

The Impact of Trade Openness on Economic Growth in Algeria: A Regression Study using the autoregressive distributed lag model (ARDL) over the Period 1990-2022

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Received: 14/04/2026

Accepted: 20/05/2026

Published: 05/06/2026

Abstract :

This study aims to analyse the impact of trade openness on economic growth in Algeria during the period 1990-2022, in light of global economic shifts and the dominance of the hydrocarbon sector in the productive structure. The study used gross domestic product as an indicator of economic growth, trade openness and oil prices as explanatory variables, using the autoregressive distributed lag (ARDL) model and the error correction model (ECM) to analyse the relationship in the short and long term. The results showed a long-run cointegration relationship between them, as well as a positive and significant effect of oil prices on economic growth, while the effect of trade openness was positive but not significant. In the short term, the results showed a positive and significant effect for both trade openness and oil prices. The study concludes that the impact of trade openness in Algeria remains limited and linked to weak economic diversification, which calls for complementary policies to promote exports and diversify productivity.

Keywords: Trade openness, Economic growth, Algeria, autoregressive distributed lag (ARDL) model.

JEL Classification : F43, O47, C32

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Introduction :

The relationship between trade openness and economic growth has received widespread attention in the economic literature, with classical and modern schools of thought addressing this relationship from multiple angles, highlighting the positive and negative effects of trade openness on economic performance. Classical theories, such as the works of Adam Smith and David Ricardo, have emphasised that trade openness promotes specialisation and division of labour, achieves a more efficient resource allocation, and raises productivity and national income through market expansion and mutual gains. The Hicks-Ohlin model focused on the role of factor endowments in determining countries' comparative advantage, emphasising that trade openness stimulates economic growth by improving resource allocation

and stimulating domestic and foreign investment. From an endogenous growth theory, recent studies, such as the works of Romer, Lucas, Grossman and Helpman, have highlighted the role of trade openness in accelerating technology transfer, spreading knowledge and promoting innovation, leading to faster growth and greater economic sustainability.

However, some schools of thought have warned of the potential risks of trade openness, especially in developing countries, where it can deepen economic dependence and harm emerging domestic industries. Studies by Prebisch and Frederick List have highlighted the need for temporary protection of national industries to cope with international competition. It is therefore clear that the relationship between trade openness and economic growth remains contingent on a number of institutional and structural conditions, including institutional efficiency, stability of economic policies and diversification of the productivity base.

Empirically, international studies have shown that trade openness often contributes positively to economic growth, either by boosting exports or attracting foreign investment, as demonstrated by early studies (Emery, 1967), (Balassa, 1978), (Sachs & Warner, 1995), and Dollar & Kraay, 2000) (in addition to recent studies in various regions such as Central and Eastern Europe, ASEAN, and the Mediterranean countries). As for the Algerian experience, the results of various local studies have shown varying effects of trade openness on growth. Some studies have shown a positive and statistically significant relationship (Mezenner&Saidj, 2023), (Djadli, 2023), while others have shown a limited or negative impact in the long term due to the Algerian economy's dependence on hydrocarbons and weak productivity diversification ((Aouarandal.,2021; Karima Habib and al., 2024)

In this context, this study aims to analyse the impact of trade openness on the Algerian economy's economic growth during the period 1990–2022, using the autoregressive distributed lag (ARDL) model and the error correction model (ECM) to estimate the relationship between trade openness, oil prices and gross domestic product. The study focuses on assessing the short- and long-term effects of trade openness, highlighting the role of the productive structure and oil resources in determining the extent to which Algeria benefits from trade policies, in order to provide policy and economic recommendations based on accurate results that support sustainable growth.

Based on the above, this research paper seeks to answer the following question: **What is the nature of the impact of trade openness on economic growth in Algeria during the period 1990-2022?**

Methodology

The study adopted a descriptive and analytical approach in its theoretical aspect, presenting and analysing various theoretical and empirical economic literature on the relationship between trade openness and economic growth, with a

focus on the specificities of the Algerian economy. On the applied side, a standard approach was employed based on annual time series for the period 1990–2022, using the autoregressive distributed lag (ARDL) model and the error correction model (ECM).

Significance of the study: This study is significant in two main dimensions: theoretical and practical. Theoretically, it contributes to enriching the economic literature on the impact of trade openness on economic growth, especially with regard to developing rentier economies, for which the results of studies remain inconclusive. From a practical point of view, the study is important in that it provides recent empirical results on the Algerian economy that can be used by decision-makers to evaluate policies on trade openness and develop alternative strategies aimed at diversifying productivity and promoting exports outside the hydrocarbon sector, thereby achieving more sustainable economic growth.

