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Fettouche Fatma*

THE IMPACT OF EXTERNAL DEBT ON ECONOMIC GROWTH: THE CASE 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 funding 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 the early 1980¹. As a result, it has become an important and current economic issue that external borrowing is a tool for the government, which is critical to achieving sustainable economic growth and inclusive development².

The expenditure of borrowed funds must be rationalized. External debt repayment has been 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 economic gains from those

* **Fettouche Fatma** – PhD student at the University Centre of Mila, Algeria; e-mail: f.fettouche@centre-univ-mila.dz

¹ Doğan, I., & Bilgili, F. (2014). The Non-Linear Impact of High and Growing Government External Debt on Economic Growth: A Markov Regime-Switching Approach. *Economic Modelling*, 39(2), 213.

² Agyeman, G., Sakyi, D., & Oteng-Abayie, E. F. (2022). External Debt and Economic Growth in Selected Sub-Saharan African Countries: The Role of Capital Flight. *Research in Globalization*, 5, 1.

borrowed funds.³ External debt is issued as a source of funding for domestic deficits due to insufficient funds from domestic savings to accelerate economic growth. However, some experimental experience and evidence suggest that countries using 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 contrary⁴.

Geographically, Algeria covers a wide area in North Africa within the Maghreb (2,381.741 km²), with a population of 44 million people. It is 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. The country's gross domestic product (GDP) is about 163 billion dollars. It is one of the petroleum economies, with more than 60% of its GDP dependent on petroleum revenues and incomes. Therefore, in this paper, we will work on the impact of external debt on economic growth in Algeria.

The study aims to reveal the relationship between economic growth and external debt; we have applied the ARDL model associated with joint integration and error correction models for 1990–2021 to investigate the existence of a long-term balance between variables⁵. The following variables have been used: GDPGR (annual growth rate of real GDP); EDS/GDP (ratio of external debt to GDP); DSS/GDP (ratio of debt service stock of GDP); EXCH (real exchange rate DZD/USD); and TRD (trade openness). This study consists of an introduction, a literature review, a methodology, an applied empirical method and data set, and, finally, results and suggestions.

Literature Review

The inability of domestic resources to achieve sustained economic growth has become a concern for many countries, especially developing ones, as 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.⁶ The results of addressing the effects of some external debt variables, public debt, and fiscal deficits, indicate that the increase in external debt had a much greater negative impact on South Asian countries' long-term growth⁷. They addressed the impact of external debt on economic growth, considering the heterogeneity in public sector management of the sub-Saharan African Group. Differences in the equality of public service management showed that external debt hindered 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 test, the P.-P. unit root test, and the ARDL boundary test. The findings showed that foreign debt had a negative impact⁸. 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 Africa⁹.

³ Roy, A. (2023). Nexus Between Economic Growth, External Debt, Oil Price, and Remittances in India: New Insight from Novel DARDL Simulations. *Resources Policy*, 83, 1.

⁴ Triatmanto, B., Bawono, S., & Wahyuni, N. (2023). The Contribution and Influence of Total External Debt, FDI, and HCI on Economic Growth in Indonesia, Thailand, Vietnam, and the Philippines. *Research in Globalization*, 7, 2.

⁵ Ada, M. S., Chigozie, A. O., & Godwin, U. (2016). The Impact of External Debt on Economic Growth in Nigeria: An ARDL Bound Testing Approach. *Journal of Economics and Sustainable Development*, 7(10), 16–27.

⁶ Mohsin, M. et al. (2021). How External Debt Led to Economic Growth in South Asia: A Policy Perspective Analysis from Quantile Regression. *Economic Analysis and Policy*, 72(788), 435.

⁷ Sandow, J. N., Oteng-Abayie, E. F., & Duodu, E. (2022). External Debt and Economic Growth in Sub-Saharan Africa: Does Heterogeneity in the Quality of Public Sector Management Make a Difference? *Heliyon*, 8, 8.

⁸ Ramzan, M., & Ahmad, E. (2014). External Debt Growth Nexus: Role of Macroeconomic Policies. *Economic Modelling*, 38, 204–210.

⁹ Omankhanlen, A. E. et al. (2020). Dynamic Relations Between Public External Debt and Economic Growth in African Countries: A Curse or Blessing? *Journal of Open Innovation*, 6(3), 88.

The research 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 ratio. It has been established that there is a positive impact relationship, such as investment and human capital on economic growth, because economic growth variables and growth are not linear¹⁰.

