

Assessing the Relationship between Financial Sustainability Indicators And Economic Growth Rates in Algeria for the Period 1990-2021

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Abstract:

This research aims to analyze the impact of financial sustainability indicators (public debt index, tax gap index, and budget deficit index) on the economic growth rate (gross domestic product) in Algeria during the period 1990_2021. The study utilizes the Auto-regressive distributed lag (ARDL) model to examine the long-term equilibrium relationship between these variables. The findings suggest that financial sustainability indicators play a significant role in fostering economic growth over the long term. However, it is important to note that these indicators alone are insufficient to ensure sustained economic growth. Consequently, the study recommends the necessity of achieving economic diversification in Algeria as a way to maintain favorable levels of financial sustainability.

Keywords: Financial Sustainability, Economic Growth, Gross Domestic Product, Public Debt, ARDL model

Jel Classification Codes : C13, E62, H61, H63, C32.

Résumé:

Cette recherche vise à analyser l'impact des indicateurs de viabilité financière (indice de la dette publique, indice de l'écart fiscal et indice du déficit budgétaire) sur le taux de croissance économique (produit intérieur brut) en Algérie au cours de la période 1990_2021. L'étude utilise le modèle de décalage distribué auto-régressif (ARDL) pour examiner la relation d'équilibre à long terme entre ces variables. Les résultats suggèrent que les indicateurs de viabilité financière jouent un rôle important dans la promotion de la croissance économique à long terme. Cependant, il est important de noter que ces indicateurs seuls sont insuffisants pour assurer une croissance économique soutenue. Par conséquent, l'étude recommande la nécessité de réaliser la diversification économique en Algérie comme un moyen de maintenir des niveaux favorables de viabilité financière.

Mots clés: Viabilité financière, Croissance Economique, Produit intérieur brut, Dette publique, modèle ARDL

Jel Classification Codes : C13, E62, H61, H63, C32.

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I. Introduction

Increased interest in analysing and examining fiscal policy outcomes and assessing their impact on Governments' financial situation and highlighted the concept of financial sustainability, which generally refers to the State's ability to sustain long-term public spending policies and public revenues without reducing its financial solvency or its ability to meet its future fiscal obligations, Financial sustainability depends on the outlook for future public spending and revenue, under which current financial policies are adjusted.

financial sustainability constitutes the most important economic challenge faced, particularly by rentier countries, including Algeria's economy, which relies on the income of petroleum levies to finance its development programmes and policies, adversely affecting financial sustainability indicators and making financial policy and macroeconomic balances hostage to oil price fluctuations.

I.1. Study Problem

This study attempts to answer the following key question :

What is the impact of financial sustainability indicators on Algeria's economic growth rate during the period 1990-2021?

Under this key question is the following sub-set of questions:

- Is there a causal link between financial sustainability indicators and Algeria's rate of economic growth during the study period ?
- What is the impact of the public debt index on Algeria's economic growth rate during the study period?
- What is the impact of the budget deficit index on Algeria's economic growth rate during the study period?
- What is the impact of the tax gap index on Algeria's economic growth rate during the study period?

I.2. Study Hypotheses

This study is based on the following hypothèses:

- There is a long-term equilibrium between financial sustainability indicators and Algeria's rate of economic growth during the period 1990-2021 ;
- The public debt index is inversely related to the rate of economic growth and affects it negatively in the short and long term during the study period ;
- The budget deficit index has a positive correlation with the rate of economic growth and affects it positively in the short and long term during the study period ;
- The tax gap index has a positive correlation with the rate of economic growth and affects it positively in the short and long term during the study period.

I.3. The Importance of Study

This study draws its importance from the importance of the concept of financial sustainability and is a prerequisite for economic growth in various economies, especially rentier economies, in order to achieve financial stability in the medium and long term.

I.4. Objectives of the Study

This study aims to measure and determine the type and direction of the relationship between financial sustainability indicators and the rate of economic growth in Algeria expressed in terms of GDP, through a standard study using the Autoregressive distributed Lag model of time gaps (ARDL) during the period from 1990 to 2021.

