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IMPACT OF EXTERNAL DEBT ON THE ECONOMIC GROWTH OF ALGERIA: AN ARDL BOUND TESTING APPROACH (1990–2021)

Abstract: Sustainable economic growth is an important macroeconomic objective for emerging states. However, if the country does not have sufficient capital to support GDP growth, and even if it lacks capital, the government can borrow some capital in the form of external debt to support GDP growth. The purpose of this study is to consider the link between economic growth and external debt in Algeria's economy. Moreover, it examines the long- and short-term implications of several factors, such as the share of external debt to GDP, the debt-to-GDP stock ratio, and the national expenditure-to-GDP ratio, the exchange rate and commercial openness. The ARDL Bound Test was used to measure the impact of external debt on economic growth. According to the study, there is a long-term negative relationship between external debt and economic growth in Algeria, which shows that the external debt has adverse effects on economic growth.

Keywords: external debt; economic growth; ARDL; Algeria.

Introduction

External borrowing is an important resource in advancing developing countries' Development. The need for external financing has increased since 1950. States have moved to borrow from international bodies because external debt has become unsustainable, creating instability in the economies of low-income developing countries in early 1980[2]. As a result, an important and current economic issue has become that external borrowing is a tool for the Government, which is critical to achieving sustainable economic growth and inclusive Development[3].

The expenditure of those borrowed funds must be rationalized. External debt repayment was ensured because doing so would hamper sustained economic growth and Development in exchange for economic shocks and financial crises, thereby contributing to investors' widespread panic and declining investment whenever the State could deal with or repay its debt and achieve

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[2] **Dogan Ibrahim, Bilgili Faik,** The nonlinear impact of high and growing government external debt on economic growth: A Markov Regime-switching approach, Economic Modelling, Vol. 39, 2014, P213.

[3] **Agyeman George, Sakyi Daniel, Abayie Eric Fosu Oteng**, External debt and economic growth in selected sub-Saharan African countries: The role of capital flight, Research in Globalization, Vol.5, 2022, P1.

economic gains from those borrowed funds.[4]External debt is issued as a source of financing for domestic deficits due to insufficient funds from domestic savings to accelerate economic growth. However, some experimental experience and evidence suggest that countries that use external debt to drive economic growth and Development can succeed in a sense that can increase economic growth while repaying their external debt. However, only some countries have seen the contrary.[5], Algeria covers a wide area geographically in North Africa within the Maghreb, the largest country in the Mediterranean and the largest area in Africa; bordered by Tunisia's northeast, Libya's east, Mali's southwest, Mauritania's southwest, western Sahara, and Morocco, Algeria is one of the petroleum economies, with an economy of more than 60% dependent on petroleum revenues and incomes and an area of 2.381.741 km with a population of 44 million. Algeria's gross domestic product (GDP) is about 163 billion dollars; therefore, in this study, we will work on the impact of external debt on economic growth in Algeria.

This study aims to reveal the Relationship between economic growth and external debt; we will apply the ARDL model associated with joint integration and error correction models for 1990-2021 to investigate the existence of a long-term balance between variables[6]. The variables to be studies were used : GDPGR (annual growth rate of real GDP), EDS/GDP(ration of external debt To GDP), DSS/GDP(ration of debt service stock of GDP), DSS/GDP(ration of debt service stock of GDP), EXCH(real exchange rate DZD/USD),TRD(trade openness).This study consists of an introduction, the second chapter, a literature review, the third chapter, a methodology, the fourth chapter, an applied empirical method and data set, the last chapter, results, and suggestions

Literature Review

The inability of domestic resources to achieve sustained economic growth has become a concern for many countries, especially developing countries, as

[4] **Roy Arup**, Nexus between economic growth, external debt, oil price, and remittances in India: New insight from novel DARDL simulations, Resources Policy, Vol 83, 2023, P1.

[5] **Triatmanto Boge, Bawono Suryaning, Wahyuni Nanik**, The contribution and influence of total external debt, FDI, and HCI on economic growth in Indonesia, Thailand, Vietnam, and the Philippines, Research in Globalization, Vol.7, 2023, P2.