Structure of the study: The study is divided into two main sections: the first section is devoted to the theoretical framework and previous studies, presenting and analysing the theoretical and empirical literature on trade openness and economic growth, with a focus on studies specific to the Algerian economy. The second axis addresses the practical aspect by presenting the standard methodology, estimating the model using the autoregressive distributed lag (ARDL) method with its various tests, and analysing the results in the short and long term.

I. Study Literature

1. Theoretical Literature

The relationship between trade openness and economic growth has received widespread attention in economic literature, with various classical and modern schools of thought offering multiple perspectives on the potential effects of this openness on economic growth and addressing the relationship between the two from multiple angles, adding a rich and multidimensional theoretical dimension to the subject.

Classical theory was one of the first theoretical frameworks to address this relationship, with Smith (1776) pointing to the impact of trade openness in creating opportunities for specialisation and division of labour and channelling surplus production to countries where specialisation and division of labour are lacking, thereby expanding the market and increasing productivity (Smith, 1776). Ricardo (1817) also believed that trade allows countries to specialise in the production of goods in which they have a comparative advantage, enjoying a lower opportunity cost regardless of the abundance of resources, leading to the efficient use of resources, mutual gains and, consequently, an increase in output and income (Ricardo, 1817). This concept was later expanded upon by the Heckscher-Ohlin model (Heckscher & Ohlin, 1933) which developed a more comprehensive framework and provided an important extension of the concept of comparative

advantage, reinterpreting it on the basis of the abundance of production factors (capital and labour in particular), whereby countries specialise in the production and exports of goods that make intensive use of their abundant factor, and import goods for which they lack productive factors. In other words, differences in productive structure and factors of production generate comparative advantages between countries. According to this model, trade openness is a catalyst for economic growth by achieving a more efficient resource allocation, raising productivity, expanding markets, and stimulating domestic and even foreign investment (Heckscher.E. F, 1933). On the other hand, the new classical growth theory (neoclassical school), developed by Solow (1956), suggests that trade openness does not necessarily lead to increased growth in the long term unless it is accompanied by external technological progress. However, it can contribute to raising income and productivity levels by improving resource allocation and accumulating physical and human capital (Solow, 1956). As for endogenous growth theories, as proposed by (Romer, 1986), (Lucas, 1988), and (Grossman & Helpman, 1991) have highlighted the role of trade openness in stimulating economic growth through deeper channels (Romer, 1986), such as technology transfer, the spread of knowledge and innovation, and increased efficiency in resource allocation (Lucas, 1988).

These theories also emphasise that trade-open countries tend to achieve faster growth as a result of their involvement in global value chains, which helps them achieve structural transformation and sustainable growth, especially when accompanied by effective industrial policies and skills development (Grossman, 1991).

On the other hand, in order for the theoretical basis to be balanced, opposing intellectual views that warn of the potential negative effects of trade openness must also be presented. A number of intellectual schools have offered critical perspectives warning of its dangers. The first of these was the mercantilist school, which warned against unequal trade openness because it leads to a drain on national wealth (precious metals, which were considered the path to power) and called for state intervention to protect national industry. Friedrich List (1841) also called for temporary protection for emerging industries because, in his view, trade openness with developed countries would destroy weak industries in developing countries (List, 1841). This was confirmed by Prebisch (1950), who believed that trade openness deepens the imbalance in trade relations between developed and developing countries due to unequal terms of exchange, leading to a loss of control over strategic sectors and, consequently, a loss of economic sovereignty, which further deepens economic dependency (Prebisch, 1950).

In conclusion, it can be said that theoretical analysis has revealed differing views on the impact of trade openness on economic growth. While many theories emphasise gains in economic efficiency, critical and opposing views point to weaknesses, leading us to conclude that the relationship between trade openness and economic growth remains subject to a number of accompanying conditions,

such as institutional efficiency, stability of macroeconomic policies, adequate infrastructure, and the availability of human capital. Unregulated openness can lead to negative effects, including deepening external dependency and harming emerging local industries that may not be able to withstand fierce foreign competition. Therefore, many studies emphasise that achieving the desired benefits of trade openness requires a sound institutional environment and sustainable policies that enhance the competitiveness of local economies.

