ISSN: 3066-9847
Research Article

Science Set Journal of Economics Research

Determinants of Sustainable Economic Growth in Angola: A Case Study on Agriculture

Mario Augusto Caetano Joao

Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences in Prague

[*]**Corresponding author:** Mario Augusto Caetano Joao, Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences in Prague.

Submitted: 16 December 2024 **Accepted:** 24 December 2024 **Published:** 31 December 2024

https://doi.org/10.63620/MKSSJER.2024.1066

Citation: *Citation: Joao, M. A. C. (2024). Determinants of Sustainable Economic Growth in Angola: A Case Study on Agriculture. Sci Set J of Economics Res, 3(6), 01-11.*

Abstract

This study analyzes the impact of the agricultural sector on economic growth in Angola and suggests policy recommendations. Annual time series data from 1993 to 2022 were used. The ARDL and error correction models were applied to analyze both long- and short-term relationships, and different statistical and econometric tests were used to examine the significance of the input data and model results, including various diagnostic tests and the Granger causality test. The study findings show stronger evidence of a long-term relationship between the dependent and independent variables than in the short run. The short-term results show themselves to be statistically insignificant. Value-added agriculture, as a metric, shows the best reaction in all the lags involved, indicating that economic growth would, caeteris paribus, respond positively to an improvement in agricultural performance in Angola, albeit after a 3-year delay. Value-added agricultural development would improve both the contribution of agricultural employment and agricultural exports toward economic growth, as well contributing to better rural development in Angola

Keywords: Economic Growth, Agriculture, ARDL Model, Angola

Introduction

Angola's economy was built by the Portuguese to be an export-oriented economy with strong agribusiness value chains. Before its independence in 1975, Angola was one of Africa's major producers and exporters of cotton, corn, banana, tobacco, sugar cane, and sisal and even became the fourth largest coffee exporter in the world after Brazil, Colombia, and Côte d'Ivoire with a share of 6.1% of the world's exports [1, 2].

The independence of Angola from the Portuguese in 1975, in midst of the Cold War, triggered what would turn out to be a long-lasting civil war, ending only in 2002. As shown in Figure 1 below, in 2002, value-added agriculture grew by 3.8%, but in the last 20 years, growth has averaged 6.2%. Local production of agricultural goods accounts for less than 30% of the country's needs, and the rest is imported [3].

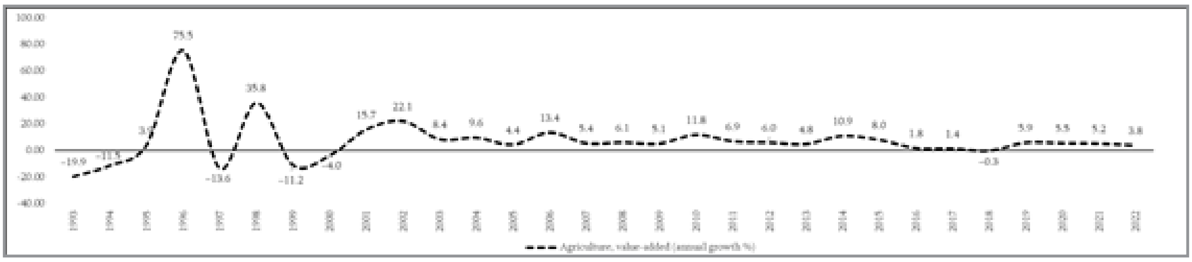

Figure 1: Angola's value-added agricultural performance in relation to GDP

Source: FAO and World Bank, online: https://databank.worldbank.org/reports.aspx?source=world-development-indicators#, 27/03/2024

However, notwithstanding this performance, only 15% of the overall arable land is currently cultivated, and 20% is suitable for irrigation. Agriculture alone will struggle to contribute to economic growth and impact the development of the country. It needs investment and development in other fields or sectors to thrive. For this reason, an increase in agricultural production per se may not contribute to economic growth in the manner that it might for other countries at different stages of development.

Hence, this study analyzes the contribution of agriculture performance to economic growth in Angola and seeks to determine what policies and measures might help boost productivity in the agricultural sector.

Research Question

This research seeks to answer the following research questions:

1. Is there a long- or short-term relationship between agriculture and economic growth?
2. What policy recommendations and policy measures could help enhance agricultural sector productivity to further unlock its diversification potential and take advantage of regional and international economic integration?

Research Objectives

The main objective of this study is to examine and quantify the relationship between agriculture and economic growth in Angola. The investigation employs an autoregressive distributed lag (ARDL) and subsequent diagnostic tests to examine the importance of agriculture in economic growth in terms of both their short-term and long-term relationships, as well as the direction of causality. The bi-directional relationship analysis between agricultural sector growth and economic growth is fundamental to the design and implementation of successful economic development policies in Angola.

Additionally, this study aimed to analyze agriculture development trends and international best practices, as well as to review agricultural policies and policy measures in Angola.

Hypothesis

The following null and alternative hypotheses will be tested in accordance with the objectives of this dissertation to determine whether the agricultural sector had an impact on economic growth during the period 2003 to 2022:

- **H0:** Agricultural sector growth does not have a significant impact on economic growth in Angola; and
- **Ha:** Agricultural sector growth has a significant impact on economic growth in Angola.

The hypotheses above will be verified on a 5% significance level in both the short and long term. If the probability of the t-value is more than the significance level, the null hypothesis will be accepted. If the probability of the t-value is less than the significance level, the null hypothesis will be rejected.

Significance of the Research

The novelty of this study is that no prior studies assessing the impact of agriculture on economic growth in Angola have been conducted. Its findings can support policymakers from Angola and its developing partners in instituting effective policies and policy measures to pursue a sustainable agricultural performance for both economic and social gain.

