ensure the sustainability of economic growth. To ensure this, it is necessary to diversify sources of income and develop other sectors to ensure economic flexibility in the face of fluctuations in oil prices.

In a related context, and regarding the current situation of the Algerian economy, ([International Monetary Fund. Middle East and Central Asia Dept., 2023b](#)) pointed out that:

- The Algerian government sets priorities for financial reform and aims to maintain prudent and sustainable policies, as the government action plan for 2021 sets an ambitious agenda for financial reforms, focused on maintaining fiscal balances and the social role of public policies.
- Facing the weaknesses of financial reserves and the stance of fiscal policy increases the risks to macroeconomic stability in Algeria, as public finances benefit from high hydrocarbon prices but reserves are weak, making them vulnerable to fluctuations in the hydrocarbon market. For example, hydrocarbon revenues accounted for about half of the total budget revenues.
- Fluctuations in oil prices cause fluctuations in budget revenues in Algeria, where the big challenge is precisely the financial and economic management, where the normative change in hydrocarbon revenues significantly affects the fiscal policy. For example, the rise in hydrocarbon revenues in the last decade has been noticeable, accounting for about 50% of the total budget revenues.
- Economic analyses emphasize the need to strengthen the mechanisms for managing government spending in Algeria, as government spending is linked to changes in the terms of trade, which shows the need to reform fiscal policy to avoid cyclical adjustment. For example, a change in government spending is associated with a certain percentage in the growth of the Algerian economy.
- The rapid accumulation of debt causes the public finances to weaken and reduce their ability to cope with external shocks, as the rise in government debt reflects the impact of repeated external shocks and increases the need for tight fiscal adjustment plans. For example, the rise in government debt since the end of 2013 to the end of 2021 reflects frequent external shocks and the weakening of the economy.
- The difficult financial situation in Algeria requires effective measures to reform fiscal policy, including strengthening fiscal reserves and improving revenue management mechanisms, in order to enhance fiscal sustainability and maintain priority spending.

If we focus on the independent variables outlined in our study, which **Table 1** reflects their evolution during the period 2012-2022

Table 1: The evolution of the independent variables of the study

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Trade openness rate (sum of exports and imports to GDP)	65.40	63.61	62.41	59.70	55.93	55.32	58.07	51.81	45.33	53.20	59.04
Final government consumption expenditure (% of GDP)	20.32	19.14	19.53	21.56	20.89	18.95	17.26	18.34	18.79	17.42	15.48
The ratio of credit extended to the private sector to GDP	14.03	16.50	18.35	21.71	22.88	24.40	24.90	25.81	29.55	25.81	21.10
The ratio of broad money to GDP	67.95	71.73	79.31	82.00	78.88	79.33	81.58	80.54	96.01	90.94	82.90

Source: <https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS?end=2022&locations=DZ&start=2012> (Accessed 3 April 2024)

Based on the data provided in **Table 1**, we can present an analysis of the development of the independent variables in our study in the following points:

- With regard to trade openness, oil prices rose, which led to the stabilization of the rate of trade openness of Algeria, but by the beginning of 2015, oil prices deteriorated sharply, which negatively affected the Algerian economy and led to a decrease in the rate of trade openness. Between 2016 and 2021, oil prices continued to fluctuate, which affected the performance of the Algerian economy, while the rate of trade openness increased between 2018 and 2021, which suggests either a change in trade policies or an improvement in economic performance. In 2022, the rate of trade openness appeared to be stable with the continuation of global economic conditions or current trade policies in Algeria.
- Final government expenditures as a percentage of GDP: These data show the proportion of final government expenditure as a percentage of GDP for each year. The percentage of final government expenditure ranges from 15.48% in 2022 to 21.56% in 2015. There has been a gradual decrease in the percentage of final government expenditure since 2015. It should be noted that this period was marked by a significant expansion in public expenditures, with involvement in large-scale projects such as transportation, housing, infrastructure, educational structures, and others. This is attributed to the rise in oil prices, which reached record levels, leading to the restoration of internal and external balances and the control of external debt, which significantly decreased.
- Private sector credit to GDP ratio: these data reflect the percentage of credit granted to the private sector compared to GDP for each year. The percentage of private sector credit ranges from 14.03% in 2012 to 29.55% in 2020. There has been a continuous increase in this ratio from 2012 to 2020, followed by a decrease in 2021. We notice that this indicator has a low value, reflecting the weakness in the development of the Algerian banking system and its low level of involvement in providing financial and banking services to the private sector. This can be attributed to the public banks' monopoly over deposit and lending activities, and their preference for financing the public sector, especially the energy and water sectors. This has resulted in crowding out the private sector in accessing necessary financing.