[6] **Stella Ada Mbah, Chigozie Agu Osmond, Godwin Umunna,** the impact of External Debt on Economic Growth in Nigeria: An ARDL Bound Testing Approach, Journal of Economics and Sustainable Development, Vol.7, No.10, 2016, P.P16-27.

external borrowing is one of the ways to solve this problem. Many researchers have studied and discussed the impact of external debt on economic growth.[7]Addressing the effects of some external debt variables, public debt, and fiscal deficits, the results concluded that the increase in external debt had a much greater shock and negative impact on South Asian country's long-term growth[8]. He addressed the impact of external debt on economic growth, considering the heterogeneity in public sector management of the sub-Sahara African Group. Differences in the equality of public service management showed that external debt hurt economic growth. However, when external debt interacted with strong public service management quality, the impact on sub-Saharan economic growth was positive.

Researchers examined the impact of external debt on economic Development in Pakistan from 1970 to 2009. External debt and GDP growth data were used to conduct the ADF, P.P. unit root test, and ARDL boundary tests. The findings indicate that foreign debt has a negative[9]. The study of the dynamic Relationship between external debt and economic growth in 43 African countries supported a long-term balance between external debt and economic growth in Africa[10]. The study examined the Relationship between enacting external borrowing in the public and private sectors on Turkey's economic growth from 1974 to 2009, using variables such as investment, human capital, trade openness, population, GDP growth, private external debt to GDP ratio, and general external debt to GDP Ration, the study found that there is a positive impact relationship such as investment and human capital on economic growth because economic growth variables and growth are not linear[11]. This study examined the Relationship between government debt and economic growth for an estimated 40 years since 1970 through the evolution of Greece's

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[7] **Muhamed Muhsin, Ullah Hafeez, Iqbal Nadeem Iqbal, Wasim Taghizadeh-Hesary Farhad,** How external debt led to economic growth in South Asia: A policy perspective analysis from quantile regression, Economic Analysis and Policy, Vol.72, 2021, P435.

[8] **Nsanyan Sandow Joshua, Abayie Eric Fosu, Oteng Duodu Emmanuel**, External debt and economic growth in Sub-Saharan Africa: does heterogeneity in the quality of public sector management make a difference? Heliyon, Vol.8, 2022, P8.

[9] **Ramzan Muhammad, Ahmad Eatzaz**, External debt growth nexus: Role of macroeconomic policies, Economic Modelling, Vol.38, 2014, PP.204-210.

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[11] **Dogan Ibrahim. Bilgiri Faik,** The nonlinear impact of high and growing government external debt on economic growth A Markov Regime Switching approach, Economic Modelling, Vol.39, 2014, P.P. 213-220.

economic growth rates. The growth equation was estimated to be based on a set of variables of fiscal policy indicators of trade openness and external competitiveness, Greece's economic structure, and indicators of investment capacity and short-term expenditure financing; the empirical results indicated a positive and statistically significant impact of debt on economic growth.[12] The study presents the impact of the debt burden on economic growth using a sample of 118 developing countries from 1989 to 2004. The results of the study pilot study indicate that there is no evidence to indicate the positive impact of debt on economic growth in the sample countries, and therefore, there is a negative impact[13], Researchers presented the Relationship between external debt and economic growth in low and high-income countries for a sample of 123 countries from 1990 to 2015. Empirical results indicate that total external debt generally adversely affects growth and is positively linked to income growth in low and middle-income countries where savings and investment were relied upon as important channels of disclosure[14]. The study examined government investment and public debt levels on the economic growth of 65 developed and developing economies emerging from 1991 to 2014. The empirical results demonstrated that government investment positively affects economic growth in heavily indebted poor countries and lower-middle-income, middle-income, and upper-middle-income economies while hurting the OCDE and E.U. member states. As for the impact of government debt on economic growth, there is an appositive impact on economic growth for most upper middle income, high-income non-CDE, and middle income[15]. The study discussed the Relationship between public debt and economic growth in developing and industrial countries during the period 1970 to 2012, with the results showing that the trend of public debt's impact on growth is seamlessly positive to negative during the period of the study depending on the level of indebtedness[16], researchers discussed the Relationship between public debt and economic growth in Uganda

[12] **Spilioti Stella, Vamvoukas George**, The impact of government debt on economic growth: An empirical investigation of the Greek market, The Journal of Economic Asymmetries, Vol.12, 2015, P.P. 34-40.