Literature Review

Many theoretical and empirical studies have sought to identify the determinants of economic growth and the correlation between agriculture and economic growth. Some studies have shown the positive and some have shown the negative impacts of agriculture on economic growth. However, most findings indicate that strong agricultural activity leads to economic growth.

Generic Studies on Agriculture and Economics Growth

Timmer's work focuses on how agriculture plays a central role in transforming economies [4]. He argues that increased agricultural productivity is essential for economic development, especially in the early stages of growth. By increasing productivity, countries can release labor and capital for industrialization, which leads to higher economic growth. Lewis's dual-sector model examines the structural transformation between the agriculture and industrial sectors [5]. In his model, agriculture serves as a reservoir of labor that can be reallocated to the industrial sector without sacrificing food security, fostering rapid economic growth.

Schultz's seminal work suggests that even traditional agricultural systems can experience significant productivity gains with the introduction of modern technologies and better resource management [6]. He argues that investment in human capital, such as education for farmers, can drive agricultural productivity and thus contribute to economic growth. Mellor explores how agriculture can foster industrialization by generating savings, investment, and food surpluses that support urban and industrial expansion [7]. His work emphasizes that growth in agriculture is crucial for labor-intensive industries, as it reduces food prices and raises wages.

Gollin et al. focus on how agricultural productivity differences can explain large portions of income disparities across countries [8]. Their study highlights the importance of improving agricultural productivity in low-income countries to bridge the income gap with developed countries. The work of Diao et al. emphasizes that agriculture remains the most significant sector for African economies and is key to poverty reduction and economic growth [9]. They argue that, without productivity improvements in agriculture, overall economic development in Africa will be slow given the large rural populations.

Christiansen et al. analyze the linkage between agricultural growth and poverty reduction [10]. Their findings suggest that growth originating from agriculture is more effective in reducing poverty than growth from other sectors, especially in low-income countries where a large proportion of the population relies on agriculture. The research of Tiffin and Irz provides empirical evidence on the relationship between agriculture and economic growth in developing countries [11]. The authors find that in many developing countries, agriculture-led growth is critical, but it becomes less so as economies diversify and mature.

Specific African Economics

In the case of African economies, with substantially better farming conditions providing comparative advantages in agricultural products, most studies examined the link between the agricultural sector and economic growth or on the link between agricultural trade and economic growth. Generally, researchers agree that agriculture has an essential effect on economic growth of the developing countries implicated in the studies, namely Msuya on Tanzania, Oyakhilomen and Zibah on Nigeria, Odetola and Etumnu on Nigeria, Izuchukwu on Nigeria, Sertoğlu et al. on Nigeria, and Moussa on Benin [12-17].

Very few studies have examined the link between agricultural investments and economic growth. When addressing the impact of investment agriculture on the agricultural output, Badibanga and Ulimwengu explore the impact of agricultural investment on economic growth and poverty reduction in the Democratic Republic of Congo (DRC) [18]. The authors develop and utilize a two-sector economic growth model to analyze the optimal allocation of investments between the agricultural and non-agricultural sectors to maximize overall economic growth and reduce poverty.

Phiri et al. examined the agriculture sector in Zambia as a determinant of economic sustainability for the period from 1983 to 2017 [19]. An ARDL model was applied to prove that impact of agriculture on economic growth in Zambia was substantial in both the short and long term. Furthermore, Runganga and Mhaka assessed the impact of agriculture on economic growth in Zimbabwe using the ARDL estimation technique for the period from 1970 to 2018 [20]. Their results show that agricultural production has a positive impact on economic growth in the short term and no impact in the long term. Bakari and Abdelhafidh investigate the relationship between agricultural investment and economic growth in Tunisia [21]. The authors employ an ARDL cointegration approach to analyze how different components of agricultural investment influence the long-term and short-term economic growth of the country.

Many theoretical and empirical studies have also analyzed the correlation between financial credit and agricultural sector growth. Some have identified a positive impact, while others have identified a negative impact, but the literature's general conclusion is that strong financial systems increase credit activity and subsequently lead to economic growth. For instance, Akram et al. demonstrated a positive effect of agricultural sector credit on agricultural sector growth in Pakistan, revealing an elasticity of agricultural credit in relation to poverty of −0.35% and –0.27% in the short term and long term, respectively [22]. Caetano Joao and Castro examined the degree of elasticity between two variables, namely, agricultural credit and agricultural growth, in Angola in the period 2003–2022 using the ARDL model [23]. Their results showed that the impact of agricultural credit on the growth of the agricultural sector was positive and statistically significant.

Research Structure and Methodology

Data Sources, Estimation Period and Econometrical Tool

The data used to estimate the time series in the present study were extracted from United Nations specialized agencies, namely, the World Bank (WB) (World Development Indicators), International Monetary Fund World Economic Outlook (IMF WEO), and Food and Agriculture Organization Statistics (FAOSTAT), as well as from Angolan statistical systems, namely, the Angola Statistical Office (INE), Ministry of Finance (MINFIN), Ministry of Agriculture and Forestry (MINAGRIF), and the National Bank of Angola (BNA). The time series data are annual, covering the period from 1993 to 2022, a total of 30 observations. According to Narayan and Wolde-Rufael, ARDL models are applicable to small sample size ranging from 30 to 80 observations [24, 25].

For the estimation exercise, the STATA 14.2 econometric tool was used.

Determination of Variables

The determination of the variables involved a combination of theoretical under-standing, empirical evidence, data availability, and statistical techniques based on the definition of the research question and literature review. Data were collected for five variables, shown in Figure 2 below.