- Theratio of broad money to GDP:these data show the ratio of broad money (cash, deposits, and lending) to GDP for each year.The ratio of broad money ranges from 67.95% in 2012 to 96.01% in 2020.There is an increase in this ratio from 2012 to 2020, followed by a decrease in 2021 and 2022.As for this indicator: in Algeria, the banking sector is experiencing a decline in confidence and banking habits, as a result of factors such as religious motivation. This pushes individuals to rely on other forms of savings such as gold and real estate, which affects the banking economy and hinders the public's motivation to transfer their money to deposits.

As for these last two indicators, which are related to the degree of development of the Algerian banking sector, (Zegrier et al., 2021, p. 358)pointed out that economic studies are interested in understanding the relationship between the banking sector and economic development, as the banking sector is considered a fundamental basis for the development process. The banking sector acts as a financial intermediary by collecting financial resources and transferring them to sectors with a financial deficit, while monitoring the performance of borrowers and diversifying risks. However, the banking environment in Algeria faces internal and external challenges that hinder the achievement of financial efficiency and effective development (See **Table 2**)

Table 2 : Internal and external challenges facing the Algerian banking system

Internal Challenges	External Challenges
<p>a) Control of the banking system by state-owned banks: this indicates an imbalance in the distribution of power in the banking sector, which can lead to a lack of competition and a lack of diversity and innovation in banking services.</p>	<p>a) The collapse of financial markets: this represents an external challenge that can affect the stability of the banking sector in Algeria due to the Global Link of financial markets and their impact on confidence and investment.</p>
<p>b) Unhealthy concentration of assets within the banking system: this indicates a lack of diversity in sources of income and investment in the banking system, which makes it vulnerable to risks and economic fluctuations.</p>	<p>b) Agreement on the liberalization of financial services for global trade: this represents a challenge for Algerian banks in increasing their competitiveness and adapting to international standards and requirements, which requires improving technology and efficiency.</p>
<p>c) Lack of real competition due to dependence on monopolistic status: this indicates the lack of motivation of banks to develop and improve their services, which can lead to the persistence of inefficient services and lack of innovation in the market.</p>	<p>c) International banking standards stipulated in the Basel resolutions: this is an external challenge related to the need to improve capital and strengthen banking procedures to meet international standards and reduce financial risks.</p>
<p>d) Low density and poor prevalence in the banking sector: this can indicate the difficulty of access to banking services for some of the population, which hinders economic and financial development and reduces the effectiveness of the banking system.</p>	
<p>e) Problem of non-performing loans: this problem indicates a weakness in the processes of granting and managing loans by banks, which negatively affects the liquidity of the banking system and increases credit risks and financial stability.</p>	
<p>f) The small size of the capital of publicbanks: this can lead to restrictions in the ability of banks to provide services and meet the needs of customers, which weakens their role in promoting economic development and reduces the effectiveness of the banking sector.</p>	

- g) Lack of development in the stock market: this can lead to a shortage of available financing for companies and institutions, which reduces investment opportunities and economic growth and increases the negative economic consequences.**

Source:Prepared by the authors, based on:Zegrier, A., Habib, K., & Tigane, A. (2021). Measuring indicators of the development of the banking sector in the face of obstacles to financing economic activity in Algeria during the period (2000-2019). *Journal of Al Mayadine Al Iktissadia*, 357–371. <https://doi.org/10.47179/2134-004-001-020> PP: 360-364

IV- Methodology, Result and Discussion:

For testing the hypotheses of the study, the Autoregressive Distributed Lag (ARDL) time series regression model is used, taking the following form:

$$GDPPCAP = f(PRVT, LL, GOV, TO) \dots\dots\dots (1)$$

For the description and sources of the variables contained in equation (1). The dependent variable shows the growth rate of real GDP per capita, as an appropriate measure of economic growth, and the other independent variables that explain changes in the dependent variable are listed in **Table 3**.

Table 3:Description and Sources of Study Variables

Code	Definition
GDPPCAP	GDP per capita (constant LCU):Real GDP per capita.
PRVT	Domestic credit to private sector (% of GDP).
LL	Liquid liabilities to GDP (%)
GOV	General government final consumption expenditure (% of GDP)
TO	Trade openness, i.e., the ratio of (exports + imports) to GDP.