[13] **JOHANSSON PERNILLA**, Debt Relief, Investment and Growth, WORLD DEVELOPMENT, Vol.38, No.4, 2010, PP.1204-1216.

[14] **Qureshi Irfan, Liaqat Zara,** The long-term consequences of external debt: Revisiting the evidence and inspecting the mechanism using panel VARs, Journal of Macroeconomics, Vol.63, 2020, P103184.

[15] **Chen Chuanglian, Yao Shujie, Hu Peiwei, Lin Yuting**, Optimal government investment and public debt in an economic growth model, China Economic Review, Vol.45, 2017, PP. 257-278.

[16] **Karadam Duygu Yolcu,** An investigation of nonlinear effects of debt on growth, The Journal of Economic Asymmetries, Vol.18, 2018, P 00097.

during the period 1980 to 2016 as a developing country that, during the developing trajectory, experienced several years of debt accumulation where, for many periods, received a financial package to alleviate its external debt and also received relief that helped to reduce the debt stock economic trajectory Uganda the results of the pilot study found the negative impact of public debt on Uganda economic growth trajectory[17]This study reviewed the Relationship between public debt and economic growth in developed countries from 2004 to 2012. The results of the pilot study showed that public debt hurts growth[18], tested the causal link between foreign and private-public debt and economic growth in 28 European Union countries from 2001 to 2012. Polit results were obtained that demonstrated a statistically significant two-way Relationship between public debt and GDP growth rate[19], the study noted the dynamic impact of external debt on GDP growth, per capita, investment, trade openness, exchange rate, and inflation in Nigeria from 1970 to 2014. Empirical results showed that external debt shocks had long-term negative effects on economic growth and investment consistent with the debt burden hypothesis foreign debt, while a short-term positive impact on inflation and a negative impact on trade openness and minimal exchange rate effects[20] .

Table 1. External Debt Economic Growth Relationship Literature Summary

Author's	Period	Countries	Methodology	Conclusion
Muhammad et al. (2021)	2000-2018	South Asia	The panel ordinary least square (OLS)	Negative
Joshua et al. (2022)	2005-2017	Sub-Sahara African	(system) and the panel smooth transition regression (PSTR)	Negative
RAMAZAN AHMED (2014)	1970-2009	Pakistan	ARDL	Negative
OMankhalen et al.(2020)	2001-2018	African Countries	Johansen Cointegration test and system	Negative

[17] **Ssempala Richard, Ssebulim Kurayish, Twinoburyo Enoch**, Uganda's experience with debt and economic growth: an empirical analysis of the effect of public debt on economic growth—1980–2016, Economic Structures, Vol. 9, No.48, 2020, P15-17.

[18] **Panizzab Ugo, Presbitero Andrea F**, Public Debt and Economic Growth in Advanced Economies: A Survey, Swiss Society of Economics and Statistics, Vol.149, No .2, 2013, P.P175-204.

[19] **Ferreira Cândida,** Debt and Economic Growth in the European Union: A Panel Granger Causality Approach, Int Adv Econ Res, Vol .22, 2016, P.P131-149.

[20] **Onafowora Olugbenga, Owoye Oluwole**, Impact of external debt shocks on economic growth in Nigeria: an SVAR analysis, Econ Change Restruct, Vol.52, 2019, P.P. 157-179.

