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The Macroeconomic Determinants Of Agricultural Productivity In Uganda (1981–2023)

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ABSTRACT

This study examines the macroeconomic determinants of agricultural productivity in Uganda from 1981 to 2023. Specifically, it analyzes the effects of inflation, government expenditure, interest rates, and exchange rates using an ARDL (2, 0, 1, 2, 0) model to capture both long-run and short-run dynamics. The long-run results reveal that government expenditure significantly enhances agricultural productivity, while high interest rates negatively affect output. Inflation and exchange rates show no statistically significant long-term effects. In the short run, government expenditure remains positively significant, and inflation exhibits a temporary positive effect, possibly reflecting short-term price incentives. Although interest rates are insignificant in

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the short run, their long-term negative effect suggests cumulative credit constraints over time. Exchange rate fluctuations are not significant in either period. Based on these findings, the study recommends increasing and efficiently allocating agricultural expenditure toward rural infrastructure and extension services, implementing financial sector reforms to reduce borrowing costs for farmers, maintaining inflation stability through prudent macroeconomic management, and adopting exchange rate risk mitigation strategies to protect agricultural incomes.

***Keywords**: Agricultural Productivity, Inflation, Government Expenditure, Interest Rates, and Exchange*

BACKGROUND

Globally, agricultural productivity is a key driver of economic growth, food security, and livelihood sustainability, particularly in developing countries where agriculture employs a large share of the labor force and contributes significantly to GDP (UN, 2019; Fuglie, 2018). Agricultural productivity is measured as the ratio of agricultural outputs to inputs, encompassing crop yields, efficiency in resource use, technological adoption, and resilience to environmental shocks (FAO, 2022; Fuglie, Gautam, Goyal, & Maloney, 2020). While global productivity gains have supported economic development and reduced food insecurity, many developing countries, including those in Sub-Saharan Africa, continue to face low agricultural performance, limiting economic growth and threatening food security (World Bank, 2023; Nin-Pratt, 2016).

Within Africa, agriculture remains the backbone of most economies, employing over 50% of the workforce and contributing substantially to national GDP (AUC, 2022). The East African Community (EAC) has made strides in promoting regional agricultural development through policy harmonization, common standards, cross-border trade facilitation, and cooperative research and development initiatives (Abro, Alemu, & Hanjra, 2020). Despite these efforts, productivity

remains uneven across the region: for example, average cereal yields in EAC member states range from 1.5 to 2.8 tons per hectare, below global averages of about 4.2 tons per hectare (FAO, 2022; FAO, 2024).

In Uganda, agriculture contributes approximately 25% to GDP, employs over 68% of the labor force, and accounts for nearly 40% of total export earnings (UBOS, 2022; BoU, 2023b). Yet average maize yields remain only 2.5 tons per hectare, only 35% of arable land is under cultivation, and subsistence farming dominates, with over 80% of farmers using rudimentary tools and minimal fertilizer or irrigation (IFAD, 2021; UBOS, 2022; Barungi, Odokonyero, & Ssewanyana, 2020). These figures position Uganda below the EAC average and underscore persistent structural challenges that limit the sector's contribution to economic growth and regional food security (IFAD, 2021; MAAIF, 2023; FAO, 2022).

Macroeconomic factors are key structural levers that influence agricultural productivity. Inflation affects input prices such as seeds, fertilizers, and mechanization costs; high inflation erodes farmers' purchasing power and reduces investment in productivity-enhancing inputs (MoFPED, 2021; MAAIF, 2023). Interest rates determine the cost and accessibility of agricultural credit, directly influencing farmers' ability to finance mechanization, irrigation, or technology adoption (BoU, 2023c; UDB, 2024). Exchange rate fluctuations impact the local cost of imported inputs and the competitiveness of export crops, affecting both profitability and investment incentives (BoU, 2023b; IPC, 2023). Government expenditure on rural infrastructure, irrigation, and extension services complements private investment, enhancing the translation of financial and technological inputs into measurable productivity gains (AUC, 2022; MoFPED, 2023). Collectively, these variables shape the enabling environment for agricultural productivity, where stable macroeconomic conditions encourage investment and growth, while volatility constrains output and efficiency.