Source:Prepared by the authors, based on:World Bank. <https://data.worldbank.org/country/algeria>

After calculating the natural logarithm of the variables mentioned above, **Table 4** illustrates the descriptive statistics for five economic variables over the period from 1980 to 2022. Each row represents a different statistical measure, such as mean, median, maximum value, minimum value, standard deviation, skewness, kurtosis, Pearson correlation, and associated probability. These statistics provide insights into the distribution and characteristics of the variables, facilitating further analysis and interpretation of economic trends.

Table 4:Descriptive Statistics of Study Variables

Series:LGDPPCAP,LPRVT,LLL,LGOV, LTO

Sample 1980 2022

Observations 43

	LGDPPCAP	LPRVT	LLL	LGOV	LTO
Mean	12.84447	-1.670232	-0.467850	-1.799548	-0.582400
Median	12.84102	-1.801938	-0.409157	-1.788675	0.581147
Maximum	13.03653	0.366554	-0.040699	-1.534314	-0.265470
Minimum	12.62394	-3.242294	-1.108486	-2.186441	-1.118267
Std. Dev.	0.128177	0.892143	0.266359	0.156024	0.188385
Skewness	-0.048924	0.044095	-0.738238	-0.643810	-0.746991
Kurtosis	1.650399	1.846800	2.733061	3.227141	3.496981
Jarque-Bera	3.280538	2.396620	4.033472	3.062955	4.441496
Probability	0.193928	0.301704	0.133089	0.216216	0.108528

Source:Prepared by the authors, based on: Outputs of EViews 13

The provided statistical table presents descriptive statistics for five economic variables spanning from 1980 to 2022. Here are some observations:

a. LGDPPCAP (Real GDP per capita):

- The mean Real GDP per capita fluctuates moderately between 12.62394 and 13.03653.

- The skewness and kurtosis values indicate a relatively balanced distribution, with Jarque-Bera test suggesting a distribution close to normal.

b. LPRVT (Domestic credit to private sector (% of GDP)):

- LPRVT ranges from -3.242294 to 0.366554, with an average of approximately -1.67.
- Skewness and kurtosis values suggest a relatively balanced distribution.

c. LLL (Liquid liabilities to GDP (%)):

- LLL exhibits a relatively diverse distribution, ranging between -1.108486 and -0.040699.
- The high kurtosis value suggests clustering of values around a specific point.

d. LGOV (General government final consumption expenditure (% of GDP)):

- LGOV ranges from -2.186441 to -1.534314, with an average of approximately -1.80.
- Skewness and kurtosis values suggest a relatively balanced distribution.

e. LTO (Trade openness):

- LTO shows a diverse distribution with values ranging between -1.118267 and 0.581147.
- Skewness and kurtosis values indicate a relatively balanced distribution.

In the context of examining the correlation between study variables and analyzing the relationship between them, Table 5 appears are the correlation coefficients between the variables LGDPPCAP, LPRVT, LLL, LGOV, and LTO:

Table 5: The Correlation Between Study Variables

	LGDPPCAP	LPRVT	LLL	LGOV	LTO
LGDPPCAP	1.000	0.237	0.737	0.167	0.448
LPRVT	0.237	1.000	0.685	0.224	-0.290
LLL	0.737	0.685	1.000	0.389	-0.076
LGOV	0.167	0.224	0.389	1.000	-0.494
LTO	0.448	-0.290	-0.076	-0.494	1.000

Source: Outputs of EViews 13

The correlation coefficients between the variables LGDPPCAP, LPRVT, LLL, LGOV, and LTO indicate various degrees of linear relationship. LGDPPCAP exhibits a strong positive correlation with LLL (0.737), while it demonstrates moderate positive correlations with LTO (0.448) and weak positive correlations with LPRVT (0.237) and LGOV (0.167). LPRVT displays a strong positive correlation with LLL (0.685) and weak positive correlations with LGDPPCAP (0.237) and LGOV (0.224), but a weak negative correlation with LTO (-0.290). LLL has a moderate positive correlation with LGOV (0.389) and very weak negative correlation with LTO (-0.076). LGOV exhibits a moderate negative correlation with LTO (-0.494). These correlations suggest potential patterns and dependencies between the economic variables, such as the association between real GDP per capita and liquid liabilities to GDP, and the inverse relationship between domestic credit to the private sector and trade openness.