The study also examined the relationship between government debt and economic growth for an estimated 40 years since 1970 through the evolution of Greece's 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, the country's economic structure, and indicators of investment capacity and short-term expenditure funding. The empirical results indicated a positive and statistically significant impact of debt on economic growth¹¹. The paper 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 pilot study revealed that there was no evidence to indicate the positive impact of debt on economic growth in the sample countries; therefore, there was a negative impact¹². 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 pointed out that, generally, total external debt had an adverse effect on growth and was positively linked to income growth in low- and middle-income countries, where savings and investment were relied upon as important channels of disclosure¹³.

The study examined government investment and public debt levels on the economic growth of 65 developed and developing economies from 1991 to 2014. The empirical results demonstrated that government investment positively influenced economic growth in heavily indebted poor countries and lower-middle-income, middle-income, and upper-middle-income economies while damaging the OCDE and EU member states. As for the impact of government debt on economic growth, there was an appositive impact on economic growth for most upper-middle-income, high-income non-CDE, and middle-income economies¹⁴.

The study discussed the relationship between public debt and economic growth in developing and industrial countries during the period 1970–2012, with the results showing that the trend of public debt's impact on growth is seamlessly positive to negative, depending on the level of indebtedness¹⁵. Researchers considered the relationship between public debt and economic growth in Uganda during the period 1980 to 2016 as a developing country that, during the developing trajectory, experienced several years of debt accumulation. For many periods, it received a financial package to alleviate its external debt and also relief that helped to reduce the debt stock economic trajectory. The results of the pilot study established a negative impact of public debt on Uganda's economic growth trajectory¹⁶.

The study reviewed the relationship between public debt and economic growth in developed countries from 2004 to 2012. The results showed that public debt obstructed growth¹⁷, and tested the causal

¹⁰ Doğan, I., & Bilgili, F. (2014). The Non-Linear Impact of High and Growing Government External Debt on Economic Growth: A Markov Regime-Switching Approach, *Economic Modelling*, 39(2), 213–220.

¹¹ Spilioti, S., & Vamvoukas, G. (2015). The Impact of Government Debt on Economic Growth: An Empirical Investigation of the Greek Market. *Journal of Economic Asymmetries*, 12, 34–40.

¹² Johansson, P. (2010). Debt Relief, Investment and Growth. *World Development*, 38(9), 1204–1216.

¹³ Qureshi, I., & Liaqat, Z. (2020). The Long-Term Consequences of External Debt: Revisiting the Evidence and Inspecting the Mechanism Using Panel VARs. *Journal of Macroeconomics*, 63(5), 103184.

¹⁴ Chen, Ch. et al. (2017). Optimal Government Investment and Public Debt in an Economic Growth Model. *China Economic Review*, 45, 257–278.

¹⁵ Karadam, D. Y. (2018). An Investigation of Non-Linear Effects of Debt on Growth. *Journal of Economic Asymmetries*, 18, e00097.

¹⁶ Ssempala, R., Ssebulim, K., & Twinoburyo, E. N. (2020). Uganda's Experience with Debt and Economic Growth: An Empirical Analysis of the Effect of Public Debt on Economic Growth–1980–2016. *Economic Structures*, 9(48), 15–17.

¹⁷ Panizza, U., & Presbitero, A. F. (2013). Public Debt and Economic Growth in Advanced Economies: A Survey. *Swiss Society of Economics and Statistics*, 149(2), 175–204.

link between foreign and private-public debt and economic growth in the 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 rate¹⁸. 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 indicated that external debt shocks had a long-term negative effect on economic growth and investment, consistent with the debt burden hypothesis foreign debt, and a short-term positive impact on inflation, a negative impact on trade openness, and minimal exchange rate effects¹⁹.

Table 1. *External Debt Economic Growth Relationship Literature Summary*

Author(s)	Period	Countries	Methodology	Conclusion
Muhammad et al. (2021)	2000–2018	South Asia	Ordinary Least Squares (OLS)	Negative
Sadow et al. (2022)	2005–2017	Sub-Saharan Africa	Panel Smooth Transition Regression (PSTR)	Negative
Ramzan & Ahmad (2014)	1970–2009	Pakistan	ARDL	Negative
Omankhaleh et al. (2020)	2001–2018	African countries	Johansen Cointegration Test and System; Generalized Method of Moments (sysGMM)	Negative
Ball & Rath (2014)	1980–2011	India	APRIL	Positive
Doğan & Bilgili (2014)	1974–2009	Turkey	Ordinary Least Squares (OLS)	Positive
Spilioti & Vamvoukas (2015)	1970–2013	Greece	Ordinary Least Squares (OLS)	Positive
Johansson (2010)	1989–2004	Developing countries	Panel	Negative
Qureshi & Liaqat (2020)	1990–2015	World	Panel VARs	Negative
Chen et al. (2017)	1991–2014	Developed and developing economies	Panel Smooth Transition Regression (PSTR)	Bidirectional casual relationship
Karadam (2018)	1970–2012	Developing and industrial countries	Panel Smooth Transition Regression (PSTR)	Negative
Ssempala et al. (2020)	1980–2016	Uganda	ARDL	Negative
Panizza et al. (2013)	2004–2013	OCDE	OLS	Negative
Onafowora & Owoye (2019)	1970–2014	Nigeria	SVAR	Negative