			Generalised Method of Moments (sysGMM)	
Ball and rath(2014)	1980-2011	India	APRIL	Positive
Doğan and Bilgili(2014)	1974-2009	Turkey	Ordinary Least Square (OLS)	positive
Spilioti and Vamvoukas (2015)	1970-2013	Greece	Ordinary Least Square (OLS)	Positive
Johansson (2010)	1989-2004	developing countries	Panel	Negative
Qureshi and Liaqat (2020)	1990-2015	World	Panel VARs	Negative
Chen et al. (2017)	1991-2014	developed and developing economies	panel smoothing transition regression (PSTR)	Bidirectional Casual Relationship
Karadam(2018)	1970-2012	Developing and industrial countries	Panel smoothing transition (PSTR)	Negative
Ssempala et al.(2020)	1980-2016	Uganda	ARDL	Negative
Panizza et al.(2013)	2004-2013	OCDE	OLS	Negative
Onafowora and Owoye	1970-2014	Nigeria	SVAR	Negative
Ferreira(2016)	2001-2012	E.U. countries	Panel Granger Causality	Bidirectional Casual Relationship

Data and Methodology

This study uses the annual GDP growth rate as a subordinate variable external debt stock-to-GDP ratio, national debt-to-GDP ratio, External debt-to-GDP ratio, expenditure-to-GDP ratio, and trade openness. These variables were included separately in the study model. Data applied consisted of 32 observations during 2021-1990 obtained from the World Bank database; for example, the beginning of the 1990 study coincided with the beginning of the accumulation of external debt. economic growth, the ARDL Bound test was applied to verify the effects of external debt and other variables on economic growth using Eviews for this study.

Using these data, the study model was formulated as follows:

$$InGDPGR_t = b_0 + b_1 InEDS/GDP_t + b_2 InDSS/GDP_t + b_3 InNEXP/GDP_t + b_4 InEXCH_t + b_5 InTRD_t + U_t \quad (1)$$

The data in the application are coded as follows:

Table 2. Data Description

Symbol	Measurement	Data Source
GDPGR	Annual Growth Rate of Real GDP	The World Bank
EDS/GDP	Ration of external debt to GDP	The World Bank
DSS/GDP	The ratio of debt service stock to GDP	The World Bank
NEXP/GDP	The ratio of national Expenditure to GDP	The World Bank
EXCH	Real Exchange Rate	The World Bank
TRD	Trade Openness	The World Bank

Transactions b_1 ،b_2 ،b_3 ،b4, and b_5 indicate the flexibility of growth of variables such as external debt GDP, external debt-to-GDP ratio, national expenditure-to-GDP ratio, real exchange rate, and trade openness, as reflected U_t the error correction factor.

Use this quantitative analytical study, where the ARDL test was conducted to verify the short and long-term balance between external debt variables and GDP growth, through the aging analysis of the ARDL model through the joint integration test to examine long-term relationships by the boundary test developed by Pesaran and All (2001) and the error correction model to see whether there is a short-term relationship between the variables.[21], ARDL model advantage is that joint integration boundary tests can be applied to study variables regardless of whether they are integrated of the same grade or combination I (1) and I (0), as well as the small sample characteristics of superior ARDL boundary test, compared to multi-variable co-integration. Thus, the ARDL model helps estimate the short and long-term parameters of the model at the same time.[22]To solve the problem of false regression from the instability of time chains, the integration test is conducted to verify that there is a stable long-term relationship between the study variables and the advantages of the ARDL model and that there are no self-correlation problems in the ARDL test procedures and

[21] **Jan Bentzen, Tom Engsted**, A revival of the autoregressive distributed lag model in estimating energy demand relationships, Energy, Vol.26, No.1, 2001, PP45-55.

[22] Dene T, Hurley; Nikolaos, Papanikolaou, Autoregressive Distributed Lag (ARDL) analysis of U.S.-China, The Quarterly Review of Economics and Finance, No 14, 2020, P5.

the internal problem can be addressed by choosing the appropriate degree of delay under the optimal delay hypothesis.[23]We have drafted the form as follows:

$$\Delta GDPGR_t = b_0 + b_1 \Delta EDS/GDP_t + b_2 \Delta DSS/GDP_t + b_3 \Delta NEXP/GDP_t + b_4 \Delta EXCH_t + b_5 \Delta TRD_t + b_6 GDPGR_{t-1} + b_7 \Delta EDS/GDP_{t-1} + b_8 \Delta DSS/GDP_{t-1} + b_9 \Delta NEXP/GDP_{t-1} + b_{10} \Delta EXCH_{t-1} + b_{11} \Delta TRD_{t-1} + U_{t-1} \quad (2)$$