Based on equation (1), an ARDL model will be estimated according to the following equation:

$$\Delta LGDPPc_t = c + \sum_{i=1}^p \beta_{1i} \Delta LGDPPCAP_{t-i} + \sum_{i=0}^{q_1} \beta_2 \Delta LPRVT_{t-i} + \sum_{i=0}^{q_2} \beta_3 \Delta LLL_{t-i} + \sum_{i=0}^{q_3} \beta_4 \Delta LGOV_{t-i} + \sum_{i=0}^{q_4} \beta_5 \Delta LTO_{t-i} + \alpha_1 LGDPPCAP_{t-1} + \alpha_2 LPRVT_{t-1} + \alpha_3 LLL_{t-1} + \alpha_4 LGOV_{t-1} + \alpha_5 LTO_{t-1} + \varepsilon_t \dots (2)$$

- Δ : Refers to first-order differences.
- L : Natural logarithm.
- c : The constant term.
- p, q_1, q_2, q_3, q_4 : The maximum lag length for the successive time delays of variables.
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$: The short-term relationship coefficients (error correction).
- $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$: The long-term relationship coefficients.
- t : Time trend.
- ε_t : Random error limit.

After applying regression to Equation (2), the Wald test (F-statistic) was conducted to discern the long-term relationship among the variables under consideration. The null and alternative hypotheses are outlined as follows:

- $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5$ (no long-run relationship).
- $H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5$ (a long-run relationship exists).

The calculated F-statistic value will be compared against the critical values listed in Table CI (iii) of (Pesaran et al., 2001, pp. 303–304) for evaluation. To estimate an ARDL model, the steps outlined by (Giles, 2013) are followed, where:

- Ensuring none of the variables are integrated of order two I (2) as this violates the methodology of the ARDL model.
- Formulating an Error Correction Unrestricted Model (UECM), which is a special type of ARDL model.
- In the second step, identifying the sufficient lag structure period for the model.
- Ensuring that the model errors are serially independent.
- Confirming the dynamic stability of the model.
- Conducting the Bounds Test to see if there is evidence of a long-term relationship between the variables.
- If the result is positive in step 6, estimating the long-term relationship "model levels", as well as separating the Error Correction Unrestricted Model (UECM).
- Using the estimated model results in step 7 to measure the dynamics of short-term relationship effects, and the long-term equilibrium relationship between the variables.

Before starting the estimation of the ARDL model and analyzing its results, it is necessary to conduct some basic tests to assess the validity of the data used in the analysis for such a model, given the estimation period of 33 years. This can be done as follows:

1) Unit Root Test (Time Series Stationarity):

The purpose of the unit root test is to examine the characteristics of the time series for all variables included in equation (1) and their logarithmic values, in order to ensure the stability of the time series data. If these series are found to be non-stationary or stationary at second-order differences, then we face a problem in estimating the ARDL model. Despite the variety of unit root tests available, the researcher will use the Augmented Dickey-Fuller test, as discussed earlier. **Table 6** illustrates the results of this test.

Table 6: Results of Unit Root or Stationary Tests

Variables	LOSC	Level		The first difference		Decision
		ADF test statistic	Prob.*	ADF test statistic	Prob.*	
LGDPPCAP	4	-1.6746	0.74443	-3.8906***	0.0002	I (1)
LPRVT	1	-1.1478	0.8356	-5.2798***	0.0000	I (1)
LLL	1	-1.4350	0.0564	-5.2645***	0.0001	I (1)
LGOV	2	-2.8752**	0.0570	-4.3735	0.0002	I (0)
LTO	1	-3.0787	0.1247	-5.5689***	0.0000	I (1)

Source: Author's calculation based on: Outputs of EViews 13

Note: Assuming the hypothesis of non-stationarity in time series, i.e., containing a unit root. The rejection of the non-stationarity hypothesis is based on MacKinnon (1996) values, according to the SIC criterion, where *, **, and *** indicate rejection of the non-stationarity hypothesis at significance levels of 10%, 5%, and 1%, respectively.

Selecting the optimal lag lengths for the variables in estimating an ARDL model **Erreur ! Argument de commutateur inconnu. Erreur ! Argument de commutateur inconnu.** illustrates the selection of optimal lag periods. p, q_1, q_2, q_3, q_4 . Where Selected model: ARDL (1,0,2,1,1).