I.5. Study Methodology

In order to answer the study problem and determine the impact of financial sustainability indicators (public debt index, Budget deficit index, The tax gap index) on the rate of economic growth in Algeria during the period 1990-2021, we relied on the analytical descriptive approach and the standard analytical approach in which we applied ARDL models using Eviews 13.

I.6. Previous Studies

Among the studies we have seen on study variables, we review the following:

- Study: Sabah Barahi (2022): **Assessment and analysis of the financial sustainability of the Algerian economy during the period 1990/2019**, *Journal of Economic Researcher*, 10(01). The study aimed at assessing and analyzing the indicators of the financial sustainability of the Algerian economy during the period 1990/2019 as a prerequisite for achieving sustainable and long-term growth. The study found that Algeria's financial behaviour was poorly sustainable and therefore the study recommended the need to promote financial sustainability in Algeria as a prerequisite for achieving economic take-off ;
- Study: Bouaishawi Mourad and Azazi Imad (2021): **Financial sustainability in Algeria under oil price volatility - Standard analytical study for 2000/2020**, *Journal of creativity*, 11(02). The study aimed at analyzing Algeria's financial sustainability in the light of oil price volatility during the period 2000/2020. The study concluded that the Algerian economy was vulnerable to sustainability owing to the impact of oil price shocks on the State's budgetary resources. The study recommended that an economic model should be created to ensure sustainable financing of the economy.

I.7. The research gap

Previous studies in analyzing financial sustainability relied on studying the relationship between public revenues and public expenditures within the time

frame of the budget or by testing the fulfillment of the financial solvency condition. However, our research is interested in measuring the extent to which financial sustainability is achieved by analyzing indicators of public debt, tax gap, and primary deficit, measuring their impact on GDP, and testing the degree of integration between them to determine the nature of the relationship between them and the extent of their balance in the long run to ascertain the financial sustainability of the state or lack thereof.

II. Theoretical Framework for Study Variables

II.1 The Concept and measurement indicators of financial sustainability

II.1.1 The concept of financial sustainability

agreement between researchers, economists and even international organizations on a unified definition. Some of them link it to the sustainability of public debt (budgetary time constraint), and some to rational spending or increased resources. Some of these concepts are summarized as follows:

Buiter considers that public expenditure is sustainable (financial policy) if the net net value (wealth) of the public sector to GDP is kept constant and in advance (i.e. the same as the previous ratio) and indefinitely.(Buiter, 1985, pp. 49-50)

According to Blanchard, sustainable financial policy can be seen as one that ultimately converges the debt-to-GDP ratio to its initial or higher but stable level (Blanchard & Sartor, 1990, p. 11). In other words, the financial sustainability of the public debt/GDP ratio is required to be stable, and in the event of exceptional situations and high ratios, it is necessary to return to the original levels thereafter.

Sturm, Gurtner and Alegre each describe the financial sustainability of oil-exporting countries as ensuring the same amount of public goods or post-oil expenditure as in the oil period without resorting to deficit financing (ensuring generational equality). (Kenan, 2015, p. 115)

Financial sustainability aims to maintain financial policy stability in general; In addition to the following points (Ben Issa, 2020, p. 80) :

- Achieving The State's financial solvency; That is, the Government's ability to meet its financial obligations on time without the risk of inability to pay ;
- Achieving economic growth by supporting economic activity's financial policy to drive growth and social well-being ;
- Achieving economic stability; That is, the Government's ability to meet its future obligations as well as current tax burdens to preserve the rights of future generations and to continue with the current expenditure and revenue policy ;

- Achieving intergenerational justice and equity ; that is, the government's ability to continue its current financial policy without transferring its cost to future generations and holding them accountable for decisions they did not participate in making.