2. Empirical studies

The 1960s and 1970s saw the emergence of the first empirical studies addressing the relationship between trade openness and economic growth. Emery (1967) found a relationship with statistical significance between export growth and per capita GDP growth in a simple empirical study of a sample of 50 countries over a limited period (1953-1963) (Emery, 1967). Subsequently, Balassa (1978) presented a study of a number of developing countries in which he confirmed the hypothesis of export-led growth, showing that exports are a major driver of economic growth when combined with supportive economic policies (Balassa, 1978). Tyler (1981) expanded the scope of the analysis to include a sample of 65 developing countries during the period 1960-1977, proving that there is a strong relationship between export growth and overall economic growth (Tyler, 1981). In the same context, we mention the study by Sachs & Warner (1995), which is one of the first quantitative analyses to use an official index that classifies countries as 'open' and "closed" on a large sample (117 countries) during the period 1970-1989. The study concluded that there was a strong and consistent effect of trade openness on cross-sectional growth rates in favour of open countries (Sachs, 1995). The study by Dollar & Kraay (2000) focused on comparing the performance of countries that increased their trade openness after 1980 with those that did not, using data on the evolution of trade-to-output ratios and economic growth over a long period of time. The result was that countries such as China, India and others experienced accelerated growth from 2.9% in the 1970s to 5% in the 1980s and 1990s, while the growth rates of other developing countries declined from 3.3% to 1.4% during the same period. (Dollar, 2000)

These early studies laid the foundations for subsequent research that was more in-depth in terms of the measurement tools and methodologies used, providing a more comprehensive understanding of the role of openness in driving growth. Many recent foreign studies have addressed the relationship between trade openness and economic growth from multiple angles, drawing on advanced economic models and diverse geographical environments, providing a solid basis for understanding the potential impact of trade openness in different contexts. These studies can be summarised as follows:

A study by (Bardi & Hfaiedh, 2021) focuses on the Mediterranean region (Mediterranean countries) and aims to clarify the relationship between trade openness and growth in eight Mediterranean countries during the period from 1975

to 2016. The researchers used the autoregressive distributed lag (ARDL) model for cross-sectional data (panel). The study concluded that trade openness, human capital and investment rates all contribute positively to economic growth, and highlighted the importance of free trade agreements with the European Union in promoting economic convergence among these countries. (Bardi, 2021)

Sowrov (2024) conducted an empirical study on 11 G20 countries, analysing the relationship between trade openness (measured by the ratio of trade to GDP), the tariff rate, and economic growth. He used ordinary least squares (OLS) regression analysis and a fixed-effects panel data model, (Fixed-effects Panel Regression), in addition to studying reverse causality (Endogeneity). The results showed a statistical significant positive relationship between trade openness and economic growth, while tariffs had a negative effect. However, its focus on major economies may weaken its generalizability to developing economies. (Sowrov, 2024)

In the European context, (Garncarz, 2024) the impact of trade openness on economic growth after the transition from a socialist to a market economy in eight Central and Eastern European countries during the period 1995-2022, using Pearson's linear correlation coefficient and a simple linear regression model based on macroeconomic data. The study demonstrated a strong relationship between openness and growth after these countries joined the European Union, reinforcing the hypothesis of integration as a tool for growth in the post-transition phase. (Garncarz, 2024)

In a case study of Turkey, (Al Jubouri, Al Azzawi, & Al Jubouri, 2024) presented an econometric analysis of the impact of trade openness on economic growth in Turkey during the period 1990-2022, using the autoregressive distributed lag (ARDL) model. The results concluded that there was a positive impact in the short and long term, noting the need to diversify the industrial base and support value-added and export-oriented sectors in order to achieve a trade surplus. (Al-Jubouri, 2024)

In a study on ASEAN, (Yaqin & Sulistyono, 2024) assessed the impact of economic trade openness on economic development in ASEAN countries during the period 2013–2022, using panel cross-sectional data, and showed that exports and foreign direct investment support economic growth, while imports had a negative impact on economic growth, as was the case with inflation. They pointed to the need to improve the quality of domestic products to strengthen trade and thus achieve sustainable economic growth. (Yaqin, 2024)