2) Estimation of the long-term relationship form of the ARDL model

From [Appendix 2](#) we note that:

- The logarithm of the ratio of credit provided to the private sector to GDP: has negatively affected economic growth in the long term, but is statistically insignificant (0.6246), where an increase in this indicator by about 1% leads to a decrease in real GDP per capita by 1.55%.
- The logarithm of liquid liabilities to gross domestic product has had a positive impact on long-term economic growth and is statistically significant (0.0832), where an increase of this indicator by about 1% leads to an increase in real GDP per capita by 24.33%.
- The logarithm of government spending to GDP: -However, after a period of slowdown - has had a positive impact on long-term economic growth and is statistically significant (0.0903), where an increase of this indicator by about 1% leads to an increase in real GDP per capita by 22.67%.
- The logarithm index of trade openness to GDP: - but after one delay-has positively affected long-term economic growth and is statistically significant (0.0003), where an increase of this indicator by about 1% leads to an increase in the per capita share of the real GDP by 79.05%.

3) Estimation of the Error Correction Model (ECM) and the short-run relationship, and the long-run relationship form for the ARDL model

From [Appendix 3](#), the results of the error correction model indicate that the coefficient of error correction speed reveals the speed (or slowness) of variables returning to equilibrium state, and this coefficient should be statistically significant and negatively signed to detect the presence of cointegration among variables. The absolute value of the coefficient of error correction speed indicates the speed of returning to equilibrium state, and the negative sign indicates short-term convergence of the dynamic model. The negative and statistically significant coefficient associated with error correction speed is a more effective means of indicating common integration. In this model, the coefficient value of error correction speed, $\text{CoinEq}(-1)$, which signifies the speed of error correction, is approximately 19.43%, and it is negative and has a highly acceptable statistical significance at the 1% level (0.0000). This means that about 19.43% of deviations and imbalances in economic growth equilibrium in the previous year are corrected in the current year, reaching equilibrium in slightly more than 5 years. This indicates that adaptation in the model was relatively slow.

4) Detecting the presence of autocorrelation among the estimation residuals

In this regard, it is important for the model errors to be serially independent. If this is not the case, the parameter estimates are not consistent (due to the lagged values of the dependent variable appearing as regressors in the model). Therefore, two tests are used:

- The first one, the Breusch-Godfrey Serial Correlation LM Test, is used to test for the presence of autocorrelation.
- The second one, the Heteroskedasticity Test: Breusch-Pagan-Godfrey, is used to test for heteroskedasticity.
- From [Appendix 4](#), the results of the first test show that the p-value for the statistic $\chi^2(2)$ is greater than 0.05, indicating that $\text{Obs} * R - \text{squared} < \chi^2(2)$. Therefore, we accept the hypothesis of no autocorrelation between errors.
- From [Appendix 5](#), the results of the second test show that the p-value for the Fisher statistic is greater than 0.05, and $\text{Obs} * R - \text{squared} < \chi^2(9)$. Therefore, we accept the null hypothesis: the absence of heteroscedasticity.

5) The Bounds Test for the ARDL Model

[Appendix 6](#) indicated the estimation results of the ARDL model are shown.

From [Appendix 7](#) and [Appendix 8](#), the statistical value of F for the Bounds Test is 8.0392, which clearly exceeds even the critical value at the 1% level for the upper bound. Consequently, the null hypothesis of "no long-run relationship between the variables" is strongly rejected.

6) ARDL Model Stability Test

According to (Dalila, 2014, pp. 291–292) to ensure the absence of any structural changes in the data used in this study, it's essential to employ appropriate tests such as Cumulative Sum of Residuals (CUSUM) and Cumulative Sum of Squares of Residuals (CUSUM of Squares). These tests are vital as they reveal two significant aspects indicating any structural changes in the data and the degree of stability and coherence between long-term and short-term parameters. Numerous studies have consistently found these tests to be associated with the Autoregressive Distributed Lag (ARDL) methodology. Therefore, the structural stability of the estimated parameters for the error correction formula of the ARDL distributed lag regression model is confirmed. If the graphical representation of the CUSUM and CUSUM of Squares tests falls within critical bounds at a 5% significance level, it implies that the error curve falls within a range of two standard deviations ($\pm 2S$). Rejecting the null hypothesis at a 5% significance level indicates that the parameters remain stable throughout the study period. From the provided graph in [Appendix 9](#), it is evident that the Cumulative Sum of Residuals (CUSUM) for this model follows a central line within the critical region boundaries, indicating the model's stability at a 5% significance level. Similarly, the Cumulative Sum of Squares of Residuals (CUSUM of Squares) forms a central line within the critical region boundaries. These tests suggest that there is stability and coherence in the model between the long-term and short-term period results.