Macroeconomic factors are key structural levers that influence agricultural productivity (Adebayo & Oladejo, 2022). Inflation affects input prices such as seeds, fertilizers, and mechanization costs; high inflation erodes farmers' purchasing power and reduces investment in

productivity-enhancing inputs. In Uganda, annual inflation averaged 4.2% between 2000 and 2023 but spiked to 6.9% in 2022, significantly raising input costs and reducing farmers' ability to adopt improved seeds or fertilizers (BoU, 2023a). Interest rates determine the cost and accessibility of agricultural credit, directly influencing farmers' ability to finance mechanization, irrigation, or technology adoption (Diao, Hazell, & Thurlow, 2017). Lending rates for agricultural loans averaged 19.5% in 2023, while only 12% of smallholder farmers accessed formal credit, limiting their investment capacity (BoU, 2023b). Exchange rate fluctuations impact the local cost of imported inputs and the competitiveness of export crops (Gollin, Lagakos, & Waugh, 2016). Between 2015 and 2023, the Uganda Shilling depreciated by approximately 28% against the US Dollar, raising the cost of imported fertilizers and machinery while affecting the pricing of exportable crops such as coffee and tea (BoU, 2023b). Government expenditure on rural infrastructure, irrigation, and extension services complements private investment; however, Uganda's agricultural budget has consistently fallen below the 10% CAADP target, averaging only 5.6% of the national budget between 2018 and 2023, limiting the provision of irrigation schemes and extension support critical for productivity gains (MoFPED, 2023).

Collectively, these variables shape the enabling environment for agricultural productivity, where stable macroeconomic conditions encourage investment and growth, while volatility manifested in high inflation, elevated interest rates, exchange rate swings, and insufficient government expenditure constrains output and efficiency (Bedasa, Gemechu, & Bedemo, 2025).Although previous literature extensively addresses technological, climatic, and sector-specific factors affecting agricultural productivity (Nhamo & Senthilkumar, 2025; Yamini, Singh, & Antar, 2025), there is limited analysis of the combined effect of macroeconomic determinants in Uganda, particularly in the regional EAC context. Most studies examine each variable in isolation, neglecting the potential interactions between inflation, interest rates, exchange rates, and government expenditure and their cumulative effect on productivity (Muwanga-Zake, 2018). This study addresses this gap

by explicitly linking these macroeconomic variables to agricultural output.

PROBLEM STATEMENT

Agricultural productivity remains a cornerstone of Uganda's economy, employing over 65% of the labor force and contributing approximately 24% to the national GDP (UBOS, 2023). The sector plays a pivotal role in food security, poverty reduction, and rural livelihoods, making its performance central to Uganda's achievement of Vision 2040 and the Sustainable Development Goals (SDGs) (IFAD, 2021).

However, despite its strategic importance, agricultural productivity in Uganda continues to underperform relative to its potential and to regional comparators. Between 2000 and 2023, agricultural value-added grew by an annual average of only 2.8%, falling short of the 6% growth target set under the Comprehensive Africa Agriculture Development Programme (CAADP) (AUC, 2022; FAO, 2022). This sluggish performance persists even as Uganda remains endowed with fertile soils, favorable climatic conditions, and abundant labor, conditions that should ordinarily position the country for agricultural excellence (World Bank, 2023).

Over the years, the Government of Uganda has implemented numerous macroeconomic and sectoral interventions to enhance agricultural productivity. Fiscal measures such as the Agriculture Cluster Development Project (ACDP), Operation Wealth Creation (OWC), and the Parish Development Model (PDM) have sought to expand agricultural financing, improve access to inputs, and strengthen market linkages (MAAIF, 2024). On the macroeconomic front, the Bank of Uganda has maintained inflation within the target range of 5% to ensure price stability and protect farmers' purchasing power (BoU, 2023c). Public expenditure toward agriculture has also increased modestly, averaging 3.4% of total government spending during 2010–2023, though still below the 10% Maputo Declaration target (AUC, 2022). Exchange rate management policies have aimed to stabilize the shilling against major currencies, while interest rate liberalization has

been pursued to improve credit access and stimulate investment in the sector (IMF, 2023).