The code expresses short-term and long-term Δ dynamics by measuring long-term relationships of variables. The error correction model is applied in the short term. The degree of delay is tested using metrics to obtain the optimal number of delays for each variable, followed by the prediction of an unlimited error correction model through one formula shown as follows:

$$\begin{aligned} \Delta \mathrm{GDP}GR_t = b_0 &+ \sum_{i=1}^{\alpha} b_1 \, \Delta GDPGR_{t-i} + \sum_{i=1}^{\alpha} b_2 \, \Delta EDS/GDP_{t-i} + \sum_{i=1}^{\alpha} b_3 \, \Delta DSS/GDP_{t-i} \\ &+ \sum_{i=1}^{\alpha} b_4 \, \Delta NEXP/GDP_{t-i} + \sum_{i=1}^{\alpha} b_5 \, \Delta EXCH_{t-i} + \sum_{i=1}^{\alpha} b_6 \, \Delta TRD_{t-i} \\ &+ b_7 GDPGR_{t-1} + b_8 EDS/GDP_{t-1} + b_9 DSS/GDP_{t-1} + b_{10} NEXP/GDP_{t-1} \\ &+ b_{11} EXCH_{t-1} + b_{11} EXCH_{t-1} + U_t \end{aligned} \quad (3)$$

The symbol expresses Δ the first difference factor, while α represents the degree of delay, and all study variables remain the same. The F statistic is applied to the variable error correction coefficient; the F statistic expresses a long-term relationship at a 5% morale level. If the F statistic is greater than the upper limit value, the hypothesis of non-integration between study variables is rejected. If it is below the maximum value, the hypothesis that variables are complementary is accepted; if it is established that there is a long-term and short-term relationship between the variables, the error correction coefficient is derived as follows:

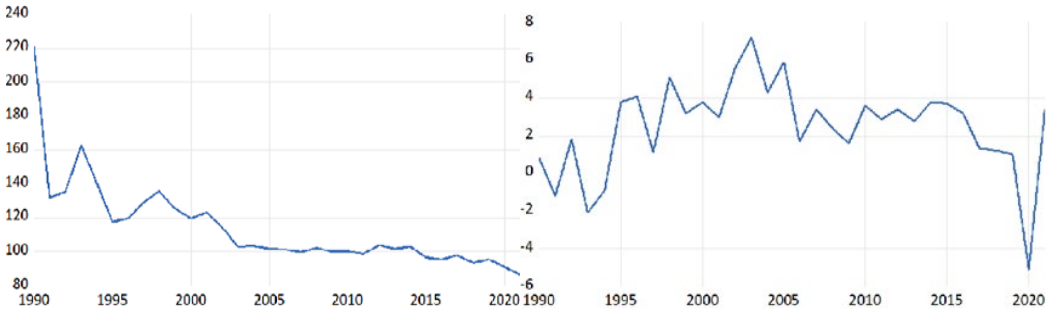
[23] Hongwei Wang, Exploring the influencing factors of environmental deterioration: evidence from China employing ARDL–VECM method with structural breaks, International Journal of Climate Change Strategies and Management,2022, P6.

$$\varepsilon_t = \Delta GDPGR_t - b_0 - \sum_{i=1}^{\alpha} b_1 (GDPGR)_{t-i} - \sum_{i=1}^{\alpha} b_2 (EDS/GDP)_{t-i} - \sum_{i=1}^{\alpha} b_3 (DSS/GDP)_{t-i} - \sum_{i=1}^{\alpha} b_4 (NEXP/GDP)_{t-i} - \sum_{i=1}^{\alpha} b_5 (EXCH)_{t-i} - \sum_{i=1}^{\alpha} b_6 (TRD)_{t-i} \quad (4)$$