Figure 2: Summary of dependent and independent variables used in the study

Variables	Definition	Measurement	Source	Expected relationship
GDP	Gross domestic product as measure for economic growth. Total values of goods and services produced domestically in the economy in a year	Annual growth (%)	WDI	Dependent
INF	Inflation, consumer prices. Annual GDP growth rate implicit deflator.	Annual change (%)	WDI	Negative
GFCF	Gross fixed capital formation as a proxy for investments. Additions to the fixed assets of the economy plus net changes in the level of inventories.	Annual growth (%)	IMF	Positive
AgrVA	Agricultural value-added growth rate as a proxy for agricultural real growth.	Annual growth (%)	FAO/INE	Positive
TO	Trade openness or trade volume. Total values of goods and services imported and exported in the economy in a year.	Annual growth (%)	BNA	Positive

Research Methodology and Model Design

The objective of this study is to evaluate the impact of agriculture on Angola's economic growth through robust methods, estimating an econometric regression model using the ARDL test. To verify the extent of the relationship between the variables in the model, the following hypotheses were raised:

- **H0:** Agriculture has no impact on economic growth; and
- **Ha:** Agriculture has an impact on economic growth.

The methodology used to quantify the impact of agriculture on economic growth using an ARDL model was as follows:

Conducting a unit root test (ADF) to check the stationarity of each time series variable. For the test, the basic equation applied involves estimating the following regression model (Nkoro and Uko 2016, p. 72):

$$\Delta Y_t = \alpha_0 + p_1 Y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

where ΔY_t represents the change in the dependent variable at time t; α_0 represents the constant term (intercept); $p_1 Y_{(t-1)}$ represents the lagged level of the dependent variable; ∑_(i=1)ᵏα_i $\Delta Y_{t(t-i)}$ is the sum of the lagged differences in the dependent variable, capturing the short-term dynamics; and ε_t is the error term (white noise);

Selecting the optimal lag length for the ARDL model using the Akaike information criterion (AIC) and specifying the long-term ARDL model equation:

$$GDP_t = \alpha_0 + \sum_{i=1}^{p1} \beta_i GDP_{t-i} + \sum_{j=1}^{p2} \beta_j INF_{t-j} + \sum_{k=1}^{p3} \beta_k GFCF_{t-k} + \sum_{l=1}^{p4} \beta_l AgrVA_{t-l} + \sum_{m=1}^{p5} \beta_m TO_{t-m} + \varepsilon_t \quad (2)$$

Estimating the short-term relationship and adding the error correction term, which is that of the long-term regression but lagged for a period:

$$\epsilon_{t-1} = X_t - \beta_0 - \beta_1 M_{t-1} \quad (3)$$

$$\Delta X_t = \beta_0 + \beta_1 \Delta M_t + \beta_2 \epsilon_{t-1} + v_t \quad (4)$$

where ΔX_t represents the change in the dependent variable X_t between two time periods. The difference operator (Δ) typically indicates a first difference; β_0 is the intercept term or constant; ΔM_t is the change in the independent variable M_t and β_1 is the coefficient that measures the effect of this change on the dependent variable X_t; β_2 ε_(t-1) is the key term in ECM, ε_(t-1) represents the lagged error correction term and β_2 represents the speed of adjustment toward long-term equilibrium.

Performing the bounds testing for cointegration and estimating the long-term relationship, as well as the short-term dynamics, using the error correction model (ECM);

Conducting a series of diagnostic tests to validate the model:

Normality of residuals (Jarque-Bera test)

$$JB = \frac{n}{6}\left(S^2 + \frac{(K-3)^2}{4}\right) \quad (5)$$

where is the sample size; S is the sample skewness; and *K* is the sample kurtosis.

Multicollinearity test

$$VIF = \frac{1}{1-R_j^2} \quad (6)$$

where, R_j^2 is the R-squared value obtained by regressing the j-th predictor on all other predictors.

Serial correlation test (Breusch-Godfrey LM test)

$$\hat{u}_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \cdots + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \cdots + \rho_p \hat{u}_{t-p} + \varepsilon_t \quad (7)$$

where, ût-i denotes the lagged residuals; αi represents the regression coefficients; p is the number of restrictions imposed by H0, and εt is the white noise error term in the auxiliary regression that satisfies all the classical assumptions.

Heteroscedasticity (Breusch-Pagan test)

$$y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots \beta_k X_{ki} + \epsilon_i \quad (8)$$

where y_i is the dependent variable; X_1i, X_2i,…, X_ki are independent variables, β0, β1,…, βk are the coefficients to be estimated, and ϵi denotes the residuals (errors).

Stability (CUSUM test)

$$CUSUM(t) = \sum_{i=1}^{t} \omega_i \quad (9)$$

where ω_i represents the recursive residuals. The cumulative sum is plotted over time to monitor the stability of the parameters.

Granger causality test

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{q} \beta_j X_{t-j} + \epsilon_t \quad (10)$$

where, Y_t is the dependent variable; X_t is the independent variable whose past values are being tested for predictive power; α_0 is the intercept, α_i denotes the coefficients for the lagged values of ; β_j denotes the coefficients for the lagged values of X; ϵ_t is the error term; and p and q are the maximum lags for and , respectively.

Data Analysis, Results and Discussion

Figure 3 below describes descriptive statistical values for economic growth, inflation, gross fixed capital formation, value-added agriculture, and trade openness. It is worth noting that the detailed analysis revealed that the GDP mean, and median values were the lowest among variables, coming to 4.2837 and 3.8400, respectively.

Figure 3: Descriptive statistics results

Variables	obs	Mean	Median	St. Dev	Min	Max	Diff.	Skewness	Kurtosis	Jar.-Bera
GDP	30	4.2837	3.8400	7.7516	–23.98	15.0300	39.0100	–1.377312	7.0198	19.7893
INF	30	358.0083	24.3500	900.7366	7.2800	4145.1100	4137.8300	3.2191	12.7660	114.0226
GFCF	30	8.3410	6.3800	26.2496	–29.22	103.0100	132.2300	1.6718	7.1160	23.4346
AgrVA	30	7.2190	5.4500	16.6132	–19.86	75.4600	95.3200	2.3055	10.9549	70.4517
TO	30	115.8067	5.2600	678.5499	–724.06	3571.1600	4295.2200	4.5617	24.0801	439.6706

Source: Author's computation using STATA 14.2.