II.1.2 Indicators measuring Financial sustainability

A country's financial sustainability is analysed according to several indicators endorsed by international organizations, which take into account developments in financial policy variables, particularly with regard to taxation; Public debt; General budget deficit. The most important indicators are:

II.1.2.1 Public debt to GDP index

This indicator measures the ratio of public debt to the level of economic activity and this is through GDP. The importance of this indicator is to give an overall picture of the burden of domestic public debt as well as the strength and stability of the economy in relation to public debt. It was relied upon as a basis for accession to the European Union in accordance with the Maastricht Treaty (1996), which stipulates that domestic and external public debt should not exceed 60% of GDP. (Mohammed et al., 2019, p. 115)

II.1.2.2 Budget Deficit Index

The calculation of this indicator is based on the estimate of the initial deficit or surplus of the general budget by calculating the difference between public expenditures without interest payments and public revenues without interest received. This indicator is based on the fact that financial policy for financial sustainability must maintain a primary budget to GDP surplus ratio at its current level in order to ensure a stable debt-to-GDP ratio. (Audrey, 2020, p. 213)

II.1.2.3 Tax Gap Index

This indicator is based on the Public Debt-to-GDP Ratio Index, and the first research on it dates back to Blanchard in 1990, which emphasized that tax policy should aim to reduce the difference between targeted (and financially sustainable) taxes and actual taxes. (Bouachaoui et al., 2020, p. 101)

II.2 The Concept and measurement indicators of economic growth

II.2.1. The concept of economic growth

Economic growth is defined as an increase in gross domestic product (GDP), resulting in an increase in average per capita real income over time, which means not only an increase in total income or gross domestic product, but also an improvement in an individual's standard of living by increasing their share of total income. (Hibour & Taleb, 2023. p. 75)

Economic growth is also defined as the rise recorded over a period of time, usually a year or successive periods of time, for a distributive economic variable that is the real net output. (Boulenoir, 2023, p. 55)

II.2.2 Indicators measuring economic growth

In order to measure economic growth, economists rely on two main indicators: (Boulenoir, 2023, p. 55)

II.2.2.1 Gross Domestic Product (GPD)

It measures the monetary value of total goods and services produced within a given geographical region's boundaries over a specified period of time and is used as an indicator to measure the short and long-term rate of economic growth, one of the most acceptable indicators in economics.

II.2.2.2 GDP per capita

Real GDP per capita is used to measure people's overall well-being and is calculated by dividing GDP by population.

III. Standard Study on the Impact of Financial Sustainability Indicators on Algeria's Economic Growth

III.1 The method and tools used

To achieve the study's objective of determining the impact of financial sustainability indicators on Algeria's GDP growth rates; We will use **Autoregressive Distributed Lag model**. This is to determine whether there is an impact of financial sustainability on economic growth in the short and long term, drawing on available annual data on these and some other assistive variables during the period (1990-2021).

III.1.1 Autoregressive Distributed Lag model

Analysis of time series is an important statistical method, which addresses economic phenomena and their interpretation over extended periods of time. The main objective of using time series models is to gather previous views of a time series in order to develop an appropriate model describing the structure inherent in the series, and then this model is used to predict future values. (Adhikari & Agrawal, 2013, p. 06)

One of the most important models of joint integration is the Engle and Granger model (1987) and the Johansen and Juselius model (1990), which require that the two series be complementary of the same degree and that the residuals resulting from their estimation are integrals of rank zero. (Wooldridge, 2012, p. 646). The Autoregressive Distributed Lag Model (ARDL) developed by Sun (1998), Pesaran et al (2001) (Pesaran, Shin, & Smith, 2001, pp. 286-326) is among the best standard models used in the joint integration test compared to other known methods, such as Angel Granger's two-step (Engel Granger To Stepmethod) or Johansen's joint integration test under the VAR model. ARDL also offers many advantages: (Afzal & Al, 2013, p. 25)

- This method is relatively more robust in small samples involving 30-80 views ;
- This method is used regardless of whether the series are integrated I(0) or I(1) or if they are mixed, and the ARDL model is ineffective if a time series is integrated I(2) ;
- The ARDL model applies a general-to-specific modelling framework by taking enough delays to get the data generation process. It estimates the number of $\lfloor (p+1) \rfloor^k$ of regressions for the purpose of obtaining the optimal delay length for each variable, where (p) is the maximum delay period that can be used and (k) is the number of internal variables in the equation. The model is chosen based on various statistical criteria such as: Akaike Info Criterion (AIC), Schwarz Info Criterion (SIC) or Hanan-Quinn Criterion (HQC) ;
- The ARDL model estimates both short-term and long-term relationships, and provides unbiased and efficient estimates.