Despite these commendable efforts, Uganda's agricultural productivity continues to face deep-rooted challenges linked to macroeconomic instability and limited financial access (MAAIF, 2023). Inflation volatility has eroded farmers' real incomes, increasing the cost of agricultural inputs such as fertilizers and seeds (Nangale, 2021). High lending rates averaging between 17% and 21% have restricted private sector borrowing for agricultural investment, especially among smallholder farmers and agribusinesses (BoU, 2023b). Similarly, exchange rate fluctuations have raised import costs for essential inputs and machinery while creating uncertainty for exporters (ADB, 2024). Furthermore, public expenditure in agriculture has been skewed toward recurrent costs and subsidies rather than infrastructure and research, thereby limiting the sector's long-term productivity gains (World Bank, 2023).

Uganda remains a net food importer for some commodities (wheat, sugar & cooking oil), and rural poverty persists at 29%, highlighting the disconnect between macroeconomic policy interventions and on-the-ground agricultural performance (UBOS, 2022; Bedasa, Gemechu, & Bedemo, 2025). Furthermore, the country faces high youth unemployment, estimated at 21.5%, which disproportionately affects rural youth who heavily rely on agriculture for income (MoGLSD, 2023; Barungi, Odokonyero, & Ssewanyana, 2020).

Most existing studies have focused on micro-level factors, such as climate change, technology adoption, and farm management practices, as drivers of agricultural productivity (Babyenda et al., 2023; Kamugisha et al., 2023; Nsubunga, 2022; Lule & Amone, 2022). While important, less attention has been given to the role of macroeconomic variables like inflation, government expenditure, interest rates, and exchange rate movements in shaping productivity in Uganda. Evidence from countries such as Ghana, Nigeria, and Tanzania shows that macroeconomic instability can affect agricultural output by influencing investment, input costs, and production incentives (Aidoo et al., 2021; Nchimbi & Msuya, 2020; Olayemi, 2022). This study therefore

addresses this gap by examining the effects of key macroeconomic factors on agricultural productivity in Uganda.

OBJECTIVES

The purpose of the study is to investigate the macroeconomic determinants of agricultural productivity in Uganda by examining how key macroeconomic variables shape the performance of the agricultural sector. Specifically, the study was designed to assess the effect of inflation on agricultural productivity, evaluate the influence of government expenditure on agricultural output, analyse the impact of interest rates on agricultural performance, and determine how fluctuations in the exchange rate affect agricultural productivity in Uganda.

THEORETICAL FRAMEWORK

This study is anchored in the modernization theory and structural transformation theory, which posit that agricultural productivity is driven by capital accumulation, technological progress, and efficient resource allocation (Rostow, 1960; Lewis, 1954). Modernization theory emphasizes the role of systematic investments and technological adoption in enhancing productivity, while structural transformation theory highlights the shift from subsistence agriculture to more productive and commercialized agriculture as a pathway to economic development (Rostow, 1960; Lewis, 1954). These theories provide a conceptual basis for analyzing how macroeconomic variables such as inflation, interest rates, exchange rates, and government expenditure affect agricultural output by influencing input costs, investment capacity, and sectoral efficiency.

Agricultural productivity (AVA) is conceptualized as a function of these macroeconomic factors:

$$AVA = f\begin{pmatrix} Inflation, Interest\ Rate, Exchange\ Rate, \\ Government\ Expenditure \end{pmatrix} \ldots\ldots\ldots 1.1$$

Inflation influences input prices such as seeds, fertilizers, and mechanization; high inflation reduces farmers' purchasing power, limiting investments in productivity-enhancing inputs (Adjognon, Liverpool-Tasie, & Reardon, 2017; MAAIF, 2021). Interest rates affect the cost of credit, shaping farmers' ability to finance mechanization, irrigation, or technology adoption (Akpan & Atan, 2021; UDB, 2024). Exchange rate fluctuations alter the local cost of imported inputs and competitiveness of export crops, impacting profitability and investment incentives (BoU, 2023b; IPC, 2023). Government expenditure on rural infrastructure, irrigation, and extension services complements private investment, translating financial and technological inputs into measurable productivity gains (AUC, 2022; MoFPED, 2023). Stable macroeconomic conditions encourage investment and technological adoption, enhancing productivity, while volatility constrains output and efficiency (Anang, Bäckman, & Rezitis, 2016).