Optimal Lag Selection

According to the results of the information criterion, the AIC was found to be the most appropriate, as it was the one with the least value. The results suggest that the most ideal lag for each variable of model ARDL is 1, 4, 2, 4, and 0 for the variables and GDP, INF, GFCF, AgrVA, and TO, respectively.

Unit Root Tests

As stated above, this study employed the Augmented Dickey Fuller (ADF) test to assess the stationarity of the series.

The ADF unit root test results shown in Figure 4 indicated that the variables were integrated in different orders and were statistically significant at the 1% level; so, a cointegration test was performed.

Figure 4: ADF unit root tests with constant and trend and with constant

Variables	wtih constant and trend				wtih constant			
	t-Statistic	t-Statistic	Level of Integration		t-Statistic	t-Statistic	Level of Integration	
	Level	1st Difference			Level	1st Difference		
GDP	–2.562	-4.702	I(1)	*	–2.191	–4.940	I(1)	*
INF	–2.456	-8.828	I(1)	*	–2.703	–6.412	I(1)	*
GFCF	–5.870	-7.415	I(0); I(1)	*	–3.478	–7.736	I(0); I(1)	*
AgrVA	–7.486	-8.546	I(0); I(1)	*	–5.023	–8.795	I(0); I(1)	*
TO	–3.682	-5.395	I(0); I(1)	*	–3.490	–5.516	I(0); I(1)	*
Critical values	–3.736	–4.371	1% level*		–3.736	–3.743	1% level*	
	–2.994	–3.596	5% level**		–2.994	–2.997	5% level**	
	–2.628	–3.238	10% level***		–2.628	–2.629	10% level***	

Source: Author's computation using STATA 14.2.

ARDL Bound Tests Results for Cointegration

series: above, the series were integrated in different orders, that, is with a combination of I(0) and I(1) series; hence, the ARDL bounds test was applied to the level of the variables to determine whether the variables had a long-term cointegration.

Figure 5: ARDL bounds testing

	H0: no cointegration							
	accept if F < critical value for I(0) regressors				reject if F > critical value for I(1) regressors			
Significance level	L1	L1	L05	L05	L025	L025	L01	L01
	lower bound	upper bound	lower bound	upper bound	lower bound	upper bound	lower bound	upper bound
	[I(0)]	[I(1)]	[I(0)]	[I(1)]	[I(0)]	[I(1)]	[I(0)]	[I(1)]
k_4	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06
	F-statistic = 4.922							

Source: Author's computation using STATA 14.2

Since the F-statistic of 4.922 was greater than the upper bounds critical values (3.52, 4.01, 4.49) at all significance levels (2.5, 5, and 10%) except the 1% significance level (5.06), the null hypothesis of no cointegration was rejected. Figure 5 confirms that there is a cointegrating relationship between the variables in the long run at the 5% significance level. So, the ARDL model was retained.

ARDL Model Estimation Result

The variables GDP, INF, GFCF, AgrVA, and TO are cointegrated, and there is a long-term equilibrium relationship. The long- and short-term models were therefore understood to have been estimated.

Long-Term Relationship

With the existence of a long-term relationship between variables, the model could quantify the effect of independent variables on the dependent variables, measuring the effect of the explanatory variables on the explained variable, as shown in Figure 6.

Figure 6: Long run estimation results

Dependent Variable: GDP						
Selected model: ARDL (1, 4, 2, 4, 0)			|	Sample: 1997 – 2022		
Number of obs =		26	|	R-squared =		0.8646
F(15, 10) =		4.26	|	Adj R-squared =		0.6614
Prob > F =		0.0129	|	Root MSE =		3.1434
Variables	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
GDP (L1)	–0.1105448	.2600489	–0.43	0.680	–.6899698	.4688802
INF (--)	–0.0744811	.0671779	–1.11	0.294	–.2241627	.0752005
INF (L1)	0.0061723	.0070951	0.87	0.405	–.0096366	.0219813
INF (L2)	–0.0027144	.005717	–0.47	0.645	–.0154526	.0100238
INF (L3)	0.0021551	.0057472	0.37	0.716	–.0106504	.0149606
INF (L4)	–0.0028874	.0099111	–0.29	0.777	–.0249708	.019196
GFCF (--)	0.260681	.1110864	2.35	0.041	.0131649	.508197
GFCF (L1)	.0943287	0.0974885	0.97	0.356	–0.1228891	0.3115466
GFCF (L2)	–0.0503897	0.087473	–0.58	0.577	–0.2452917	0.1445124
AgrVA (--)	0.5231656	0.2810496	1.86	0.092	–0.1030519	1.149383
AgrVA (L1)	0.4240959	0.2498977	1.70	0.121	–0.1327108	0.9809027
AgrVA (L2)	0.2270528	0.1675906	1.35	0.205	–0.1463624	0.6004681
AgrVA (L3)	0.3192587	0.129282	2.47	0.033	0.0312006	0.6073169
AgrVA (L4)	0.3249003	0.1923665	1.69	0.122	–0.103719	0.7535195
TO	–0.0001505	0.0051783	–0.03	0.977	–0.0116885	0.0113876
_cons	–7.244381	3.340386	–2.17	0.055	–14.68723	0.1984631

Source: Author's computation using STATA 14.2.

The results of the regression analysis presented an R-squared value of 0.8646, which indicated that 86.46% of the variation in the GDP was explained by the independent variables INF, GFCF, AgrVA, and TO in the model. The adjusted R-squared value of 0.6614 accounted for the number of variables in the model, suggesting that after penalizing for the number of predictors, around 66.14% of the variation in GDP is still explained. The F-statistic of 4.26 tested the overall significance of the model. A probability (Prob > F) of 0.0129 meant that the model was statistically significant at the 5% level, as this value was less than 0.05. Furthermore, the root MSE value of 3.1434 represented the standard deviation of the residuals, indicating the model's prediction error.

