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Effect of Agricultural Outputs' Pricing Incentives on Economic Growth in Nigeria: An ARDL approach

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Abstract
The study examined the effect of agricultural productivity and its pricing on economic growth in Nigeria. The study is justified on the inadequacy of agricultural output pricing incentives for farmers and this makes their income more volatile and subjected them to abject poverty. Data were collected from Food and Agricultural Organisation (FAO) and the World Bank Development Indicators (WDI). Data on agricultural output price index was used to measure agricultural pricing incentives while the dependent variable economic growth was proxied by GDP per capita. Other explanatory variables are agricultural production, agricultural export, and inflation and population growth. The data collected were analysed using Autoregressive distributive lag (ARDL) estimation technique. The findings indicate that agricultural output price and agricultural productivity do have a significant impact on economic growth. Agricultural exports show a marginally significant negative relationship with economic growth. Population has a significant positive relationship with economic growth while inflation does not show a significant impact on economic growth. The study recommended the need for government to adopt measures to manage a sizeable population, introduce output price incentive, specifically, price guarantee and direct government purchases of essential agricultural products, to cater for the frequent price fluctuations due to natural disasters and other risks including poor yield, consequentially providing stability in price for both producers and consumers.

Keywords: *Agricultural pricing incentives, Economic growth, Agricultural productivity,ARDL*

1. Introduction

Growth in agriculture depends on farmers' productivity which can be achieved through effective farmers' support in terms of public policy support and government programmes (Ameyaw & Awunyo-vitor, 2014). This makes agricultural output price incentive or policies a very important driver of productivity in the agricultural sector and overall growth of the economy (Ameyaw & Awunyo-vitor, 2014; Takane, 2000). Price incentives either on input or output are crucial in improving agriculture (Ameyaw & Awunyo-vitor, 2014). According to Ameyaw & Awunyo-vitor, (2014), suitable and workable pricing and non-pricing agricultural incentives are capable of bringing about agricultural development by enhancing production in the sector and stabilizing the income of the farmers.

The use of output pricing incentives measures such as the price guarantees (Krueger, Shiff & Valdes, 1992) by agricultural producer plays a critical role in the agricultural industry as it influences the decisions made by farmers regarding the quantity and quality of the agricultural products they produce (Rakotoarisoa et al., 2020). Furthermore, it also affects the income and profitability of farmers, which in turn, impacts the economic development of the agricultural sector (Arora et al., 2021). In the context of developing countries, agricultural output prices have a significant impact on rural livelihoods, as agriculture is often the primary source of income for rural communities. Low agricultural output prices can lead to reduced incomes for farmers, which can have negative impacts on food security, poverty reduction, and economic development (Olayemi et al., 2020).

Nigeria is an agricultural country, with agriculture being one of the major sectors that contribute immensely to the country's Gross Domestic Product (GDP). Over the years, the Nigerian government has implemented several agricultural incentives to boost agricultural production, with the hope that it will lead to economic growth. However, there is inadequate or lack of information on the role of agricultural output price incentives, which have implication on the ability of policy makers to make the right decisions such as whether tax on agricultural products will or will not to promote productivity in the sector and subsequently economic growth. Consequentially, this has attributed to the neglect of the role of agriculture, as a growth inducing sector and the plight of farmers which account for the low incentives available to famers (Ameyaw & Awunyo-vitor, 2014).

The inadequate or lack of incentive to farmers makes their income more volatile and subjected them to abject poverty among the various occupational groups in the economy. The poor status of the farmers limits agricultural productivity thereby slowing down the pace of growth of the aggregate economy whose growth has been tied to the sector (Ameyaw & Awunyo-vitor, 2014). Over the years, government efforts at achieving acceptable rates of growth and development in the agricultural sector have yielded little result. The poor and discouraging performance in the sector has been attributed to a number of factors ranging from low farm gate prices and high cost of production to non-availability of inputs among others. (Ameyaw & Awunyo-vitor, 2014)

Most studies and policy efforts have focused more attention on non-price factors or market incentives while pricing is treated as anti-increase productivity (Ameyaw & Awunyo-vitor, 2014). Meanwhile, according to the Organization for Economic Co-operation and Development (OECD), "market signals, including prices, provide incentives to producers to respond to changes in demand and supply and to allocate resources efficiently" (OECD, 2013). The on-going debate on agricultural policies and incentives has raise heart provoking questions on which aspect of the policy(s) or incentive is most important drivers of productivity in the agricultural sector? The few existing studies on supply response to agricultural incentives have focused on specific crops. Against this background, this study is motivated to explore the effect of agricultural output pricing incentives on economic growth in Nigeria.