METHODOLOGY

This study employed a longitudinal time series research design to analyse the macroeconomic determinants of agricultural productivity in Uganda, consistent with Kerlinger's (1986) definition of research design as a structured plan for addressing research questions. A time series approach is appropriate for capturing long-term trends and dynamic interactions between agricultural productivity and macroeconomic variables such as inflation, interest rates, government expenditure, and exchange rates (Stock & Watson, 2020). The study used secondary quantitative data obtained from credible national sources, including UBOS, MoFPED, and the Bank of Uganda, ensuring reliability and consistency for empirical analysis.

Variables were measured using internationally recognised indicators: Agricultural Value Added (AVA) for productivity (World Bank, 2022), CPI-based inflation, commercial lending rates for credit costs (BoU, 2023a), nominal UGX/USD exchange rates, and recurrent government expenditure in agriculture (MoFPED, 2023). A priori expectations were drawn from established literature (Fan et al., 2005;

Timmer, 2002; Barungi et al., 2020). The empirical model (i) was derived from the general time-series structure.

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=0}^{q1} \theta_{1j} X_{1,t-j} + \sum_{j=0}^{q2} Q_{2j} X_{2,t-j} + \cdots + \sum_{j=0}^{qk} Q_{kj} X_{k,t-j} + \varepsilon_t \ldots\ldots\ldots\ldots \text{i}$$

leading to the study's empirical specification (ii);

$$AVA_t = B_0 + \beta_1 IFR + \beta_2 logGEA + \beta_3 IR + \beta_4 LogER + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots ii$$

Pre-estimation involved unit root testing using the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) to determine the order of integration of the variables. The ARDL bounds testing approach (Pesaran et al., 2001) was adopted due to its suitability for models containing a mixture of I(0) and I(1) variables. Model diagnostics, including the VIF test for multicollinearity, the LM test for serial correlation (Kennedy, 2008; Greene, 2012), and the White/Breusch-Pagan test for heteroscedasticity, were conducted to ensure robustness (Gujarati & Porter, 2009).

To stabilize the variance, reduce heteroscedasticity, and interpret the coefficients as elasticities, all continuous variables in the model were transformed into natural logarithms. This logarithmic transformation ensures that the relationships between variables are expressed in relative (percentage) terms, facilitating easier comparison and interpretation of the estimated effects (Stock & Watson, 2020). It also helps mitigate the influence of extreme values and improves the normality of the residuals, which is a key assumption in regression analysis (Wooldridge, 2013; Stock & Watson, 2020).

All analyses were performed using STATA 17, and ethical considerations were upheld through transparent, responsible use of secondary data for academic purposes (Stock & Watson, 2020). The independent variables, government expenditure, interest rates, inflation, and exchange rate volatility, were selected for their theoretical and empirical relevance to agricultural productivity (Obi, 2020; Deininger, Jin, & Ma, 2022). Population growth was controlled for to account for other factors that may affect the model's explanatory power

(Kamugisha *et al*., 2023). Agricultural value added (AVA) was used as a proxy for productivity because it quantifies sectoral output relative to inputs and provides a comparable measure of agricultural performance, even though it is not identical to true productivity (World Bank, 2023).

Descriptive analysis of the study variables

The table below presents the descriptive statistics of the Study variables. Table 1 below summarizes the main descriptive statistics for the study variables. Agricultural productivity had an average value of 32.02 units, with a standard deviation of 12.55, indicating moderate dispersion over the study period. The minimum and maximum values (17.18 and 54.72) show that productivity varied across years, while the coefficient of variation (39.2%) suggests moderate stability compared to other macroeconomic indicators. The exchange rate had a mean of 1,806.99 UGX, but showed substantial fluctuation, as reflected by its high standard deviation (1,173.63) and wide range from 44.67 to 3,730.35.

Its coefficient of variation (64.9%) indicates considerable instability, which may affect both input costs and export competitiveness. Government expenditure on agriculture also displayed large swings, with a mean of 4,100,175 units and a high CV of 125.6%, pointing to inconsistent annual budget allocations. Interest rates were relatively stable compared to other variables, averaging 23.0% with a CV of 22.6%, though they remained consistently high, potentially limiting farmers' access to affordable credit. Inflation, however, showed extreme volatility, with a mean of 36.3%, a very high standard deviation (64.3), and a CV of 177.1%, reflecting significant macroeconomic instability during the period.