III.1.2 Study period and data sources

This study uses annual data on Algeria for the period 1990-2021. Data on the study variables have been obtained from the Bank of Algeria's annual reports; World Bank database; National debt of statistics.

III.1.3 Study model

Based on economic theory and previous empirical studies on the impact of financial sustainability indicators on Algeria's economic growth rates, the following model will be estimated:

$$\text{LGDP} = f(\text{LGD}, \text{LBD}, \text{LTG}) \dots\dots\dots (01)$$

t= 1990-2021

where :

- LGDP: GDP logarithm (billion Algerian dinars);
- LGD: logarithm of the public debt index as a percentage of GDP;
- LBD: budget deficit index logarithm;
- LTG: Tax Gap Index logarithm.

To estimate the impact of financial sustainability indicators on Algeria's economic growth rates; The ARDL model will be used, under the following formula:

$$\begin{aligned} \Delta LGDP_t = & \beta_0 + \sum_{t=1}^p \beta_{1t} \Delta LGDP_{t-i} + \sum_{t=1}^{q1} \beta_{2t} \Delta LGD_{t-i} \\ & + \sum_{t=1}^{q2} \beta_{3t} \Delta LBD_{t-i} + \sum_{t=1}^{q3} \beta_{4t} \Delta LTG_{t-i} + \alpha_1 LGDP_{t-1} \\ & + \alpha_2 LGD_{t-1} + \alpha_3 LBD_{t-1} + \alpha_4 LTG_{t-1} \\ & + \varepsilon_t \dots \dots \dots (02) \end{aligned}$$

Where :

- Δ : Refers to first-degree differences;
- 0β : Fixed limit;
- $p, q1, q2, q3$: The upper limit for slowing periods of study variables;
- T : Time direction;
- ε_t : Random error limit;
- $4\beta, 3\beta, 2\beta, 1\beta$: Short-term relationship coefficients;
- $4\alpha, 3\alpha, 2\alpha, 1\alpha$: Long-term relationship coefficients.

III.2 Results and discussion

III.2.1 Unit Root Test

As a preliminary stage, the stability of the time series in question must be studied to determine their degree of integration. Until the ARDL model is applied, all study variables must be integrated from ranks I (0) or I (1). In this study, we will rely on Dickie Fuller's Developer Test (ADF) and PP test to detect the degree of integration of the study variables.

Table No. 1 show the results of the (ADF) and (PP) test for the unit root or stability (stationarity). Comparing the calculated values with the tabular values at the level of $5\% = \alpha$, it becomes clear that all the study variables (GDP logarithm, public debt index logarithm as a percentage of GDP, budget deficit index logarithm and tax gap index logarithm) are unstable at the level. When making first-order differences on these variables and re-conducting the same previous tests, All these variables have become stable.

As a conclusion, all study variables are first-order integrated, i.e. form I (1), and therefore the joint integration test can be performed using the Bounding Test method.

III.2.2 Joint Integration Test Using the bounds test method

In order to test the joint integration relationship (test for a long-term balancing relationship between study variables) the ARDL model must be estimated. The AIC standard has been relied upon to determine optimal time delays, so that the appropriate model is the one through which the lowest value of the AIC is obtained. The model selected in this study is ARDL (3,1,3,1), as illustrated in figure No. (01).