In the same context, a study (Nam & Ryu, 2024) focused on Southeast Asian countries, examining the impact of trade openness on economic growth in the countries of the Association of Southeast Asian Nations. Trade openness is defined here as lower trade barriers and higher trade volume. The results indicated that lower trade barriers may have a negative impact on output in developing economies, meaning that excessive trade openness hinders economic growth, while

increased trade volume is positively associated with output. The study concluded that the economic effects of trade openness are not uniform, but are influenced by the level of trade barriers in each country. What distinguishes this study is its interactive analysis of trade barriers and trade volume, which provides a greater understanding of the causal relationship. (Nam, 2024)

A study by (Boudiaf, 2024) found that trade openness in Arab countries (represented by the ratio of exports and imports to GDP) has a positive impact on growth, especially in rentier states, This is due to the dependence of many Arab economies on trade revenues from oil exports, making trade openness a crucial factor in stimulating their economic growth. He added that despite the positive results, the fragility of economic and institutional structures in some countries remains a question mark over the sustainability of this growth. (Boudiaf, 2024)

On the other hand, Yeboah & Adamec (2025) analysed the impact of investment and trade openness on economic performance in West African countries (ECOWAS) during the period 1993-2022, using PMG and NARDL models and several variables such as: fixed capital formation, unemployment rate, population growth, labour force participation, external debt, and commodity trade. The results showed a clear difference between the short and long term, with non-linear and asymmetric relationships, which gives the study a rich empirical dimension. (Yeboah, 2025)

Finally, in a study by (Seti, Mazwane, & Christian, 2025), the researchers used a dynamic GMM model to analyse the impact of financial and trade openness on economic growth in ten emerging and developing countries during the period 1970-2023. The study concluded that both types of openness support economic growth, with this effect being reinforced in the context of economic and political stability. The results pointed to the importance of formulating policies that promote integration into the global financial and trade systems, provided that these policies are supported by sound macroeconomic fundamentals and strong institutions (policies that balance global integration with the national interests of countries). The study recommends that policymakers seek to achieve carefully considered strategic liberalisation in order to ensure sustainable and inclusive growth. (Seti, 2025)

Algeria has also seen growing interest from researchers studying the relationship between trade openness and economic growth, given the challenges associated with economic transformation and heavy dependence on oil revenues. We will therefore examine some of the empirical studies that have examined this relationship using different analytical approaches and various time series data. Most of them concluded that there is a positive relationship, while some showed a negative or insignificant relationship, reflecting the diversity of results and the different contexts and methodologies.

A study by Bendahmane, Dib, & Aouar (2020), covering the period 1990-2018 and using an autoregressive distributed lag (ARDL) model to analyse the

impact of trade openness on economic growth in the Algerian economy, showed a long-run relationship between the two, but the impact was negative and insignificant in both the short and long term.

This is due to the nature of Algeria's productive structure, weak economic diversification, and the country's dependence on hydrocarbons without strengthening its export capacity outside the hydrocarbon sector. (Bendahmane, 2020)

In turn, (Djadli, 2023) used the autoregressive distributed lag (ARDL) model to study the relationship between foreign investment, trade openness and economic growth during the period 1980–2020, concluding that there is a positive and statistically significant relationship between trade openness and growth, while foreign investment showed a negative and insignificant relationship, reflecting its limited impact in the absence of an attractive institutional environment. (Djadli, 2023)

In a broader context, a study by (Mezenner & Saidj, 2023) used a dynamic GMM model to analyse the implications of both financial and trade openness on economic growth in three North African countries (Algeria, Tunisia and Egypt) during the period 1990–2022. The results confirmed that trade openness and financial openness support economic growth. The study also revealed that the existence of a developed financial sector can enhance the positive impact of trade openness on economic growth, highlighting the importance of developing financial institutions alongside trade policies to maximise economic gains. (Mezenner, 2023)

A study by (Saadi & Mouley, 2024) the impact of trade openness and foreign direct investment flows on economic growth in Algeria during the period 1990–2020, and found a long-run complementary relationship between the variables, supporting the hypothesis that trade openness contributes to improved economic performance. (Saadi, 2024)

Similarly, a study by (Habib, Zegrier, & Belkhhir, 2024) addressed the determinants of economic growth in Algeria, highlighting the impact of credit granted to the private sector, government spending, and trade openness on the Algerian economy. It aimed to analyse and assess the impact of these factors on economic growth using annual data for the period from 1980 to 2022, which was analysed using the autoregressive distributed lag (ARDL) model. The study concluded that trade openness promotes growth but makes the Algerian economy hostage to oil price fluctuations. (Habib, 2024)

The study by (Cherif, Belhaoues, Chachoua, & Boussaid, 2025) used the NARDL methodology to measure the impact of trade openness on growth during the period 1980–2023. and found that both positive and negative shocks to the trade openness index have a similar effect on economic growth, both in the long and short term. This study therefore supports the hypothesis that trade openness contributes to economic growth. (Cherif, 2025)

This variation in results depending on the period studied, the variables used, and the model employed opens the door to more accurate studies that take into account the nature of the rentier economy and the challenges of openness in the absence of diversified productivity.