Table 1: Descriptive analysis of the study variables (variables are in their original units of measurement)

Variable	n	Mean	Std. Dev.	Min	Max	Coefficient of Variation(CV)
Agricultural productivity	42	32.01	12.55	17.18	54.72	39.2
Exchange rate	42	1806.98	1173.63	44.67	3730.35	64.9
Government expenditure	42	4100175	5149278	482.05	1.74e+07	125.6
Interest rate	42	23.0	5.2	16.7	38.2	22.6
Inflation	42	36.3	64.3	-0.3	238.1	177.1

Source: Author's compilation

Augmented Dickey-Fuller (ADF) unit root test results for the series in levels: The study began by testing all variables for stationarity to determine their order of integration, which is essential for selecting the appropriate econometric model. The Augmented Dickey-Fuller (ADF) test was applied to each series in both levels and first differences. The results show that government expenditure and inflation are stationary at levels (I(0)), while agricultural productivity, exchange rate, and interest rate are non-stationary in levels but become stationary after first differencing (I(1)) as illustrated in Table 2 below.

Table 2: Augmented Dickey-Fuller unit root test results for the series

Variable	ADF Statistic	Probability	ADF in 1st Difference	Probability	Final Order of Integration
Agricultural productivity	-2.886	0.8512	-2.886	0.0012	I(1)
Log(Exchange rate)	-2.885	0.0665	-2.885	0.0000	I(1)
Log(Government expenditure)	-2.885	0.0028	—	—	I(0)
Inflation	-2.886	0.0034	—	—	I(0)
Interest rate	-2.886	0.1311	-2.886	0.0000	I(1)

Source: Author's compilation

This mixture of I(0) and I(1) variables supports the use of the **Autoregressive Distributed Lag (ARDL)** modeling framework.

Multicollinearity Test: Table 3 presents the Variance Inflation Factor (VIF) results used to assess multicollinearity among the independent variables in the regression model. The VIF values for all variables fall below the conventional threshold of 10, indicating no severe multicollinearity issues. Government expenditure (log-transformed) has the highest VIF (4.58), suggesting moderate correlation with other predictors, but it remains within acceptable limits. Inflation (VIF = 3.06) and the log-transformed exchange rate (VIF = 3.26) also show moderate multicollinearity, while the interest rate (VIF = 2.06) exhibits the lowest correlation with other regressors. The mean VIF of 3.24 further confirms that multicollinearity is not a significant concern in the model, ensuring the reliability of the regression estimates.

Table 3: Multicollinearity test using variance inflation factor

Variable	VIF
$loggovexp$	4.58
inf	3.06
$logexcrate$	3.26
lrate	2.06
Mean VIF	**3.24**

Source: Author's compilation

Bounds test for cointegration:

This was conducted to ascertain the existence of a longrun relationship as shown in Table 4. The bounds test for cointegration produced an F-statistic of 4.49, which exceeds the 5% upper critical bound value of 4.09, indicating evidence of a long-run relationship among the variables at the conventional significance level. At the stricter 1% level, the F-statistic falls between the lower and upper bounds, making the result less conclusive. Overall, the test confirms that a stable long-run equilibrium exists among agricultural productivity and its macroeconomic determinants, with the slight variation in strength reflecting the sensitivity of the test to different significance levels.

Table 4: Bounds test for cointegration

F-statistic	**4.486**	**K = 4**
Critical value bounds		
Significance	**I(0) Bound**	**I(1) Bound**
10%	2.474	3.570
5%	2.914	4.096
1%	3.874	5.220

Source: Author's compilation

Optimal lags for the ARDL model: The optimal lags for ARDL used in the model were based on the matrix list e(lags) as shown in Table 5 below. According to the results, the matrix list e(lags) selected, 2 for Agriculture productivity, 0 for the natural log of exchange rate, 1 for the natural log of government expenditure, 2 for inflation and 0 for interest rate as optimal lags for the ARDL model.

Table 5: Optimal lags for ARDL using matrix list

Variable	**Agrpdcvty**	**logexcrate**	**loggovexp**	**inf**	**ir**
Lag (r1)	2	0	1	2	0

Source: Author's compilation

Regression estimates for study objectives: Based on the unit root test results and cointegrating relationships in the empirical model, this study utilised the Auto-Regressive Distributed Lag (ARDL) model.