The Joint Integration Relationship between study variables is tested within the framework of the **Unrestricted Error Correction Model (UECM)**, And we will test the null hypothesis that there is no joint integration (long-term equilibrium relationship) between the variables as follows:

$$H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$$

In contrast to the alternative hypothesis that there is a joint integration relationship in the long run:

$$H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$$

Through table No. (02) ,showing the results of the Joint Integration Test (ARDL Bounds Test), the statistical value (F-statistic) is 10.7357 which is greater than the critical value of the upper limit at a significant level of 1% (4.84). Hence, the null hypothesis is rejected, which states that there is no joint integration between the variables, and this indicates the existence of a long-term equilibrium relationship between the logarithm of the GDP and the logarithm of the financial sustainability indicators.

III.2.3 Estimating the joint integration relationship in the long run

Previous results have confirmed the existence of joint integration between study variables, and we will estimate the long-term equilibrium relationship of the ARDL model (3,1,3,1).

The results of estimating the long-term relationship between the study variables shown in Table No. (03) indicate that the logarithm of the public debt index as a percentage of GDP (LGD) has no statistically significant effect on the logarithm of GDP (LGDP) in the long term, as well as the logarithm of the budget deficit index (LBD) which is also statistically insignificant at the level of 5 %.

As for the tax gap index (LTG) logarithmic variable, it had a positive and statistically significant effect at the level of 1%. When the tax gap increases by 1%, GDP increases by 3.36%.

III.2.4 Estimating the error correction formula for the model (ARDL-ECM):

The short-term relationship is to estimate the error correction model, which represents the expression of variables used in the variance model. In addition to the error correction limit slowed down for one time CointEq (-1) as an

interpretative variable, the error correction limit measures the speed at which the imbalance adjusts in the short term to long-term balance. If the value of the error correction limit parameter is negative and significant, this indicates a long-term relationship between the variables.

We note from Table No. (04), which shows the results of the short-term estimation of the examined model, that CointEq (-1) error correction coefficient has a negative and significant value, reaching 0.0878. This confirms the existence of a long-term equilibrium relationship between the study's variables. The value of the error correction parameter shows that about 8.7% of the short-term imbalance in GDP in the previous period can be corrected in the current period towards the long-term relationship when there is any change or shock in financial sustainability indicators.

As evidenced by the results of the short-term relationship estimate, GDP in the short term is negatively affected at a level of 5% by the increase in the logarithm of the public debt index as a percentage of GDP (LGD); the latter's increase of 1% would lead to a decrease in GDP by 0.28%. As for the impact of the LBD logarithm, it had no statistically significant effect on GDP in the short term. As for the log variable, the tax gap index (LTG), It had a positive and statistically significant impact at a level of 5%, as a 1% increase would result in a 0.29% increase in GDP.

III.2.5 Diagnostic tests for standard model validity

The most important diagnostic tests to test the validity of the study model can be summed up as follows:

III.2.5.1 Structural Stability Test for Model coefficients

From figure No. (02) and Figure No. (03), we note that the graph for both tests (CUSUM) and (SUSUMSQ) is within the critical boundary frame at Level 5. Thus, we accept the null hypothesis, which states that all parameters of the estimated model are stable, and therefore long- and short-term parameters of the model will remain static.

III.2.5.2 Autocorrelation problem test

(LM) test results clarifies that (Prob = 0.1017) which is greater than 0.05 and therefore we accept the null hypothesis, which states that there is no autocorrelation between the residuals, and this means that the estimated model is autocorrelation problem free.

III.2.5.3 Heteroskedasticity problem test

It is also noted from the (Breusch-Pagan-Godfrey) test results that (Prob = 0.1302) which is greater than 0.05. Consequently, we accept the null hypothesis that the model is Heteroskedasticity problem free, which in turn means that the estimated model is free from the non-stationarity of homoscedasticity problem.

III.2.5.4 The suitability of the model identification or design test (Ramsey RESET)

The Ramsey RESET test indicates that the model does not have the problem of unsuitability of the functional form; Prob = 0.5365 (greater than 0.05), which confirms the null hypothesis that the function does not suffer from the problem of indeterminacy.

III.2.5.5 Residuals natural distribution test

We note from Figure No. (04) that the probability value of the Jarque-Bera test is 0.5985, which is greater than 0.05. Therefore, we accept the null hypothesis which stipulates that the residuals are naturally distributed.