V- Conclusions and Recommendations:

This study aimed to analyze the factors of economic growth in Algeria using the ARDL model, focusing on the impact of private sector credit, government spending, and trade openness. Based on the analysis using the ARDL model of the factors affecting economic growth in Algeria, it becomes clear that there are several factors that significantly affect economic growth:

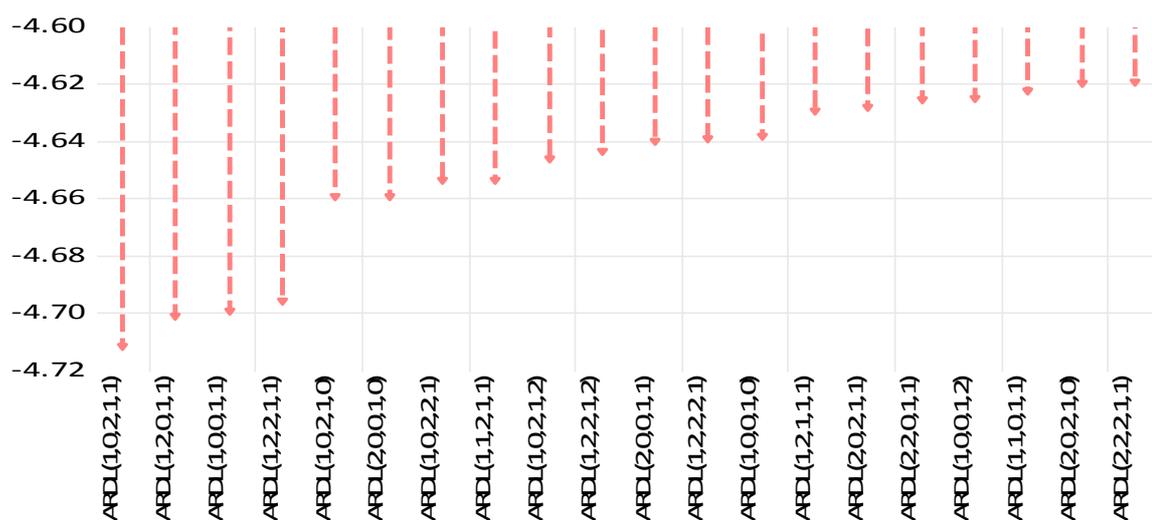
- a) **The logarithm of the ratio of credit provided to the private sector to gross domestic product (GDP):** has had a negative impact on economic growth. This reflects the underdevelopment of the Algerian banking system and its limited involvement in providing financial and banking services to the private sector. This can be attributed to the monopoly of public banks over deposit and lending activities, and their preference for financing the public sector, especially the energy and water sectors. This has led to a kind of displacement of the private sector in accessing the necessary funding.
- b) **The logarithm of the liquid liabilities ratio to gross domestic product (GDP):** has had a positive but weak impact on economic growth in Algeria, for several reasons. Firstly, the Algerian economy suffers from the problem of off-bank trading, depriving it of additional financial resources to fund productive investments. Secondly, the issue of liquidity surplus indicates inefficiency in allocating financial resources and banks' reluctance to provide loans to economically viable projects, thus diminishing their role in stimulating economic growth.
- c) **The logarithm of government spending to gross domestic product (GDP):** indicates that economic growth was negatively influenced by government spending, both in the short and long term, despite previous forecasts. This is due to the significant expansion of government expenditures, especially since 2001, reflecting the Keynesian approach adopted by the government in public spending. According to this approach, government spending is a stimulus for the national economy, therefore any increase in government spending necessarily leads to an increase in economic growth, which contributes to reducing unemployment rates. This is embodied by investments in major projects such as transport, housing, infrastructure, education, as well as wage increases for workers and employees. This success is partly due to the rise in oil prices.
- d) **The logarithm of trade openness, i.e., the ratio (exports + imports) to gross domestic product (GDP):** has positively affected economic growth in the long term, because the high impact of this indicator, supported by the rise in oil prices on World Markets, has contributed to an increase in oil revenues, part of which the government has directed towards financing economic recovery programs as mentioned above and the resulting benefits. Despite these benefits, there are costs in the fact that the Algerian economy's dependence on petroleum exports, which accounted for about 97% of total exports, and the resulting oil rent revenues as a source of financing its activities, makes this economy hostage to fluctuations in oil prices on world markets.