Table 6: The ARDL (2, 0, 1, 2, 0) regression estimates

agrpdcvty	Coef.	P-value	Sig
Long-run Estimates			
Log(excrate)	.372	0.197	
Log(govexp)	.766	0.015	**
ir	-.831	0.029	**
inf	.186	0.439	
Short-run Estimates			
Log(excrate)	.174	0.185	
Log(govexp)	1.989	0.000	***
ir	.0178	0.215	
inf	.0771	0.000	***
ECT	-0.021	0.038	***

Source: Author's compilation * *p<.01, ** p<.05, * p<.1***

In the long-run equilibrium relationship, two variables emerge as statistically significant determinants of agricultural productivity. Government expenditure shows a strong positive effect, which underscores the crucial role of sustained public investment in enhancing agricultural output. Conversely, interest rates demonstrate a significant negative relationship. This aligns with economic theory, as higher interest rates typically constrain farmers' access to credit and investment capacity. The exchange rate and inflation show no statistically significant long-run effects, suggesting their impacts may be neutralised over extended periods.

In the short run, Government expenditure maintains its strong positive influence, emphasising the effectiveness of timely fiscal interventions. Inflation shows a significant positive short-run effect, possibly reflecting initial price incentives for production before cost-push pressures emerge. Interestingly, while interest rates showed a statistically negative long-run effect, their short-run impact is statistically insignificant, suggesting their constraining effects

accumulate over time rather than appearing immediately. Exchange rate fluctuations continue to show no significant impact in the short run.

Error correction term: The statistically significant (P-value = 0.038) and negative Error Correction Term (ECT) of -0.021 confirms a valid long-run cointegrating relationship among the variables, indicating that any short-run deviations from equilibrium are systematically corrected over time. Specifically, this coefficient reveals a relatively slow adjustment speed, meaning approximately 2.1% of any disequilibrium from the previous quarter is corrected in the current period; for instance, a 1% shock to agricultural productivity away from its long-run path would be corrected by about 0.021% in the subsequent quarter.

Post diagnostic tests: The study conducted post-model estimation tests to validate the robustness of the model.

Test for heteroscedasticity using Breusch–Pagan test: As indicated in Table 7, the Chi-squared test statistic of 0.08 with 1 degree of freedom yielded a p-value of 0.7742, indicating that the null hypothesis of constant variance cannot be rejected. This suggests that there is no evidence of heteroscedasticity in the model. Therefore, the assumption of constant variance in the error terms holds, supporting the reliability of the regression results as indicated in Table 8.

Table 7: Breusch–Pagan test for heteroscedasticity

Chi2(1)	**P-value**
0.08	0.7742

Source: Author's compilation

Test for autocorrelation using the Breusch-Godfrey test: The Breusch-Godfrey test yielded a chi-square of 4.356 with a p-value of 0.6169, indicating no evidence of serial correlation in the ARDL model residuals. This suggests the model's error terms are independent over

time, supporting the adequacy of the lag structure and the reliability of the estimated coefficients.

Table 8: Breusch-Godfrey test for autocorrelation

chi2	Prob>chi2
4.356	0.6169

Source: Author's compilation

The Breusch-Godfrey test results presented in Table 8 provide crucial insights into the presence of serial correlation in our ARDL model residuals. The test yielded a chi-square statistic of 4.356 with a corresponding p-value of 0.6169, which is statistically insignificant at conventional levels (e.g., 5% or 10%). This high P-value (well above 0.05) leads us to fail to reject the null hypothesis of no autocorrelation, indicating that the residuals are serially uncorrelated.

DISCUSSION OF RESULTS: GOVERNMENT EXPENDITURE AND AGRICULTURAL PRODUCTIVITY

Government expenditure was found to be the most consistent and influential driver of agricultural productivity, exerting a strong positive effect in both the short and long run. Ideally, this suggests that sustained and well-targeted public spending should be scaled up to meet or surpass the CAADP benchmark of 10% of the national budget, thereby addressing Uganda's persistent underinvestment in agriculture, which averages only 3–5% (AUC, 2022; IFPRI, 2021).

This result is consistent with the modernization theory, which emphasizes the role of institutional support and state-led investment in accelerating agricultural development (Obi, 2020; Rostow, 1960), as well as in structural transformation theory, which stresses the importance of channeling resources into productive sectors to enhance long-term growth and structural change (Lewis, 1954; Adebayo & Oladejo, 2022). Empirical evidence reinforces this finding at both the national and global levels.