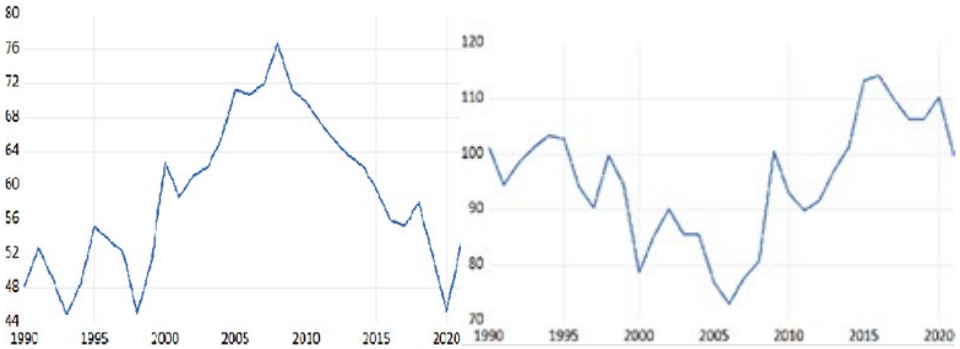
Empirical Result and Discussion

When tracking the study variables in Figure 1, the evolution of GDP growth, national spending as a proportion of GDP, and trade openness follows precarious trends over the study's period. While the real exchange rate trend follows a negative trend from high to very low, the same for the external debt share of GDP and debt service shares to GDP is trending from high to very low levels during the study period.

EXCH **GDPGR**



NEXP TRD



DSS EDS

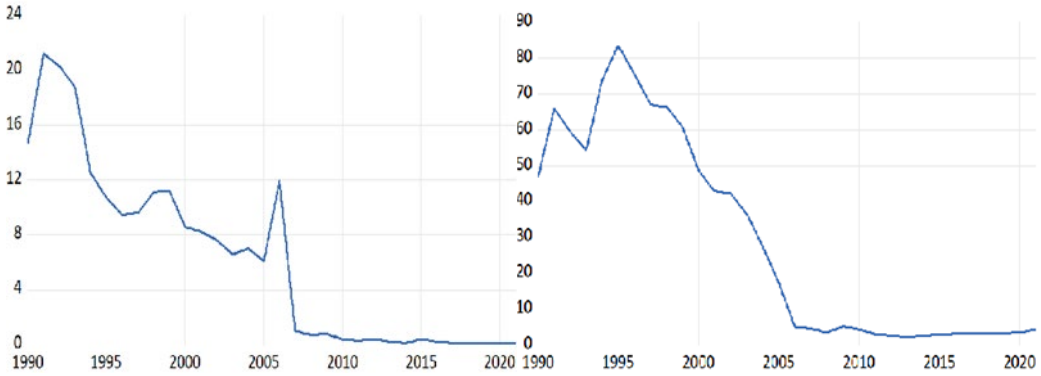


Figure 1. Graphs of Variables

There is a discrepancy in the time chains of study variables during the period studied for all development variables. The problem of variability is particularly frequent in horizontal C.T. data:

H_0=σ^2 (constant variance)

H_1≠σ^2 (varying variance)

The nowhere hypothesizes that the variability is constant. In contrast, the alternative hypothesis is that the variability is variable. In contrast, non-static variation tests indicate no correlation between the error factor and the explanatory variables of the study.

Table 3. Heteroscedasticity Test

Heteroscedasticity Test	F-Statistic	Prob
Breuch-Pegan-Godfrey	0.724920	0.6683
Harvey	0.646584	0.7306

We note from the probability values of the Breuch Pegan Godfrey test that there is no problem with variability. We accept the hypothesis H_0 since the probability value is 0.05 < 0.66 at a 5% morale level. At the same time, there is also no variability problem according to the Harvey test, which is equal to 0.73 > 0.05 at a 5% morale level, and from which the hypothesis is accepted H_0, there is a constant discrepancy.

Table 4: Autocorrelation Test

Breuch-Godfrey Serial Correlation Test			
F-Statistic	0.85	Prob.F(2,19)	0.44
Obs*R-Squared	2.47	Prob Chi. Square(2)	0.29

Table 3 results show Breuch Godfrey's 0.44 Prob. And Prob. The chi-square test (2) 0.29 shows no autocorrelation problem.