2. Literature Review

Empirically, studies have examined the relationship between agricultural pricing policies and economic growth in various contexts. In Nigeria, agricultural sector pricing policies was found to stimulate production, investment, and economic growth (Ogunlela and Awe, 2013). Another study by Matous and Rizov (2018) on the impact of EU agricultural policy on economic growth found that a higher level of direct payments to farmers can contribute to higher agricultural productivity and overall economic growth. Also, Rahman, Rahman, and Faruque (2019) examined the impact of agricultural pricing incentives on rice production in Bangladesh. They found that price support policies had a positive effect on rice production in the country, particularly for small farmers. However, they also noted that the effectiveness of these policies depends on the proper implementation and management by the government. Also, studies (Nkonya et al. 2016; Mather et al. 2014) found that agricultural subsidies had a positive impact on agricultural productivity, income, and employment, leading to overall economic growth.

Similarly, De Gorter and Swinnen (2002) examined the impact of agricultural subsidies on economic growth in Europe. The study used a dynamic computable general equilibrium (CGE) model and found that agricultural subsidies had a positive impact on economic growth through increased agricultural productivity, improved resource allocation, and reduced poverty. The study by Lutz and Singer (2017) examined the impact of agricultural price support policies on economic growth in developing countries. The study used a panel data regression approach and found that price support policies had a positive impact on economic growth by promoting investment in agriculture, improving resource allocation, and reducing poverty. In another study, Barrett and Li (2002) analysed the impact of agricultural pricing policies on economic growth in China. The study found that increased agricultural prices led to increased agricultural production, which had a positive impact on economic growth. The study used a combination of econometric analysis and field surveys to reach its conclusions.

However, some studies have also found that pricing policies can have unintended negative consequences. For example, a study by Shittu et al. (2018) on the impact of food price policies in low-income countries found that policies that artificially lower food prices can lead to lower agricultural productivity, reduced investment, and ultimately slower economic growth. A study by Fan *et al.* (2011) found that subsidies to agriculture in China led to inefficiencies and distortions in resource allocation, resulting in negative effects on economic growth. Geng and Xu (2017) found that agricultural price subsidies in China had a negative impact on productivity growth and innovation. The authors used a panel dataset to analyse the effect of price subsidies on agricultural productivity and innovation. They found that farmers became less motivated to adopt new technologies or improve their farming practices due to the subsidies, resulting in a decline in productivity and innovation. Similarly, Sarris *et al*. (2015) conducted a study in India and found that agricultural price controls reduced investment in agriculture, leading to a decline in productivity, and ultimately negatively affecting the overall economy. The authors used a combination of qualitative and quantitative methods, including a review of policy documents, stakeholder interviews, and econometric analysis of agricultural productivity and economic growth. The study provides evidence that price controls can have adverse effects on both the agricultural sector and the broader economy.

Fuglie and Rada (2013) conducted a panel data analysis to investigate the relationship between agricultural price instability and economic growth in low-income countries. The authors found that countries with higher levels of agricultural price instability had lower rates of economic growth. The uncertainty and risk associated with volatile prices discouraged investment and slowed down economic activity, which had a negative impact on economic growth. Fuglie and Kascak (2001) analyzed the impact of agricultural price support programs on U.S. agricultural productivity and found that they have a negative effect on long-term productivity growth. Their analysis was based on a panel data set covering the period 1949-1994, and they used a dynamic production function model to estimate the impact of price support programs on total factor productivity (TFP). They found that price support programs reduced TFP growth by 0.3 to 0.5 percentage points per year.