The current GFCF and GFCF L1 showed positive effects on the GDP, especially the current GFCF with a coefficient of 0.260681 and a statistically significant p-value of 0.041, suggesting that an increase in GFCF positively affected the GDP. However, the AgrVA, by a large margin, had the most positive effect on the GDP in the current situation and all four lags. The largest coefficient was found in the current lag (0.5231656), but it was marginally significant, with a p-value of 0.092. The lagged term AgrVA L3 was significant (p = 0.033), reinforcing that past agricultural performance positively affected the GDP. The other lagged AgrVA terms did not show significant effects.

Short-Term Relationship

Notwithstanding the fact that the ARDL model confirmed the long-term relationship between independent and dependent variables, understanding the short-term relationship between independent variables and any dependent variable is crucial in econometric and time series analysis, as it provides immediate insights and predictive power, informs policy and business decisions, enhances model accuracy, and aligns with economic theories.

Figure 7: Short run dynamics and error correction model results

Dependent Variable: dGDP						
Selected model: ARDL (1, 4, 2, 4, 0)			|	Sample: 1998 – 2022		
Number of obs	=	25	|	R-squared	=	0.6957
F(13, 11)	=	1.93	|	Adj R-squared	=	0.3361
Prob > F	=	0.1401	|	Root MSE	=	4.0474
Variables	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
dGDP (L1)	0.0023519	0.2854678	0.01	0.994	–0.6259586	0.6306624
dINF (L1)	0.0080467	0.0058876	1.37	0.199	–0.0049117	0.021005
dINF (L2)	–0.0036696	0.0045577	–0.81	0.438	–0.013701	0.0063618
dINF (L3)	–0.0013722	0.0036919	–0.37	0.717	–0.0094981	0.0067536
dINF (L4)	–0.005568	0.0044847	–1.24	0.240	–0.0154388	0.0043027
dGFCF (L1)	–0.0732744	0.0966643	–0.76	0.464	–0.2860311	0.1394823
dGFCF (L2)	–0.1018163	0.0700228	–1.45	0.174	–0.2559355	0.0523029
dAgrVA (L1)	–0.005955	0.2648605	–0.02	0.982	–0.5889089	0.576999
dAgrVA (L2)	0.3141319	0.1927046	1.63	0.131	–0.1100081	0.7382719
dAgrVA (L3)	0.2642865	0.1466784	1.80	0.099	–0.0585505	0.5871236
dAgrVA (L4)	0.1896218	0.1633749	1.16	0.270	–0.169964	0.5492076
dTO	0.0048409	0.003352	1.44	0.177	–0.0025367	0.0122186
ECT	–0.7702031	0.5392338	–1.43	0.181	–1.957049	0.4166424
_cons	–0.3418246	0.954606	–0.36	0.727	–2.442898	1.759249
_cons	–7.244381	3.340386	–2.17	0.055	–14.68723	0.1984631

Source: Author's computation using STATA 14.2

Based on the ARDL short-term dynamics and ECM results shown in figure 7 above, the R-squared value of 0.6957 indicates that approximately 69.57% of the variation in the dGDP (dependent variable) was explained by the independent variables (dINF, dGFCF, dAgrVA, dTO, and ECT). This suggests a moderately good fit. Furthermore, the adjusted R-squared value of 0.3361 demonstrates that after adjusting for the number of predictors, the explanatory power decreases to 33.61%, indicating that some independent variables may not significantly contribute to the explanation of the variation in dGDP.

The dAgrVA positive coefficient of 0.1896 indicates a positive relationship between value-added agriculture and GDP growth. However, this effect was also not statistically significant, as the p-value of 0.270 was higher than the 5% significance level (0.05). Looking at the error correction term (ECT), indicating the speed of adjustment towards long-term equilibrium, the coefficient of –0.7702 suggests that approximately 77% of the disequilibrium from the previous period's shock was corrected in the cur-rent period. However, the p-value of 0.181 shows that this correction term was not statistically significant. Nevertheless, the F-statistic (Prob > F) value of 0.1401 also shows that it was not statistically significant at the 5% significance level (0.05). This means that the overall regression is not significant, and the model, in the short run, may not explain the dependent variable sufficiently.

Diagnostic Tests Results

Following the methodology outlined in Section 4, diagnostic tests were performed through (i) normality, (ii) autocorrelation, (iii) heteroscedasticity, and (iv) stability tests.

Normality Tests

According to Figure 8 below, the Jarque–Bera statistic of 4.352 was calculated based on the skewness and kurtosis of the residuals, and the higher this value, the greater the deviation from normality. When interpretating data skewness (–0.413), the residuals were slightly negatively skewed, indicating a small leftward asymmetry. However, the skewness was close to zero, suggesting near symmetry. On the other hand, the kurtosis value of 4.826 was greater than 3, which indicates that the residuals had heavier tails than a normal distribution (i.e., more extreme values). However, this value was not excessively high. This test result supports the adequacy of the model in terms of normally distributed residuals, which is a crucial assumption for many types of regression analyses.