In conclusion, we present the following recommendations:

- Strengthening the macroeconomic environment and investment climate through the development of legislation and laws, focusing on property rights and eliminating administrative corruption to increase investor confidence and strengthen economic infrastructure, especially in the banking sector and transportation.
- Promote investment in human capital to build qualified and trained human resources on technical means, and create a competitive environment that fights brain drain.
- Creating an appropriate banking environment and developing institutional governance to build confidence in the banking system, in addition to increasing transparency and disclosure.
- Developing the Islamic banking environment to attract savings and reduce cash circulation outside banks.
- Modernizing and developing the process of investing in human capital in banks through training and improving the banking services provided to the public, commensurate with the requirements of comprehensive banking and effective risk management.
- Promoting Financial Inclusion aims to make financial services accessible to all, including low-income groups and remote areas, through the development of infrastructure and the use of financial technology. This promotes economic growth and contributes to sustainable development, providing innovative and low-cost financial solutions to meet the needs of non-banking people and remote areas.

Appendices:

Appendix 1 : Selecting the optimal lag lengths for the variables in estimating an ARDL model Schwarz Criteria (top 20 models)



Source: Outputs of EViews 13

Appendix 2: The long-term relationship form of the ARDL model

Deterministics: Rest. constant (Case 2)

$$CE = LGDPPCAP (-1) - (-0.015472 * LPRVT + 0.243334 * LLL (-1) + 0.226866 * LGOV (-1) + 0.790576 * LTO (-1) + 13.823103)$$

Cointegrating Coefficients

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LPRVT	-0.0155	0.0313	-0.4936	0.6246
LLL(-1)	0.2433	0.1366	1.7814	0.0833
LGOV(-1)	0.2269	0.1304	1.7402	0.0904
LTO(-1)	0.7906	0.1958	4.0368	0.0003
C	13.8231	0.3054	45.2562	0.0000

Source: Outputs of EViews 13

Appendix 3 :Error Correction

Dependent Variable: D(LGDPPCAP)

Method: ARDL

Date: 04/15/24 Time: 09:33

Sample: 1982 2022

Included observations: 41

Dependent lags: 2 (Automatic)

Deterministics: Restricted constant and no trend (Case 2)

Model selection method: Schwarz criterion (SIC)

Number of models evaluated: 162

Selected model: ARDL (1,0,2,1,1)

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.194292	0.025960	-7.4843477	0.0000
D(LLL)	0.061007	0.026170	2.3312225	0.0255
D(LLL(-1))	0.068946	0.022223	3.1025138	0.0037
D(LGOV)	-0.112448	0.037036	-3.0361443	0.0044
D(LTO)	0.060481	0.031169	1.9404643	0.0602
R-squared	0.675485	Mean dependent var		0.004988
Adjusted R-squared	0.639428	S.D. dependent var		0.025923
S.E. of regression	0.015566	Akaike info criterion		-5.373585
Sum squared resid	0.008723	Schwarz criterion		-5.164613
Log likelihood	115.158498	Hannan-Quinn criter.		-5.297489
F-statistic	18.733692	Durbin-Watson stat		2.144546
Prob(F-statistic)	0.000000			

* p-values are incompatible with t-Bounds distribution.

Source:Outputs of EViews 13

Appendix 4 : The results of the model's linear correlation test

Breusch-Godfrey Serial Correlation LM Test:

Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.216666	Prob. F(2,29)	0.8065
Obs*R-squared	0.603622	Prob. Chi-Square(2)	0.7395

Source : Outputs of EViews 13

Appendix 5 : The results of the model's test for heteroscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoskedasticity

F-statistic	1.221857	Prob. F(9,31)	0.3176
Obs*R-squared	10.735728	Prob. Chi-Square(9)	0.2943
Scaled explained SS	9.153602	Prob. Chi-Square(9)	0.4232