II. Study methodology and model used

1. Model used:

$$Y = f(ouv, OP)$$

The model can be written in its general form, resulting in the following equation:

$$PIB_t = C + C_1ouv_t + C_2OP_t + \varepsilon_t$$

Where:

pib: Gross domestic product

ouv: Trade openness

op: Oil price

ouv: Random error term in period t

2. Study sample and time period

The sample under study is Algeria. The study period extends from 1990 to 2022, and its selection is justified by the following reasons:

- The beginning of the period coincided with economic reforms and trade liberalization in Algeria.
- It included periods of sharp fluctuations in oil prices.
- It contained internal and external shocks that affected economic growth (oil crises, the 2008 crisis, the COVID-19 pandemic).

This makes it a rich period for testing the relationship between trade openness and economic growth.

3. Study data sources:

The data used in the model estimation are annual data for the period (1990-2022), for which we relied on data from the National Statistics Office (ONS.dz) and the World Bank (Worldbank.org).

4. Description of the variables used in the study and the reasons for their selection:

The standard model is based on an interpretation of economic growth in Algeria through two key variables, namely **trade openness** and **oil prices**, which is an economically justified choice given the nature of the Algerian economy. Below, we explain in detail each of the variables used in the standard model:

- **Dependent variable: real gross domestic product (PIB):**

- This variable represents economic growth, whereby the national economy is considered to be growing if the gross domestic product y for period $t=1$ is greater than the gross domestic product for period $t=0$, i.e. $y_1 > y_0$. It can be said that the national economy has achieved growth when the value of the GDP growth rate is positive, using real constant prices to remove the effect of inflation. Since the aim of the study is to analyse the impact of trade openness on economic growth, the choice of gross domestic product (GDP) as a dependent variable is appropriate and consistent with the economic literature. We obtained data for this variable from World Bank statistics (WDI).

- **First independent variable: Global Trade Openness Index (ouv):**

- The trade openness index represents the degree of integration of the national economy into international trade and is often measured as the trade-to-GDP ratio. In theory:
- **International trade theory** and endogenous growth models assume that trade openness contributes to:
 - improved resource allocation,
 - technology and knowledge transfer,
 - market expansion,
 - and increased productivity.

Trade openness is therefore expected to have a positive impact on economic growth.

However, in the case of Algeria, this impact may be uncertain, given the dependence on hydrocarbons for foreign trade and the weakness of the non-oil productivity base, which may make trade openness a factor with limited or even negative impact in some periods. The data for this variable was taken from World Bank statistics (WDI).

- **Second independent variable: Oil price index (OP):**

The price of oil is a decisive variable in explaining the Algerian economy's economic growth, as Algeria is a **rentier economy** that has a significant dependence on hydrocarbons and relies on them as its main source of public revenue and foreign exchange. Numerous studies have confirmed that oil prices and their rise play an important role in the Algerian economy, both in terms of financing development programmes and contributing to increased trade openness. Like other oil-exporting countries, Algeria has high openness rates as a result of the dual role of export revenues, which contribute to increasing the ratio of exports of goods and services to gross domestic product (GDP) and are also a source of

financing for imports, thereby increasing the ratio of imports of goods and services to GDP.

Conversely, a decline in these rates leads to economic imbalances and slower economic growth. Therefore, a **strong positive correlation** between the price of oil and gross domestic product is expected. The data for this variable was taken from the Office for National Statistics (ONS).