In Uganda, for example, MoFPED (2021) reports that increased government spending on extension services has improved farmers' access to information and skills, while investment in rural infrastructure such as roads and storage facilities has reduced post-harvest losses and enhanced market connectivity. Similarly, Kamugisha et al. (2023) highlight that government funding for agricultural research and technology adoption has contributed to yield improvements across several staple crops.

However, not all evidence is in complete agreement. Some scholars argue that the effectiveness of government expenditure is conditional on how resources are allocated. Spending that is skewed toward recurrent expenditures, subsidies, or poorly managed programs may not translate into productivity growth (Mogues & Benin, 2012; Benin, 2015). Furthermore, other authors caution that misallocation of public spending can even have negative growth effects, underscoring the importance of efficiency, composition, and governance in shaping outcomes (Devarajan, Swaroop, & Zou, 1996).

Interest rates and agricultural productivity

Interest rates were found to exert a significant adverse effect on agricultural productivity in the long run, while the short-run effect was statistically insignificant. Ideally, this suggests that maintaining affordable and stable credit markets would enable farmers to invest more sustainably in mechanisation, high-yield seed varieties, and modern farm inputs, thereby enhancing productivity and resilience. However, Uganda's persistently high lending rates, often exceeding double digits, continue to pose a barrier to long-term agricultural investment (BoU, 2023a).

The result is theoretically supported by structural transformation theory, which posits that high borrowing costs suppress capital accumulation and slow the transition from traditional to modern agricultural practices (Deininger, Jin, & Ma, 2022). By constraining access to affordable finance, elevated interest rates inhibit resource reallocation into productivity-enhancing technologies, undermining the structural shift needed for growth.

Empirical studies reinforce this conclusion. For instance, Nsubuga (2022) finds that elevated lending rates in Uganda significantly reduce the adoption of fertilisers and mechanisation among smallholder farmers. Similarly, Lule & Amone (2022) show that higher borrowing costs deter farmers from accessing formal loans, thereby limiting investment in irrigation and other long-term productivity measures. The delayed effect observed in this study may also be explained by farmers' initial reliance on informal credit networks or the lagged adjustment to monetary policy changes, which temporarily cushions the immediate impact of interest rate fluctuations (Nsubuga, 2022). Nevertheless, evidence from other contexts suggests that the relationship between interest rates and agricultural productivity may be conditional. Some studies argue that where credit guarantee schemes or subsidized lending programs exist, farmers are less sensitive to market interest rates (Sanka & Makhura, 2025). Others highlight that interest rate effects may vary across farm sizes and crop types, with commercial farmers being more responsive than subsistence farmers (Wang, Gui, Meng, Wang, & Hu, 2025).

Inflation and agricultural productivity

Inflation displayed a short-run positive effect on agricultural productivity, contrasting with its long-run insignificance. This aligns with Modernisation Theory's micro-level focus, where initial price rises may incentivise production (Smith & Okello, 2020). However, prolonged inflation can erode purchasing power. The long-run neutrality suggests that inflationary shocks are absorbed over time, possibly through adaptive strategies such as input substitution (Babyenda et al., 2023). Notably, the study results corroborate with Fugile (2018), who concluded that high inflation creates economic uncertainty, discouraging investments in productivity-enhancing technologies and practices critical for improving agricultural output.
Furthermore, the study results agree with Binswanger-Mkhize and Savastano (2017), who note that inflationary pressures often disproportionately affect smallholder farmers, who lack the resources to hedge against price volatility. Similarly, the study findings,

consistent with Headey and Fan (2010), demonstrate that inflationary spikes in food and input prices during the 2007–2008 global food crisis reduced agricultural productivity in developing countries by limiting access to inputs.

Inflation was found to exert a positive short-run effect on agricultural productivity, but its impact became statistically insignificant in the long run. Ideally, moderate price increases can incentivize farmers to expand production in the short term by promising higher returns (BoU, 2023b). However, to sustain these gains, policymakers would need to maintain inflation within a stable and predictable range, ensuring that rising prices do not outpace input affordability or erode farmers' purchasing power. Uganda's experience of volatile inflation rates illustrates how short-term incentives can be offset by long-term instability (BoU, 2023a).

The result is theoretically consistent with modernization theory, which at the micro-level highlights how rising prices can initially stimulate production responses by encouraging adoption of improved practices (Smith & Okello, 2020). Yet, when inflation persists, it undermines household welfare and discourages long-term investment, aligning with evidence from Sub-Saharan Africa showing that prolonged inflation weakens agricultural growth prospects (IFPRI, 2021).