¹⁸ Ferreira, C. (2016). Debt and Economic Growth in the European Union: A Panel Granger Causality Approach. *International Advances in Economic Research*, 22, 131–149.

¹⁹ Onafowora, O., & Owoye, O. (2019). Impact of External Debt Shocks on Economic Growth in Nigeria: A SVAR Analysis. *Economic Change and Restructuring*, 52(4), 157–179.

Ferreira (2016)	2001–2012	EU countries	Panel Granger Causality	Bidirectional casual relationship
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Data and Methodology

This study uses the annual GDP growth rate and the following subordinate variables: 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. The data applied consisted of 32 observations during the period 1990–2021, obtained from the World Bank database; for example, the beginning of the 1990 study coincided with the beginning of the accumulation of external debt. 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:

$$lnGDPGR_t = b_0 + b_1lnEDS/GDP_t + b_2lnDSS/GDP_t + b_3lnNEXP/GDP_t + b_4lnEXCH_t + b_5lnTRD_t + U_t \quad (1)$$

The data in the application are coded as follows:

Table 2. Data Description

Symbol	Measurement	Data Source
GDPGR	Annual growth rate of real GDP	World Bank
EDS/GDP	Ratio of external debt to GDP	World Bank
DSS/GDP	Ratio of debt service stock to GDP	World Bank
NEXP/GDP	Ratio of national expenditure to GDP	World Bank
EXCH	Real exchange rate	World Bank
TRD	Trade openness	World Bank

Transactions b_1 , b_2 , b_3 , b_4 , and b_5 indicate the growth flexibility 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 error correction factor.

This quantitative analytical study employed the ARDL test to verify the short-term and long-term balance between external debt variables and GDP growth. The aging analysis of the ARDL model, the cointegration test, the boundary test developed by Pesaran et al. (2001), and the error correction model were used to examine long-term relationships and to see whether there was a short-term relationship between the variables²⁰. The advantage of the ARDL model is that joint integration boundary tests can be applied to study variables, regardless of whether they are integrated in the same grade or combination I (1) and I (0), as well as the small sample characteristics of the superior ARDL boundary test, compared to multi-variable cointegration. Thus, the ARDL model helps estimate the short- and long-term parameters of the model at the same time²¹. 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

²⁰ Bentzen, J., & Engsted, T. (2001). A Revival of the Autoregressive Distributed Lag Model in Estimating Energy Demand Relationships. *Energy*, 26(1), 45–55.

²¹ Hurley, D. T., & Papanikolaou, N. (2021). Autoregressive Distributed Lag (ARDL) Analysis of U.S.-China Commodity Trade Dynamics. *The Quarterly Review of Economics and Finance*, 14, 5.

study variables and the advantages of the ARDL model, that there are no self-correlation problems in the ARDL test procedures, and that the internal problem can be addressed by choosing the appropriate degree of delay under the optimal delay hypothesis²². We have drafted the form as follows:

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

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:

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

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 short- and long-term relationship between the variables, the error correction coefficient is derived as follows:

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

Empirical Results 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 follow precarious trends over the study period. While the real exchange rate trend follows a negative path from high to very low, the one for the external debt share of GDP and debt service shares to GDP goes from high to very low levels during the study period.

²² Wang, H. (2022). 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*, 6.