5. Model estimation steps and presentation of results

To estimate the model, we will use the autoregressive distributed lag model:

$$\Delta VarU_{dif} = \alpha + \beta_1 VarU_{dif,t-1} + \beta_2 VarY_{dif,t-1} + \sum_{i=1}^p \gamma_1 \Delta VarY_{dif,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarU_{dif,t-i} + \varepsilon_t$$

$$\Delta VarU_{gap} = \alpha + \beta_1 VarU_{gap,t-1} + \beta_2 VarY_{gap,t-1} + \sum_{i=1}^p \gamma_1 \Delta VarY_{gap,t-i} + \sum_{i=1}^q \gamma_2 \Delta VarU_{gap,t-i} + \varepsilon_t$$

5.1. Estimating the standard model using the autoregressive distributed lag (ARDL) model

a. Testing the stability of time series:

Table 1: Results of the ADF and PP tests

Variable	Difference	PP.ADF				
		Calculated Value	Critical Value at 5%	PP Calculated Value	PP Critical Value at 5%	Decision
ouv	ouv	-3.23	-3.61	-3.04	-3.61	Do not reject H0
	D (ouv)	-3.42	-2.99	-3.39	-2.99	Reject H0
PIB	pib	-3 .06	-3.61	2.47	-1 .95	Do not reject H0
	D(pib)	-4.55	-3 .6	-3.53	-1 .95	Reject H0
OP	OP	-2 .06	-3.61	2.47	-1 .95	Do not reject H0
	D(OP)	-4.55	-3 .6	-3.53	-1 .95	Reject H0

Source: Prepared by researchers based on Eviews.9 outputs

The ADF and PP tests show that the null hypothesis that the variables do not have a unit root cannot be rejected, but this hypothesis can be rejected for the first differences. This means that the variables are integrated of order (1)I.

b. Frontier methodology for testing cointegration:

$$pib = \alpha + B_1 pib_{t-1} + B_2 ouv_{t-1} + B_2 OP_{t-1} \sum_{i=1}^p y_1 \Delta ouv_{t-p} + \sum_{i=1}^p y_2 \Delta pib_{t-p} + \sum_{i=1}^p y_2 \Delta OP_{it-p}$$

F-statistic for testing the existence of a cointegration relationship first and therefore:

- **H₀ : $\beta_1 = \beta_2 = 0$** : The null hypothesis, which means that there is no relationship between the variables
- **H₁ : $\beta_1 \neq \beta_2 \neq 0$** : The alternative hypothesis posits the existence of a long-run cointegration relationship between the model variables.

Table 2: Bounds test for the existence of a long-run relationship

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic k	6.171054 2		Asymptotic: n=1000	
		10%	2.63	3.35
		5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

Source: Prepared by researchers using EVIEWS 9 software.

Based on the table above, proposed by Pesaran, Shin, & Smith (2001) at significance levels of 5% and 10% (Pesaran, 2001), the Fisher's statistic ($F=6.17$) at $K=2$ (number of independent variables) indicates that it is greater than the upper critical value (3.87) at a significance level of 10%, This confirms the rejection of the null hypothesis, which states that there is no cointegration between the variables, and we accept the alternative hypothesis and thus the existence of a long-run relationship between gross domestic product, trade openness and oil prices.

c. Estimating the long-run relationship: We estimate the long-run relationship within the autoregressive distributed lag (ARDL) model using the most prominent software dedicated to such models, namely **EvIEWS 9**. This stage involves obtaining long-term parameter estimates and long-run equilibrium results. We relied on lag

periods according to the AKAIKE INFORMATION CRITERION, as shown in the following table:

Table 3: Long-term parameter estimates

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PP	45.08476	2.951585	15.27477	0.0000
OPNS	14.96756	12.87309	1.162701	0.2586
C	96.17776	661.0422	0.145494	0.8858
EC = PIBK - (45.0848*PP + 14.9676*OPNS + 96.1778)				

Source: Prepared by researchers using Eviews 9 software.

Table 3 shows the regression results for explaining gross domestic product using the following independent variables: trade openness and oil price.

We note that there is a significant positive relationship between oil price and gross domestic product, i.e. a one-dollar increase in the price of oil corresponds to an increase of \$45.08 in gross domestic product. We also note a positive but insignificant relationship between trade openness and gross domestic product, i.e. trade openness has no effect on economic growth in Algeria in the long term.

d. Error Correction Model (ECM autoregressive distributed lag): The following table (Table 4) consists of two parts, where the first part (upper) shows the estimation of the error correction model (ECM), i.e., it represents the short-run relationship, while the second part (lower) shows the estimation of the long-run relationship. The statistical analysis of our model is as follows:

Table 4: Results of the error correction model estimates for the autoregressive distributed lag (ARDL) model