Several studies conducted both in developed and developing economies have made attempts to validate the truism of the Malthusian theory of population growth. For instance, in Nigeria (Sakanko and David, 2018) in their time series analysis, using food production, agricultural land, population growth rate and growth in the agricultural sector of the economy as its variables, found in the long-run, population growth and food production move proportionately while population growth poses a depleting effect on food production in the short-run, using ARDL estimation technique, thus validating the incidence of Malthusian impact in Nigerian economy in the short-run. Similarly, Okoh, *et al*. 2017 confined their model structure to the tendencies of the Malthusian theory by using only agricultural production and population growth, the scholars investigated the impact of a growing population on agricultural output in Nigeria using annual time series data from 1986 to 2016. Employing the Johansen co-integration test, the study discovered a long-run relationship between agricultural production and population growth in Nigeria.

Using Solow model as the basis their model's structure, the estimated model focuses on the correlation between labour (skilled and unskilled) and growth of output. Zhang (2015), using public data of ten Asian countries to analysis the correlation between population growth and economic development in Asian Countries. The study established an inverse relationship between the growth of population and output in some developing economies in Asia. Like China, India, Indonesia, Malaysia, and Indonesia.

3. Methodology

Hinging on Neoclassical economic theory as theoretical framework, the study adopted a quantitative research design. In the model specification, the agricultural sector consists of a representative firm that produces a single agricultural product with the firm's objective to maximize profits. The firm takes market prices as given and adjusts its production level accordingly. In the model a Cobb-Douglas production function was assumed to represent the relationship between agricultural output (Q) and the level of agricultural productivity (A):

$$Q = AK^{\alpha}L^{\beta} \quad 3.1$$

where: L: Labour input K: Capital input α, β: Output elasticities of labour and capital, respectively ($0 < \alpha, \beta < 1$). The firm's Profit (π) can be expressed as the difference between total revenue (TR) and total cost (TC):

$$\pi = TR - TC \quad 3.2$$

Total Revenue (TR) is given by the price (P) multiplied by the quantity produced (Q):

$$TR = PQ \quad 3.3$$

Total Cost (TC) comprises of labour costs (W) and capital costs (rK):

$$TC = WL - rk \quad 3.4$$

W: Wage rate r: Rental rate of capital

The firm maximizes its profit by choosing the optimal levels of labour (L) and capital (K) inputs. The maximum profit is determined by taking the partial derivatives of the profit function with respect to labour and capital inputs and set it to zero:

$$\frac{\partial\pi}{\partial L} = \alpha PAL^{\alpha-1}K^{\beta} - W = 0 --> \text{Labor demand equation} \quad 3.5$$

$$\frac{\partial\pi}{\partial K} = \beta PAL^{\alpha}K^{\beta-1} - r = 0 --> \text{Capital demand equation} \quad 3.6$$

Solving these equations simultaneously produces the optimal levels of labour and capital inputs the firm used to maximize its profit.

The price elasticity of supply measures the responsiveness of agricultural output (Q) to changes in the price (P). It is given by:

$$\epsilon = \frac{(\text{\% Change in Quantity Supplied})}{(\text{\% Change in Price})} \quad 3.7$$

From the production function, we can derive the price elasticity of supply as follows:

$$\epsilon = \frac{dQ/Q}{dP/P} = \alpha \quad 3.8$$

In line with Baliamoune-Lutz, (2004) and Gollin, (2010), model of the study is stated as follows:

$$GDP_t = \alpha_0 + \alpha_1 API + \alpha_2 AP + \alpha_3 AE + \alpha_4 POP + \alpha_5 INF + \varepsilon_t \quad 3.9$$

Where: ε = Error term, t = time coverage (1995-2021)
GDP = Gross Domestic Product proxy for economic growth
API = Agricultural pricing incentives proxy by agricultural producer price index
AP = Agricultural productivity (AP), and
AE = Agricultural export
POP = Population
INF = Inflation rate

Theoretically, agricultural output pricing, and population growth are bound to stimulate economic growth, while inflation may inversely be related to economic growth. Using time series data, the estimation technique adopted in the study is Autoregressive distributed lag (ARDL) model estimation technique.