Empirical findings reinforce this conclusion. For instance, Babyenda et al. (2023) show that farmers often adapt to inflationary pressures through input substitution and reduced reliance on imported inputs, which helps neutralize the long-run impact. Similarly, Fuglie (2018) concludes that high and sustained inflation generates economic uncertainty, discouraging farmers from investing in productivity-enhancing technologies and long-term practices (Fuglie, 2018). The findings also agree with Binswanger-Mkhize and Savastano (2017), who demonstrate that inflation disproportionately harms smallholder farmers, as they lack adequate financial buffers to hedge against price volatility.

Consistent with these observations, Headey and Fan (2010) document how the 2007–2008 global food price crisis sharply curtailed access to fertilizers and other critical inputs in developing countries,

thereby reducing agricultural productivity. Nonetheless, contrasting perspectives suggest that mild, stable inflation, if accompanied by well-functioning credit and input markets, can enhance agricultural incentives without destabilizing farmers' investment behavior (Ghosh, 2013; Ihugba, Ihugba, Eches, & Okafor, 2025). This highlights the importance of macroeconomic stability and complementary policies in determining whether inflation acts as a stimulus or a constraint on agricultural productivity.

Exchange rate and agricultural productivity

Exchange rate volatility was found to be statistically insignificant in both the short and long run, suggesting a limited overall effect on agricultural productivity in Uganda during the study period. According to trade theory, exchange rate movements can influence productivity through two channels: by affecting the cost of imported inputs, where depreciation raises costs, and by altering export competitiveness, where depreciation can boost revenue (Edwards & Golub, 2004). The observed insignificance may reflect offsetting effects between these channels, as also noted in empirical studies showing that exchange rate volatility can discourage agricultural investment due to uncertainty (Choga & Mashao, 2025), while Kato & Nuwagaba (2020) find that sharp depreciations in Uganda increased costs for smallholders using imported inputs, reducing productivity.

The divergence in this study may be explained by methodological differences, aggregated national data, or Uganda's relatively low reliance on imported inputs for staple crops. These results suggest that crop-specific studies, particularly for export-oriented commodities like coffee, could provide more nuanced insights into how exchange rate dynamics affect agricultural productivity (UCDA, 2020).

CONCLUSION

The study shows that macroeconomic factors affect agricultural productivity in Uganda in different ways. Government expenditure remains the strongest positive contributor, underscoring the value of

continued support to agricultural services and infrastructure. Interest rates negatively influence productivity in the long run by limiting farmers' access to affordable credit. Inflation has a mild short-run positive effect but no meaningful influence over time. The exchange rate was found to be insignificant, likely due to Uganda's limited dependence on imported inputs for most staple crops.

Policy Recommendations:

Prioritizing strategic public expenditure in agriculture

The Ugandan government should work toward meeting the CAADP target of allocating at least 10% of the national budget to agriculture. Increased funding should support key rural infrastructure such as roads and storage facilities to reduce losses and improve market access, while expanded extension services can help farmers adopt modern practices and build resilience. To maximise the benefits of public spending, efficiency and accountability must be strengthened through transparent budget tracking and more participatory planning processes that reflect farmers' real needs.

Reforming agricultural credit systems to lower financial barriers

Given the negative effect of high interest rates on productivity, Uganda's financial sector needs targeted reforms to improve credit access for farmers. The Bank of Uganda could support lower lending rates for agricultural loans and expand the Agricultural Credit Facility to reach more smallholders. The government, commercial banks, and microfinance institutions should also promote alternative forms of collateral, such as warehouse receipts and movable asset registries, while strengthening rural SACCOs. Complementing these efforts with financial literacy programs would help farmers make better use of available credit and ease long-standing access challenges.

Stabilise inflation through monetary and supply-side measures:

High inflation reduces farmers' purchasing power and disrupts input markets. Uganda's central bank should strengthen monetary policy to limit inflation spikes and support overall stability. The government can also promote domestic input production, such as fertiliser plants, to reduce dependence on costly imports. Well-targeted input subsidies can help farmers access essential inputs without distorting markets. Improving value chains and market information systems would further stabilise food prices and reduce supply-side shocks.

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