ARDL Error Correction Regression				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PP)	30.04310	1.470554	20.42979	0.0000
D(PP(-1))	4.874995	1.704774	-2.859613	0.0097
D(PP(-2))	2.889934	1.739878	-1.660998	0.1123
D(OPNS)	11.32560	5.279232	-2.145312	0.0444
CointEq(-1)*	-0.376587	0.070682	-5.327931	0.0000
R-squared	0.959855	Meandependentvar		55.09397
Adjusted R-squared	0.952873	S.D. dependent var		499.8882
S.E. of regression	108.5194	Akaike info criterion		12.37217
Sumsquaredresid	270858.4	Schwarz criterion		12.61006
Log likelihood	-168.2103	Hannan-Quinn criter.		12.44489
Durbin-Watson stat	2.033014			
* p-value incompatible with t-Bounds distribution.				

Source: Prepared by researchers using Eviews 9 software

We note that the error correction coefficient is negative (-0.37) and the significance is $t=-5.3$ at a significance level of 1%, thus verifying the validity of the error correction. There is a positive relationship between GDP and oil prices, and between trade openness and GDP.

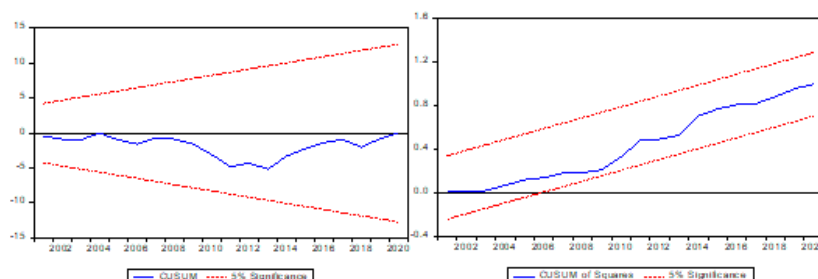
To clarify further, this means that the behaviour of the dependent variable, represented by the economic growth index, takes two and a half periods to reach long-run economic equilibrium. The results also show that 37% of the deviation of gross domestic product from the long-run economic equilibrium level will be corrected each year.

We note that there is a significant positive relationship between the price of oil and economic growth, i.e. a one-dollar increase in the price of oil corresponds to a \$4.87 increase in gross domestic product. We also observe a significant positive correlation between trade openness and gross domestic product, i.e. a one-dollar

increase in trade openness corresponds to an increase of \$11.32 in gross domestic product in the short term.

e. Model stability test:

Figure 01: Cumulative sum test of residuals and cumulative sum of residual squares



Source: Prepared by researchers using Eviews 9 software

The structural stability of the estimated error correction coefficients for the autoregressive distributed lag model is verified if the graphs of the CUSUM and Squares of CUSUM tests fall within the critical limits. The results of these two tests in (Figure 1) show that there is stability and consistency in the model between the long-term and short-term results, and that the variables are stable over time. Therefore, the ARDL model is the ideal model that can be relied upon in analysing and interpreting the results.

f. Breusch-Pagan-Godfrey heteroskedasticity test (Breusch-Pagan-Godfrey heteroskedasticityTest):

Table 5: Breusch-Godfrey serial correlation test for errors.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.100784	Prob. F(2,18)	0.9046
Obs*R-squared	0.310079	Prob. Chi-Square(2)	0.8564

Source: Prepared by researchers using Eviews 9 software

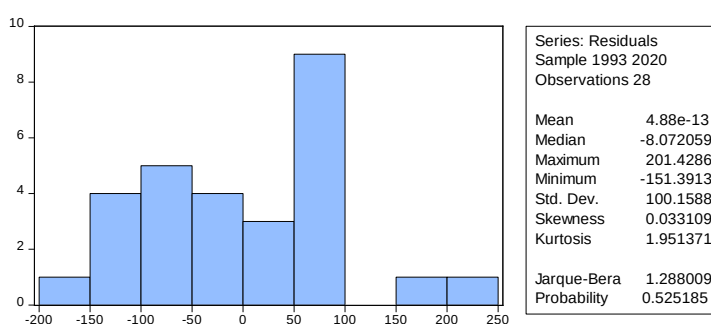
The statistical P-values 0.9046 and 0.8564 for Fisher and $^2\chi$ are greater than 0.05, and we therefore accept the null hypothesis, which states that there is no serial autocorrelation of errors in the model under study.