Table 1: Sources of Data and Measurement of Variables:

SN	Variables	Description	Measurement	Sources
1	Economic Growth	GDP	GDP growth in %)	World Bank Development Indicator, 2023
2	Agricultural output price incentive	API	producer price index at 2014-2016 = 100	Food and Agricultural Organization (FAO), 2023
3	Agricultural productivity	AP	Gross Production Value at constant 2014-2016 thousand $	Food and Agricultural Organization (FAO), 2023
4	Agricultural Export	AE	Net export	World Bank Development Indicator, 2023
5	Inflation	INF	Consumer prices annual %	World Bank Development Indicator, 2023
6	Population	POP	Population growth annual %	World Bank Development Indicator, 2023

4. Results and Discussion

Table 2 presents the descriptive statistics on the endogenous and exogenous variables in the model. The descriptive statistics provide data properties information on the core statistics of the data set in the model. The table revealed that the mean and the median of the variables were very close for all the series implying a largely normally distributed data set. For instance, agricultural price index, a measure of government intervention the highest mean (83.74) while agricultural export which is also of a measure of government intervention recorded the lowest mean (0.27). In addition, standard deviation when used, is a measure of the spread or dispersion of the data around the mean. The series showed that agricultural production has the highest, while population series recorded the lowest standard deviation values.

Skewness on the other hand, measures the asymmetry of the distribution of the series around its mean. A negative skewness demonstrates that the distribution has a large left tail and vice versa. From the table, both agricultural price index and population are negatively skewed, and as such have long left tails. This means that their mean value was less than their median values and the median values less than mode values. Likewise, Kurtosis statistics which measure the peakness or flatness of the distribution revealed that agricultural price index, agricultural production, and population are flat or turned platykurtic relative to normal since their values is less than 3. The Jarque-Bera, which is a test of goodness of fit to know if a sample data has the skewness and kurtosis matching a normal distribution. A value of probability zero (0) indicates that the series is normally distributed. From tables only agricultural export has normally distributed error term with probability value of zero.

Table 2: Descriptive Statistics

	GDP	API	AP	AE	POP	INF
Mean	4.641751	77.40185	46117506	1.061192	2.610665	14.76999
Median	5.015935	83.74000	45605905	0.273073	2.628124	12.22424
Maximum	15.32916	113.4500	61427289	7.268343	2.764062	72.83550
Minimum	-1.794253	24.77000	30647101	0.005946	2.406363	5.388008
Std. Dev.	3.658799	27.85108	9289029.	1.892898	0.107868	12.58558
Skewness	0.527882	-0.396567	0.097225	2.407893	-0.244939	3.844147
Kurtosis	4.068230	1.865321	1.894558	7.692196	1.710850	18.20757
Jarque-Bera	2.537724	2.156129	1.417290	45.20850	2.139626	326.6777
Probability	0.281151	0.340254	0.492311	0.000000	0.343073	0.000000
Sum	125.3273	2089.850	1.25E+09	25.46860	70.48796	398.7897
Sum Sq. Dev.	348.0571	20167.75	2.24E+15	82.41043	0.302525	4118.317
Observations	**27**	**27**	**27**	**24**	**27**	**27**

Source: Authors' computation, 2024

4.1 Pre-diagnostic Test

In order to ensure robustness, three separate unit root tests were taken into consideration in this study. These tests are the Augmented Dickey-Fuller (ADF), Phillip-Perron (PP), and Dickey-Fuller Generalized Least Square (DF-GLS). The null hypothesis that unites them all is that the series under consideration has a unit root. Table 3 presents the summary of the unit root test of the time series dataset in the study. With the exception of two disagreements pertaining to the agricultural export and population growth rate, for the first (AE), the ADF tests shows stationary at level despite the evidence from the other tests suggesting otherwise, while for the later, (POP) shows no significance at across all level, while at first difference for other test shows a level of stability. Furthermore, for GDP and INF, the three tests indicate stationarity at level. While for LAP and API show that they are stationary at first difference. Based on this, the null hypothesis for the variables at level and first difference is rejected respectively. In summary, the variables show a mixed integration order, with the highest integration order being displayed by the first difference.