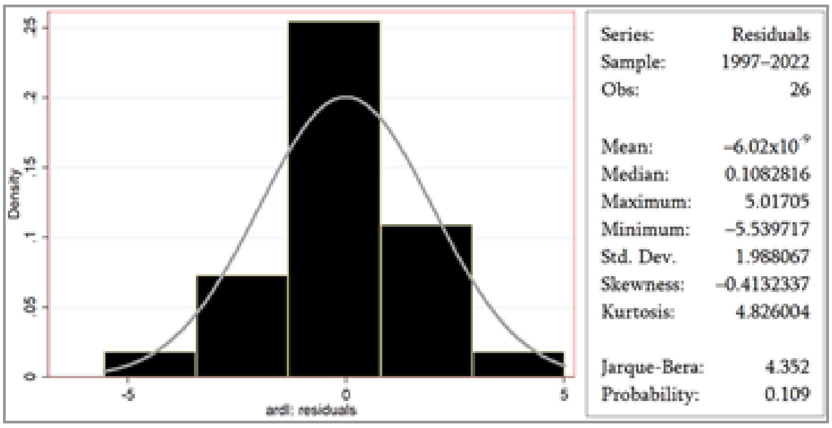

Figure 8: Normality test
Source: Author's computation using STATA 14.2

Multicollinearity Test
In the results in Figure 9 below, the mean VIF of 1.37 ((1.67+1.38+1.29+1.14)/4) indicates low multicollinearity, implying that the predictors did not strongly correlate with each other and were not inflated due to multicollinearity. This suggests that the model is well-specified, and the individual contributions of AgrVA, INF, GFCF, and TO can be interpreted with confidence.

Figure 9: VIF results

Variable	VIF	1/VIF
AgrVA	1.67	0.599409
INF	1.38	0.723536
GFCF	1.29	0.777786
TO	1.14	0.877629
Mean VIF	1.37	

Source: Author's computation using STATA 14.2

Autocorrelation Test
Figure 10 below shows the autocorrelation test results. Since the p-value of 0.2471 was greater than the typical significance level of 0.05, the null hypothesis of no autocorrelation is rejected. This suggests that there is no evidence of autocorrelation in the residuals of the model at lag 1. This implies that, in simpler terms, the residuals appear to be uncorrelated, indicating that the model did not exhibit signs of serial correlation at the first lag.

Figure 10: Breusch-Godfrey test for autocorrelation

lags (p)	chi2	degrees of freedom	Prob > chi2
1	1.34	1	0.2471

Source: Author's computation using STATA 14.2

Heteroscedasticity Test
Figure 11 below shows the heteroscedasticity test results. Since the p-value of 0.519 was greater than the 0.05 significance level, the null hypothesis was not rejected.

Figure 11: White's test for heteroscedasticity

chi2	df	Prob > chi2
25.00	26	0.519

Source: Author's computation using STATA 14.2.

Stability Tests
The cumulative sum of recursive residuals (CUSUM) test in Figure 12 shows model stability, as the CUSUM test results are within the limits of the 5% significance level. The ARDL model is stable, and stability exists within the model parameters.

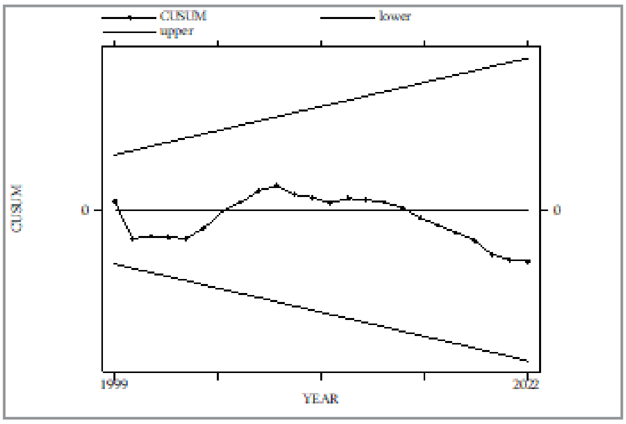

Figure 12: CUSUM test results
Source: Author's computation using STATA 14.2.

Causality Analysis Results
The Granger test results in Figure 13 suggest a mix of unidirectional and bidirectional causalities, offering important insights with respect to policy, particularly regarding the roles of investment and trade in economic growth.

Figure 13: Granger Causality Test

Null hypothesis	Equation	Excluded	chi2	df	Prob > chi2	Result
INF does not Granger-cause GDP	GDP	INF	0.25126	2	0.882	Accept the null hypothesis
GDP Granger-cause INF	INF	GDP	12.677	2	0.002	Reject the null hypothesis
GFCF Granger-causes GDP	GDP	GFCF	7.5034	2	0.023	Reject the null hypothesis
GDP does not Granger-cause GFCF	GFCF	GDP	2.3588	2	0.307	Accept the null hypothesis
AgrVA does not Granger-cause GDP	GDP	AgrVA	1.9204	2	0.383	Accept the null hypothesis
GDP Granger-cause AgrVA	AgrVA	GDP	8.5052	2	0.014	Reject the null hypothesis
TO Granger-cause GDP	GDP	TO	7.878	2	0.019	Reject the null hypothesis
GDP does not Granger-cause TO	TO	GDP	0.9022	2	0.637	Accept the null hypothesis

Source: Author's computation using STATA 14.2.

Discussion
From the model point of view, the long-term ARDL (1, 4, 2, 4, 0) model examines the impact of various lagged values of GDP, inflation, gross fixed capital formation, value-added agriculture, and trade openness on the GDP. The lag structure captures both the immediate and the delayed effects of the explanatory variables on the GDP. The objective of this research was to analyze the impact of value-added agriculture on economic growth in Angola, and the results address this concern. The structure of the long-term model has a good fit, with an R-squared of 86.46%, suggesting that the variables explain most of the variation in the GDP. When examining the significance, although the overall model is significant (Prob > F is 0.0129), most of the individual variables are not statistically significant at the conventional 5% level. This means that, despite the model being generally good, most of the individual predictors cannot reliably be said to affect the GDP in this specific sample period.

Looking at the key long-term results of the long-term estimation model, the GFCF current period coefficient is significant (p = 0.041) and positive, implying that increases in the GFCF positively impact the GDP. Furthermore, the AgrVA current and third lag coefficients are significant (p = 0.033 and p = 0.092, respectively), indicating a positive relationship with the GDP, particularly with respect to recent values.