IV. Conclusion

This study aimed to measure the impact of financial sustainability indicators (public debt index, budget deficit index, tax gap index) on economic growth rates expressed in GDP in Algeria during the period (1990-2021), as this study was based on the (ARDL) model provided by (Pesaran) for joint integration. This study concluded a set of results that can be summarized as follows:

- Bounds test results indicated a long-term balanced relationship between GDP and financial sustainability indicators ;
- The results of the estimating the long-term relationship between the study variables indicated that the public debt index has no statistically significant impact at the level 5% on the long-term economic growth rate. This result is contrary to economic theory, but is fully consistent with Algeria's economic reality. Algeria has pursued a strict monetary and financial policy based primarily on reducing the size of public debt through several actions, including: Prepayment of external debt, financial cleansing of public institutions' debt by banks , in addition to the decision of the public authorities not to resort to the option of external borrowing due to its negative repercussions for the State's future financial sustainability. By establishing the Revenue Control Fund in 2000, the Algerian State's savings policy has greatly contributed to reducing the size of external indebtedness and thus achieving financial sustainability ;
- The same applies to the impact of the budget deficit index; it is also statistically insignificant at the level of 5%. This is consistent with classical economic thought, which assumes that economic balance is achieved automatically through the market mechanism without the state's intervention in its various economic policies, including financial policy. According to classical thinking, the deficit in the public budget is particularly futile in terms of the impact on income and employment. The State will only be able to identify the deficit in the public budget. In addition to its negative impact on interest rates and negatively affecting

investment through the so-called crowding effect, which results in the public sector crowding out the private sector on the volume of investments ;

- The tax gap index has a positive and statistically significant effect in the long run at the significance level of 1%. Increasing the tax gap by 1% results in a 3.36% increase in GDP. This result is in line with economic theory, but it is not a reflection of Algeria's economy, which relies on rentier revenues primarily from the exploitation of depleted resources (oil). This poses the problem of financial sustainability in rentier economies, including Algeria's. The structure of public expenditures also guarantees a small proportion of investment-oriented expenditures and is predominantly social (social expenditures).

Based on the findings, this study presents the following recommendations:

- Rationalizing public expenditures in Algeria by managing the pace of growth in a way that is in line with the State's financial capabilities, especially considering that oil revenue is the dominant source of public revenue, which is constantly influenced by fluctuations in oil prices on world markets;
- Achieving economic diversification and lack of reliance on depleted economic resources (oil) to reduce the magnitude of external shocks to which Algeria's economy can be exposed, directly affecting levels of financial sustainability;
- Developing and modernizing the general budgetary process, particularly with regard to the tax system, is crucial to increase normal tax revenues and achieve tax justice among its mandate holders through digitization in this area;
- Activating the role of the financial market as a primary source of funding for the government's emergency needs, and marketing the issuance of public bonds at the lowest possible cost and for short and medium terms.

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V. Appendices

Table 1: Unit Root Test Results for Study Variables Using ADF and PP Test

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

		<u>At Level</u>			
		LGDP	LGD	LBD	LTG
With Constant	t-Statistic	-4.4130	-1.5368	-2.0759	-3.3653
	Prob.	0.0015 ***	0.5017 n0	0.2551 n0	0.0203 **
With Constant & Trend	t-Statistic	-2.4074	-0.6688	-1.8191	-2.6643
	Prob.	0.3688 n0	0.9665 n0	0.6710 n0	0.2570 n0
Without Constant & Trend	t-Statistic	4.8888	-0.4859	-0.1802	-0.0173
	Prob.	1.0000 n0	0.4969 n0	0.6132 n0	0.6693 n0
		<u>At First Difference</u>			
		d(LGDP)	d(LGD)	d(LBD)	d(LTG)
With Constant	t-Statistic	-4.8364	-2.6616	-5.6684	-4.3221
	Prob.	0.0005 ***	0.0925 *	0.0001 ***	0.0020 ***
With Constant & Trend	t-Statistic	-5.7322	-3.0103	-5.6922	-4.5990
	Prob.	0.0003 ***	0.1461 n0	0.0003 ***	0.0049 ***
Without Constant & Trend	t-Statistic	-3.2802	-2.7052	-5.7811	-4.4432
	Prob.	0.0019 ***	0.0086 ***	0.0000 ***	0.0001 ***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on Mackinnon (1996) one-sided p-values.