Table 6: Heteroskedasticity Test for error variance stability

Heteroskedasticity Test: ARCH			
F-statistic	0.278360	Prob. F(1,25)	0.6024
Obs*R-squared	0.297318	Prob. Chi-Square(1)	0.5856

Source: Prepared by researchers using Eviews 9 software

The statistical P-values 0.6024 and 0.5856 for Fisher and χ^2 , respectively, are greater than 0.05, and we therefore accept the null hypothesis, i.e. that the variance of the errors is homogeneous and constant, which means that the variables are independent of each other and there is no linear correlation between them.

Figure 2: Testing the normal distribution of errors

Source: Prepared by researchers using Eviews 9 software

- **H₀**: The random error follows a normal distribution
- **H₁**: The random error does not follow a random distribution

We note from the figure that the probability 0.5251 is greater than 0.05, and therefore we reject the alternative hypothesis and accept the null hypothesis, and thus the random errors follow a normal distribution.

6. Discussion of results

The results of the benchmark study indicate the relationship between gross domestic product, trade openness, and the price of oil in Algeria during the period 1990–2022, using the autoregressive distributed lag (ARDL) model and the error correction model.

- **ADF and PP** stationarity tests showed that all variables are non-stationary at levels but become stationary at first differences, meaning they are integrated of order I(1). This justifies the use of the autoregressive distributed lag (ARDL) model to test the long-run relationship between the variables.

- The Bound test for cointegration showed an F-statistic higher than the upper critical value at the 5% and 10% significance levels, rejecting the null hypothesis

of no long-run relationship. This indicates the existence of a **long-run relationship** between gross domestic product, trade openness and oil prices, i.e. any long-term change in trade openness or oil prices will be reflected in Algerian economic growth.

- **Long-term estimates** showed that **the oil price has a strong positive impact** on gross domestic product, with the coefficients indicating that a \$1 increase in the oil price corresponds to an increase of approximately \$45 in gross domestic product. This confirms that the Algerian economy remains heavily dependent on hydrocarbons as its main source of economic growth, which is consistent with the nature of Algeria's rentier economy.

Trade openness has had a positive but insignificant impact in the long term, indicating that foreign trade, despite its theoretical importance in improving growth through technology transfer and market expansion, has not translated into a tangible increase in gross domestic product during this period. This is due to Algeria's dependence on oil exports and the weakness of its non-oil productivity.

- **The results of the error correction model** clarified the short-run relationship. The coefficients between trade openness, oil prices and gross domestic product in the short run were more significant, showing that any increase in oil prices or trade openness is matched by a temporary increase in gross domestic product. The error correction coefficient (-0.376) is significant at 1%, meaning that about 37% of the deviation from equilibrium in gross domestic product is corrected annually, reflecting the speed with which the Algerian economy moves towards equilibrium after any short-term shock.

- **Diagnostic tests** confirmed the validity of the model through:

- No autocorrelation between errors
- Homogeneous variance of errors
- Normal distribution of errors
- Structural stability of the model over time

This indicates that the autoregressive distributed lag (ARDL) and ECM estimates are reliable and can be used to explain the impact of trade openness and oil prices on Algerian economic growth.

Finally, it can be said that the results confirm that the Algerian economy is predominantly oil-based, with oil prices playing a decisive role in determining growth, while trade openness has a limited impact in the long term. In the short term, trade openness appears to have a positive symbolic effect, meaning that trade policy can temporarily stimulate growth, but cannot be relied upon as a key factor in achieving sustainable growth without diversifying the productivity base.

Conclusion

This study highlighted and clarified the impact of trade openness on economic growth, which many economic thinkers consider to be of paramount importance in driving economic growth. This has led most countries around the world to implement trade liberalization, assert themselves and penetrate international markets.

The results of the empirical study showed that the Algerian economy remains primarily influenced by oil prices, with long-term estimates showing that higher oil prices are accompanied by a significant increase in gross domestic product, while trade openness has not had a significant long-term impact on economic growth. In the short term, however, trade openness has had a significant positive impact, suggesting that the Algerian economy could benefit from trade policies in the short term, but without being a source of sustainable growth in the absence of a diversified productivity base.

Algeria, like other countries, must keep pace with global developments, especially since it is rich in natural, material and human resources that qualify it to be among the leading economies. However, there are many obstacles that have prevented this, the most prominent of which is excessive dependence on the hydrocarbon sector. To overcome this problem, the study points to the need to diversify productivity and encourage non-hydrocarbon exports, in addition to strengthening the capacities of economic institutions and encouraging innovation and technology to improve the sustainability of economic growth.

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