Source : Outputs of EViews 13

Appendix 6 : Estimation of the ARDL model**Dependent Variable: LGDPPCAP****Method: ARDL****Date: 04/15/24 Time: 07:44****Sample: 1982 2022****Included observations: 41****Dependent lags: 2 (Automatic)****Automatic-lag linear regressors (2 max. lags): LPRVT LLL LGOV LTO****Deterministics: Restricted constant and no trend (Case 2)****Model selection method: Schwarz criterion (SIC)****Number of models evaluated: 162****Selected model: ARDL (1,0,2,1,1)****HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LGDPPCAP (-1)	0.80571	0.04331	18.60312	0.00000
LPRVT	-0.00301	0.00680	-0.44195	0.66159
LLL	0.06101	0.04186	1.45752	0.15503
LLL (-1)	0.05522	0.04825	1.14446	0.26119
LLL (-2)	-0.06895	0.02002	-3.44469	0.00166
LGOV	-0.11245	0.03997	-2.81318	0.00844
LGOV (-1)	0.15653	0.04126	3.79322	0.00065
LTO	0.06048	0.03666	1.64986	0.10907
LTO (-1)	0.09312	0.02983	3.12136	0.00388
C	2.68571	0.56289	4.77128	0.00004
R-squared	0.98716	Mean dependent var		12.84793
Adjusted R-squared	0.98343	S.D. dependent var		0.13033
S.E. of regression	0.01677	Akaike info criterion		-5.12968
Sum squared resid	0.00872	Schwarz criterion		-4.71174
Log likelihood	115.15850	Hannan-Quinn criter.		-4.97749
F-statistic	264.85800	Durbin-Watson stat		2.14455
Prob(F-statistic)	0.00000			

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

Source: Outputs of EViews 13

Appendix 7 :Bounds Test**Null hypothesis: No levels relationship**

Number of cointegrating variables: 4

Trend type: Rest. constant (Case 2)

Sample size: 41

Test Statistic	Value
F-statistic	8.039256

Source : Outputs of EViews 13

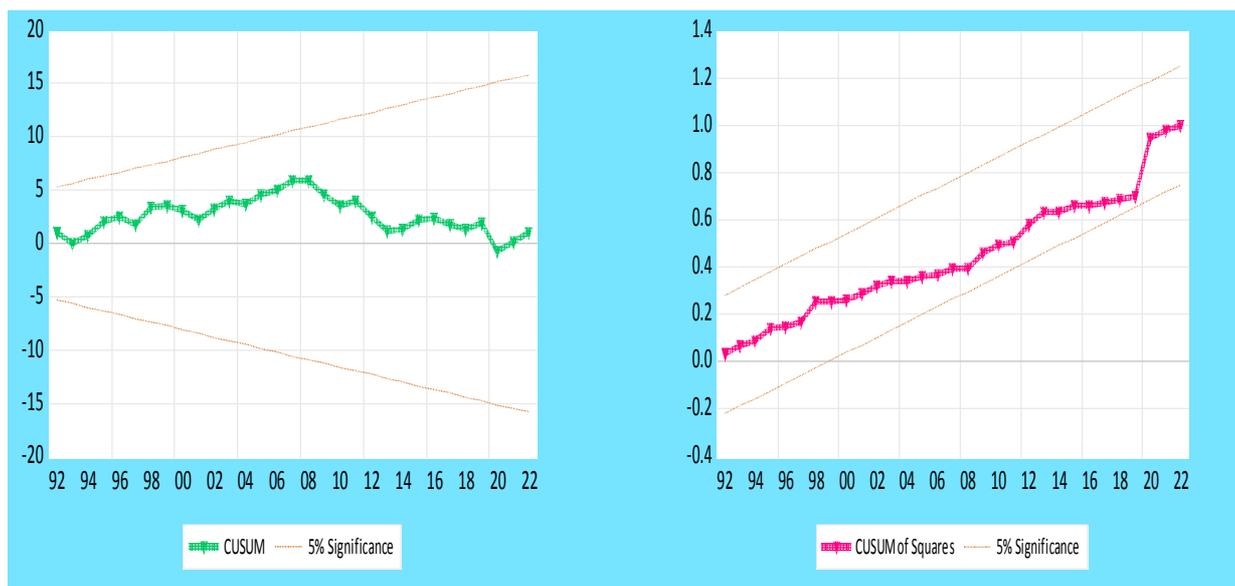
Appendix 8 :Bounds Critical Values

Sample Size	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
40	2.427	3.395	2.893	4	3.967	5.455
45	2.402	3.345	2.85	3.905	3.892	5.173
Asymptotic	2.2	3.09	2.56	3.49	3.29	4.37

*** I(0) and I(1) are respectively the stationary and non-stationary bounds.**

Source:Outputs of EViews 13

Appendix9: Plot of Cumulative Sum of Recursive Residuals Plot of Cumulative Sum of Squares of Recursive Residuals



Source: Outputs of EViews 13

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