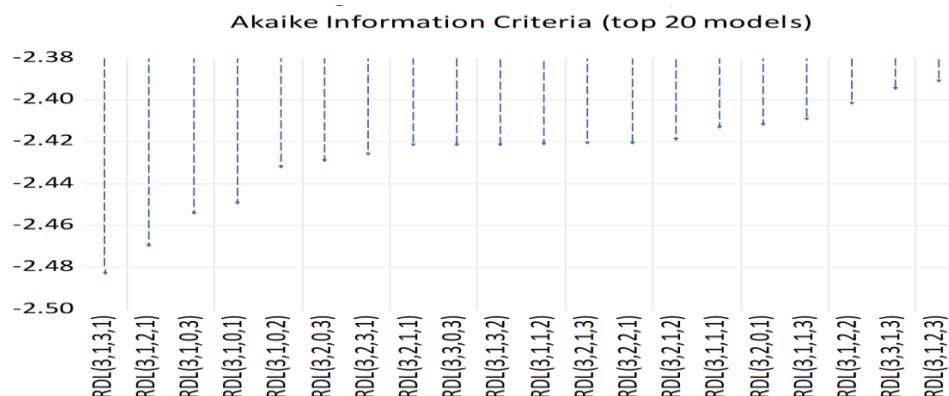
UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

		<u>At Level</u>			
		LGDP	LGD	LBD	LTG
With Constant	t-Statistic	-12.0940	-1.2442	-2.0159	-3.4429
	Prob.	0.0000 ***	0.6422 n0	0.2788 n0	0.0169 **
With Constant & Trend	t-Statistic	-2.5469	-0.2910	-1.7360	-2.8385
	Prob.	0.3052 n0	0.9873 n0	0.7107 n0	0.1952 n0
Without Constant & Trend	t-Statistic	3.7724	-0.4257	-0.1337	-0.0332
	Prob.	0.9999 n0	0.5213 n0	0.6296 n0	0.6640 n0
		<u>At First Difference</u>			
		d(LGDP)	d(LGD)	d(LBD)	d(LTG)
With Constant	t-Statistic	-4.8824	-2.5684	-5.6684	-4.1559
	Prob.	0.0005 ***	0.1105 n0	0.0001 ***	0.0030 ***
With Constant & Trend	t-Statistic	-12.8177	-2.9911	-5.6922	-4.5107
	Prob.	0.0000 ***	0.1511 n0	0.0003 ***	0.0060 ***
Without Constant & Trend	t-Statistic	-3.2680	-2.6150	-5.7811	-4.3013
	Prob.	0.0020 ***	0.0108 **	0.0000 ***	0.0001 ***

Source: Eviews.13 Outputs

Figure 1: Determining the number of delays in (ARDL) model



Source: Eviews.13 Outputs

Table 2. ARDL Bounds test results

Bounds Test

Null hypothesis: No levels relationship
Number of cointegrating variables: 3
Trend type: None (Case 1)
Sample size: 29

Test Statistic	Value
F-statistic	10.735754
t-statistic	-3.387025

Bounds Critical Values

Sample Size	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F-Statistic						
30	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000
Asymptotic	2.010	3.100	2.450	3.630	3.420	4.840
t-Statistic						
Asymptotic	-1.620	-3.000	-1.950	-3.330	-2.580	-3.970

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

Source: Eviews.13 Outputs

Table 3. long-term coefficients estimation results

Cointegrating Specification

Deterministics: None (Case 1)

CE = LGDP(-1) - (-0.064230*LGDP(-1) + 0.060925*LBD(-1) + 3.368631*LTG(-1))

Cointegrating Coefficients

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.064230	0.324191	-0.198124	0.8445
LBD(-1)	0.060925	0.518483	0.117506	0.9074
LTG(-1)	3.368631	0.331191	10.17126	0.0000

Note: * Coefficients derived from the CEC regression.