Table 5: ARDL Long Run Form and Bound Test

Conditional Error Correction				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
c	-7.588306	11.41624	-0.664694	0.5135
GDPGD(-1)*	-0.996642	0.182633	-5.457065	0.0000
DSS(-1)	-0.253065	0.177622	-1.424742	0.1689
EDS**	-0.106617	0.029549	3.608178	0.0017
EXCH**	-0.026882	0.051107	-0.525998	0.6044
NEXP**	-0.007534	0.057732	-0.130505	0.8974
TRD**	0.215850	0.089022	2.424685	0.0244
D(DSS)	0.060327	0.179471	0.336138	0.7401
D(DSS(-1))	0.347651	0.159828	2.175162	0.0412

* P-value incompatible with t-bounds distribution.

When the number of annual observations and data is considered, the maximum length of delay is 2, based on Akaike (AIC) and Schwarz (SIC) standards.

In order to have a long-term relationship between the study variables and the application of the ARDL model, which is the most appropriate model for the study, the results of the ARDL model in Table 4 indicate that GDP growth has a negative relationship with external debt.

Table 6: ARDL Error Correction Regression

ECM Regression **(Restricted Constant and Trend)**				
Variable	**Coefficient**	**Std.Error**	**t-statistic**	**Prob.**
D(DSS)	0 .060327	0.126886	0.475441	0.6394
D(DSS(-1))	0.347651	0.116545	2.982974	0.0071
CointEq(-1)*	-0.996642	0.139770	-7.130566	0.0000

*p-value incompatible with t-Bounds distribution

Tables 5 and 6 show that the error correction factor is a negative CointEq (-1), and in the long term, there is a statistically significant relationship between GDP growth and gross debt service to GDP.

Table 6 reveals a positive statistically significant correlation between the external debt stock and the dependent external debt variable.

Table 7: ARDL F-Bound Test

Null hypothesis :No levels of Relationship		**Critic Value %1**		**Critic Value %5**	
K	F-statistic	I(0)	I(1)	I(0)	I(1)
5	5.649441	3.06	4.15	2.39	3.38

* K is the number of independent variables.

From Table 7, the statistical value F is greater than the critical value, so the hypothesis that there is no integration between the study variables is unacceptable.

Conclusion

Keynes addressed external debt and its Relationship to GDP growth and State intervention in economic activity when needed. The Keynesians presented their views on developing countries as being able to contribute to supporting economic growth by using external debt as a tool to help Development. "Harrod Domar" presented a proposal on the possibility of increasing income through external borrowing through investment projects; in this context, several studies have at different times addressed the issue of the relationship between external debt and the GDP growth rate.

As a developing country, we discussed the impact of external debt on Algeria's economic growth by applying the ARDL model during the period 2021-1990, where we applied diagnostic tests, serial correlation test, Discrepancy Problem Detection Test, Error Correction Model, ARDL Bound Test and, as a result, in parallel with previous literature, there was no short-term correlation between external debt and GDP growth. However, a one-way relationship was found between external debt and GDP growth.

According to the results of the ARDL model in the long-term analysis, there is a long-term negative correlation between external debt and GDP growth, where a 1% increase in external debt leads to a 0.99% decline in GDP growth, similar to empirical studies. These findings show that economic growth is adversely affected if Algeria's external debt rises. According to this study, economic growth is adversely affected by a rise in Algeria's external debt.

According to the study's data, Algeria's 2006 external debt to GDP recorded 5.24%, compared with GDP growth for the same period of 1.7%. In 2021, foreign debt fell by 4.50%, followed by a 3.4% rise in GDP growth. Moreover, it should be noted that the use and orientation of external loans to productive sectors contribute to the creation of added value in the national economy; external debt must, therefore, be rationalized and channelled in order to encourage and build an export production base economic growth in Algeria has been adversely affected by the failure to channel external debt into genuine and efficient investments, With this result, it is recommended that developing countries direct external debt to encourage and support GDP growth in order to ensure debt sustainability.

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