The economic significance of the coefficients is important. The presence of significant lags, such as the third lag for AgrVA, suggests a long-term equilibrium relationship, where agriculture influences the GDP growth over a prolonged period. Therefore, long-term investment in agriculture could be crucial for sustained economic growth as a 1% increase in agricultural value-added product is associated with a 0.319% increase in GDP after three years.

When analyzing the short-term dynamics, only the third lag of dAgrVA shows marginal statistical significance in impacting the GDP, emphasizing the importance of investment in agricultural productivity to foster economic growth. When measuring the speed of adjustment back to long-term equilibrium after a short-term shock, the ECT coefficient (–0.7702) is found to be negative, as expected, which means the model is moving toward equilibrium in the long run. In practical terms, it takes approximately 1.3 years for the model to recover from short-term shocks (1/0.7702 = 1.298). But this adjustment is not statistically robust since the p-value (0.181) shows that the ECT is not statistically significant. The possible implications are that, although the ECT has the expected negative sign, its lack of significance may imply weak long-term dynamics or that shocks to the system take longer to dissipate.

Similar findings on the positive impact of agriculture on economic growth are found in Msuya in Tanzania; Izuchukwu , Odetola and Etumnu, Oyakhilomen and Zibah , and Sertoğlu et al. in Nigeria; Moussa on Benin; Runganga and Mhaka on Zimbabwe; Phiri et al. in Zambia; and Bakari and Abdelhafidh on Tunisia [14, 10, 17, 18, 22, 13, 20, 19, 3].

Conclusion

Summary Conclusion

This research has examined the impact of the agricultural sector on economic growth in Angola using data from 1993 to 2022. When analyzing data, ARDL bounds testing was utilized for a cointegration approach. The ARDL bounds test was performed to assess if variables in the model have a long-term equilibrium relationship. The ARDL (1, 4, 2, 4, 0) model results indicate that the GFCF has an immediate and significant positive effect on the GDP, suggesting that investment in physical capital plays a crucial role in driving short-term economic growth. On the other hand, value-added agriculture (AgrVA) shows a delayed but significant effect on the GDP, particularly at the third lag, indicating that the agricultural sector's contributions to growth manifest over time. None of the lags in inflation or trade openness are significant, suggesting that these factors do not directly influence GDP in the periods studied. The overall high R-squared (0.8646) shows that the model fits the data well, but the significance of lagged variables highlights the need for long-term planning and sustained investment, especially in agriculture and capital formation, for continued economic growth.

The ECM results provide insights into both short-term dynamics and long-term equilibrium adjustment for GDP. While the error correction term is negative, as expected, it is not statistically significant, suggesting that adjustments back to long-term equilibrium after a shock are not rapid or robust in this context. The short-term dynamics indicate that inflation, capital formation, and trade openness have no statistically significant impact on GDP in the short term. However, value-added agriculture shows a marginally significant positive effect after three periods, hinting that agriculture may play a delayed role in influencing short-term GDP growth. Overall, the model highlights weak short-term relationships and a slow adjustment to long-term equilibrium, which calls for further investigation into the underlying dynamics of GDP growth. The diagnostic tests indicate that the model is robust and well-specified. The residuals are normally distributed, there is no significant multicollinearity, and the residuals show no evidence of autocorrelation or heteroscedasticity. Furthermore, the model demonstrates overall stability, as confirmed by the cumulative sum of recursive residuals (CUSUM) test.

Policy Recommendation

Based on the ARDL short- and long-term results from our research on the agricultural sector's impact on Angola's economic growth, several policy recommendations can be drawn to support sustained economic development. Given that gross fixed capital formation (GFCF) has a significant positive impact on GDP in the short term, the Angolan government should prioritize public and private investments in infrastructure, machinery, and industrial capital. Additionally, it is advisable to strengthen long-term investment in the agricultural sector to realize its delayed but significant impact on economic growth. This can include funding for modern farming techniques, irrigation systems, research and development (R&D), and extension services for farmers. On the other hand, building capacity for processing and value addition in agriculture (value chains), especially for high-potential crops such as cassava, coffee, maize, and livestock, is extremely important. Still in the value chains, improving rural infrastructure, such as roads, storage facilities, and market access points, to support agricultural productivity and reduce transaction costs for farmers is of capital importance.

When looking at the ECT results and its statistical insignificance, it is advisable to implement structural reforms aimed at improving the efficiency of institutions and markets to enable faster adjustments to economic shocks. This may include improving governance, reducing regulatory barriers, and increasing financial market accessibility. Furthermore, even though inflation did not show a direct impact on GDP, maintaining low and stable inflation rates is essential for investor confidence and long-term economic planning.

In summary, the findings of this study suggest that while Angola can achieve short-term economic gains through increased capital formation, the agricultural sector holds the key to sustained long-term growth. Strategic investments in agricultural productivity, infrastructure, and governance reforms, combined with export diversification, will help solidify Angola's economic growth trajectory over the coming decades. Addressing the slow adjustment to long-term equilibrium by streamlining economic governance and enhancing institutional efficiency will further boost Angola's economic resilience.

Accomplishment of Research Objectives

The core objective of this study was to assess the impact of agriculture on economic growth in Angola, which was positive. Furthermore, this study addressed the following research questions:

1. "Is there a long or short run relationship between agriculture and economic growth?"

- Subsection 4.4 on the findings of the ARDL model estimation shows the existence, in the long and short term, of a positive relationship between AgrVA and GDP. Among other independent variables, AgrVA has shown itself to be the major determinant of economic growth, with long-term coefficients spanning from 0.2270528 to 0.5231656 (average 0.36369466) and a short-term coefficients spanning from 0.1896218 to 0.3141319 (average 0.1905213), which means that on average, a 1% increase would result, in the long and short term, ceteris paribus, in a 0.36 and 0.19% increase in GDP, respectively. On the other hand, statistical significance shows that impact is delayed, on average, by 3 years (lag 3).