Source: Eviews.13 Outputs

Table 4. Short-term relationship estimation results

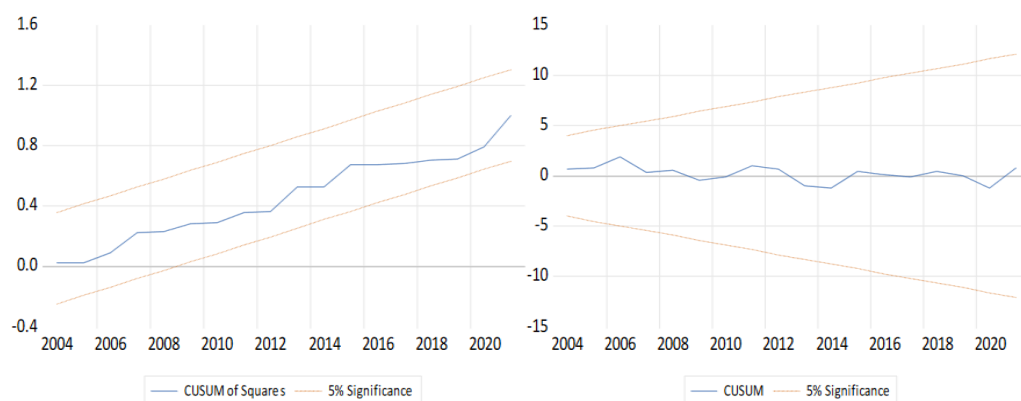
Dependent Variable: D(LGDP)				
Method: ARDL				
Date: 05/15/23 Time: 17:14				
Sample: 1993 2021				
Included observations: 29				
Dependent lags: 3 (Automatic)				
Automatic-lag linear regressors (3 max. lags): LGD LBD LTG				
Deterministics: No constant and no trend (Case 1)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 192				
Selected model: ARDL(3,1,3,1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)*	-0.087802	0.025923	-3.387025	0.0033
LGD(-1)	-0.005640	0.029629	-0.190337	0.8512
LBD(-1)	0.005349	0.046329	0.115463	0.9094
LTG(-1)	0.295772	0.081089	3.647507	0.0018
D(LGDP(-1))	-0.180548	0.163902	-1.101560	0.2852
D(LGDP(-2))	-0.383921	0.131452	-2.920629	0.0091
D(LGD)	-0.283440	0.083383	-3.399258	0.0032
D(LBD)	-0.001359	0.053815	-0.025260	0.9801
D(LBD(-1))	0.078852	0.039023	2.020674	0.0584
D(LBD(-2))	0.055117	0.044331	1.243299	0.2297
D(LTG)	-0.188798	0.130191	-1.450158	0.1642
R-squared	0.760747	Mean dependent var	0.104137	
Adjusted R-squared	0.627829	S.D. dependent var	0.099569	
S.E. of regression	0.060743	Akaike info criterion	-2.482637	
Sum squared resid	0.066415	Schwarz criterion	-1.964007	
Log likelihood	46.99823	Hannan-Quinn criter.	-2.320209	
F-statistic	5.723431	Durbin-Watson stat	2.374691	
Prob(F-statistic)	0.000700			

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

Source: Eviews.13 Outputs

Figure 2: Cumulative sum of successive residuals

Figure 3: Cumulative sum of squares of successive residuals



Source: Eviews.13 Outputs

Table 5. Diagnostic tests results

الاختبار الإحصائي	القيمة المحسوبة	قيمة الاحتمال
Serial Correlation (LM test)	2.6455	0.1017
Heteroskedasticity (Breusch-Pagan-Godfrey)	16.3052	0.1302
Ramsey RESET Test	0.3979	0.5365

Source: Eviews.13 Outputs

Figure 4: Natural Distribution Test - Normality (Jarque-Bera)