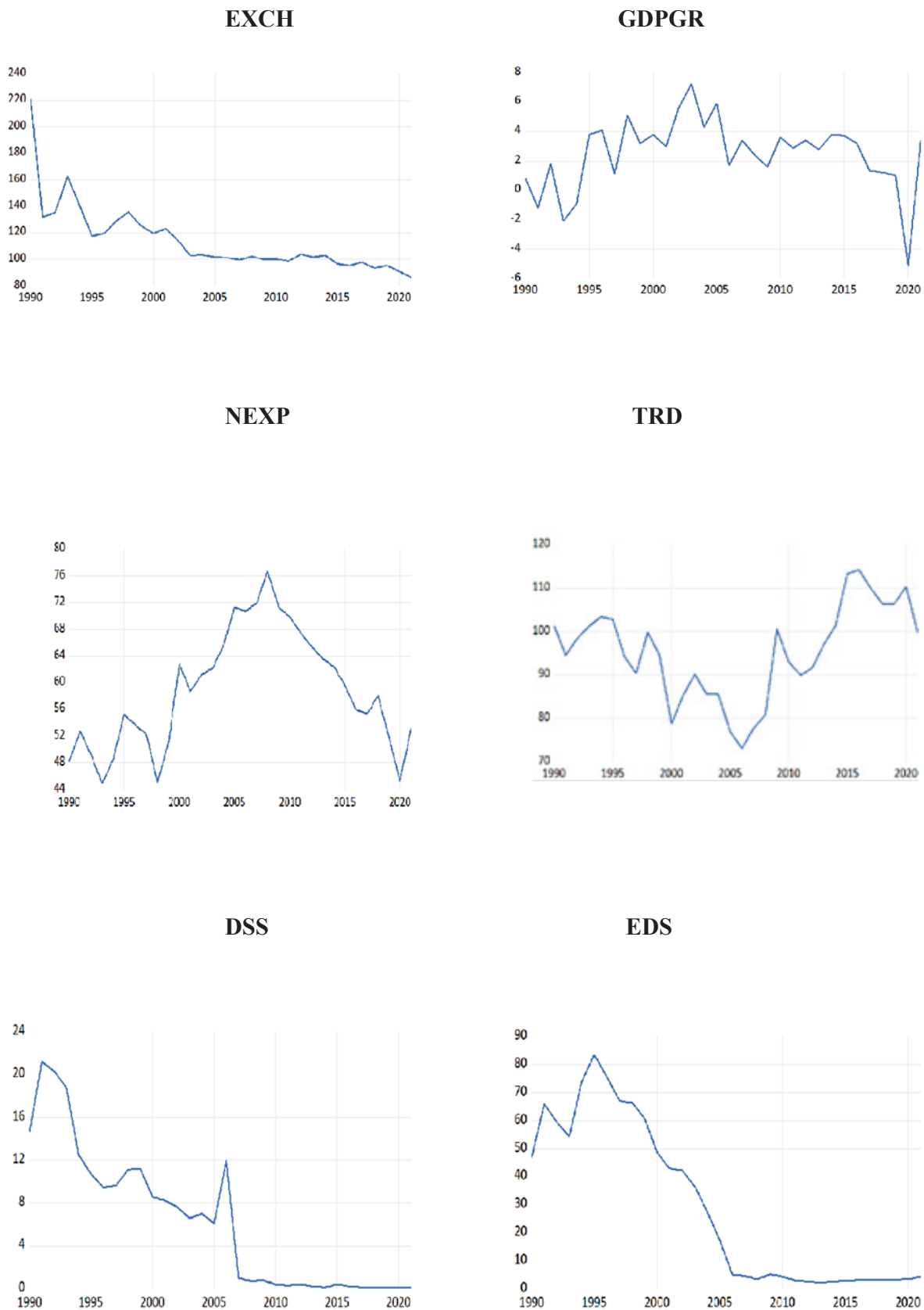


Figure 1. Graphs of the Variables Included

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 CT data:

$H_0 = \sigma^2$ (constant variance);

$H_1 \neq \sigma^2$ (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.
Breusch-Pagan-Godfrey	0.724920	0.6683
Harvey	0.646584	0.7306

We note from the probability values of the Breusch-Pagan-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 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 H_0 is accepted, there is a constant discrepancy.

Table 4. Autocorrelation Test

Breusch-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

The results presented in Table 3 show Breusch-Godfrey's 0.44 Prob. and Prob. The 0.29 Chi-Square test (2) 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

*The P-value is incompatible with the 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

* The P-value is incompatible with the t-bounds distribution.

Tables 5 and 6 show that the error correction factor is a negative CointEq (-1), and that 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		Critical Value %1		Critical Value %5	
K	F-Statistic	(0)	I(1)	I(0)	I(1)
5	5.649441	.06	4.15	2.39	3.38

* K is the number of independent variables.

Table 7 indicates that 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 with GDP growth and with 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 via 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 for the period 1990–2021. We applied diagnostic tests, the serial correlation test, the discrepancy problem detection test, the error correction model, and the ARDL bound test. 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 the country’s external debt.

According to the study data, Algeria’s 2006 external debt to GDP recorded 5.24%, compared to a GDP growth of 1.7% for the same period. 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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