2. "What policy recommendations could help enhance agricultural sector productivity?"

- Possible policy measures are addressed in Section 5.2, where the findings of this research suggest that, while Angola can achieve short-term economic gains through increased capital formation, the agricultural sector holds the key to sustained long-term growth. Strategic investments in agricultural productivity, infrastructure, and governance reforms, combined with export diversification, will help solidify Angola's economic growth trajectory over the coming decades. Addressing the slow adjustment to long-term equilibrium by streamlining economic governance and enhancing institutional efficiency will further boost Angola's economic resilience.

Limitations of the Research

The main limitation of this study is that the data series is not sufficiently robust (long) to show more statistically significant results, especially when running the ARDL model 1, 4, 2, 4, and 0, as some data were not available. The war in Angola, from the liberation struggle to the civil war, lasted more than 40 years, and institutional capacity in all angles was heavily compromised. One more limitation of this study was the availability of separate statistics for life stock, agriculture, fisheries, and forestry, which forced the study to adopt aggregated statistics as a proxy for value-added agriculture. It is worth noting that economic growth may also be affected by other variables other than those used in the regression exercise, such as infrastructure, including water and energy availability, and capacity building.

References

3. Dilolwa Carlos. (2000). Contribuição à História Económica de Angola, 2nd ed. Luanda: Nzila.
4. Caetano Joao Mario. (2005). Ekonomika angolského zemědělství. In Lusofonní Afrika 1975–2005 África Lusófona. Edited by Mário Caetano Joao, Petr Jelinek, Aleš Knitl. Malá Strana: Ústav Mezinarodních Vztahů, 107-117.
5. Caetano Joao., Mario Augusto., Abreu Monteiro de Castro. (2023). The Impact of Agricultural Credit on the Growth of the Agricultural Sector in Angola. Sustainability, 15, 14704.
6. Timmer, Peter. (1988). The Agriculture Transformation. Handbook of Development Economics. Amsterdam: Elsevier Science Publishers B.V, 1.
7. Lewis Arthur, W. (1954). Economic Development with Unlimited Supplies of Labor. Manchester School, 22, 139-191.
8. Schultz Theodore. (1964). Transforming Traditional Agriculture. New Haven: Yale University Press.
9. Mellor John, W. (1995). Agriculture on the Road to Industrialization. Baltimore: Johns Hopkins University Press.
10. Gollin Douglas., Stephen Parente., Richard Rogerson. (2002). The Role of Agriculture in Development. American Economic Review, 92, 160-164.
11. Diao, Xinshen., Peter Hazell., James Thurlow. (2010). The role of agriculture in African development. World Development, 38, 1375-1383.
12. Christiaensen Luc., Lionel Demery., Jesper Kuhl. (2011). The (Evolving) Role of Agriculture in Poverty Reduction—An Empirical Perspective. Journal of Development Economics 96, 239-254.
13. Tiffin Richard., Xavier Irz. (2006). Is Agriculture the Engine of Growth? Agricultural Economics, 35, 79-89.
14. Msuya Elibariki. (2007). The Impact of Foreign Direct Investment on Agricultural Productivity and Poverty Reduction in Tanzania. MPRA Paper 3671.
15. Oyakhilomen Oyinbo., Rekwot Zibah. (2014). Agricultural Production and Economic Growth in Nigeria: Implication for Rural Poverty Alleviation. The Quarterly Journal of International Agriculture, 53, 207-223.
16. Odetola Tolulope., Chinonso Etumnu. (2013). Contribution of Agriculture to Economic Growth in Nigeria. Paper presented at the 18th Annual Conference of the African Econometric Society, Accra, Ghana, 26, 1-29.
17. Izuchukwu Oji-Okoro. (2011). Analysis of the Contribution of Agriculture Sector on the Nigerian Economy Development. World Review of Business Research, 1, 191-200.
18. Sertoğlu Kamil., Sevin Ugural., Festus Bekun. (2017). The contribution of agricultural sector on economic growth of Nigeria. International Journal of Economics and Financial Issues, 7, 547-552.
19. Moussa Aboubakari. (2018). Does Agricultural Sector Contribute to the Economic Growth in Case of Republic of Benin? Journal of Social Economics Research, 5, 85-93.
20. Badibanga Thaddée., John Ulimwengu. (2020). Optimal investment for agricultural growth and poverty reduction in the Democratic Republic of Congo a two-sector economic growth model. Applied Economics, 52: 135-155.
21. Phiri Joseph., Karel Malec., Socrates Majune., Seth Appiah-Kubi., Zdeňka Gebeltová., Mansoor Maitah., …. & Kamal Abdullahi. (2020). Agriculture as a Determinant of Zambian Economic Sustainability. Sustainability, 12, 4559.
22. Runganga Raynold., Simbarashe Mhaka. (2021). Impact of Agricultural Production on Economic Growth in Zimbabwe. MPRA.
23. Bakari Sayef., Samir Abdelhafidh. (2018). Structure of Agricultural Investment and Economic Growth in Tunisia: An ARDL Cointegration Approach. Economic Research Guardian, Weissberg Publishing, 8, 40-64.
24. Akram Waqar., Zakir Hussain., Hazoor Sabir., Ijaz Hussain. (2008). Impact of agriculture credit on growth and poverty in Pakistan. European Journal of Scientific Research, 23, 243-251.
25. Narayan Paresh. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied Economics, 37, 1979-1990.
26. Wolde-Rufael Yemane. (2010). Bounds test approach to cointegration and causality between nuclear energy consumption and economic growth in India. Energy Policy, 38, 52-58.
27. Nkoro Emeka., Uko Aham. (2016). Autoregressive Distributed Lag (ARDL) Cointegration Technique: Application and Interpretation. Journal of Statistical and Econometric Methods, 5, 63-91.