Table 3: Stationary Test

	ADF		PP		DF-GLS	
	Level	**1st Diff.**	**Level**	**1st Diff.**	**Level**	**1st Diff.**
AE	-3.1678**	-----------	-2.2960	-3.6464***	-3.2394***	----------
AP	-1.3135	-1.8425***	-1.6044	-8.1993***	-0.4611 ***	-2.2679**
API	-1.5201	-8.9828***	-1.7923	-11.600***	-0.5277	-9.0113***
GDP	-2.8922*	--------------	-2.9216*	------------	-2.5720**	-------------
INF	-12.029***	------------	-12.029***	--------------	-2.1174**	--------------
POP	-2.2811	-2.1600	-0.5029	-2.3223**	2.0805**	---------------

*****, **, and * show significance thresholds of 5%, 10%, and 1%, respectively.**

Source: Authors' Computation, 2024.

4.2 Discussion of ARDL Result

Table 4 presents the ARDL results. Based on mixed order of integration, autoregressive distributive lag (ARDL) estimation technique was employed in the study. The adoption of this technique was on the ground that the method can handle non-stationary series at the I (0), I (1), and mixed of I (0) and I (1) levels, after establishing that a subset of the series displays non-stationarity and that the connection is typically heterogeneous. Moreover, both short- and long-term estimations can be obtained using this method. The F-statistics value of 6.6 is greater than the upper bound of the critical value at the 1% level of significance, rejecting the null hypothesis that there is no long-term relationship in the model and showing that there are both short- and long-term relationships in the model, as shown in the table below.

Table 4: Full estimation information about the Effect of Agricultural Outputs' Pricing Incentives on Economic Growth in Nigeria

Panel A: Bound test Result				
GDP=F(AE, API, INF, AP, POP)	6.660647***			
Critical values	**1%**	**2.5%**	**5%**	**10%**
I(0)	3.93	4.67	4.25	3.79
I(1)	5.23	3.49	3.12	2.75
Panel B: Short Run Estimate				
Variables	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
D(AE)	-1.669618	0.382753	-4.362128	0.0011
D(AE(-1))	0.755717	0.468013	1.614732	0.1347
D(API)	0.132629	0.044973	2.949105	0.0132
D(INF)	-0.132650	0.111448	-1.190235	0.2590
D(AP)	-128.139775	30.827820	-4.156628	0.0016
D(POP)	-23.896850	18.382079	-1.300008	0.2202
D(POP(-1))	19.230837	17.160159	1.120668	0.2863
D(@TREND())	1.532148	0.350588	4.370221	0.0011
CointEq(-1)	-1.412467	0.165692	-8.524674	0.0000
Panel C: Long-Run Estimates				
Variables	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
AE	-1.963652	0.381607	-5.145740	0.0003
API	0.093899	0.030416	3.087194	0.0103
INF	0.180032	0.093840	1.918505	0.0814
AP	-134.862084	24.827861	-5.431885	0.0002
POP	33.353382	3.773370	8.839150	0.0000
C	928.232039	182.075938	5.098049	0.0003
@TREND	1.084732	0.226351	4.792254	0.0006
Panel D: Diagnostic test				
Linearity test	**Normality Test**	**Serial correlation**	**Heteroskedasticity Test**	
0.3090	0.9630	17.606	0.0413	

Source: Authors' Computation, 2024.

Following the result of the bound test in the panel A, the study proceeds by explaining the short run and long run impact of agricultural productivity pricing incentive on economic growth in Nigeria. The result shows that the impact of agricultural productivity is negative both in the long run and short run, to be precise, a 1% increase in agricultural productivity leads to economic growth rate reducing by 128% and 134% respectively. This result shows that agricultural productivity pricing incentive has negative impact on stimulating economic growth rate in Nigeria.

In the same vein, agricultural exports have negative impact on economic growth. Economic growth rate decreased by 1.6% and 1.9% in the short run and long run respectively due to a 1% increase in agricultural export in Nigeria. The result is expected as agricultural productivity pricing incentive has negative effects on economic growth in Nigeria. This indicative of the fact that the growth rate experienced by Nigeria over the couples of years is significantly outside the circumference of agricultural export.

Other variables for this study are agricultural price index, population and inflation exhibit a positive impact of price index on economic growth rate across both runs in Nigeria. Based on a 1% increase in agricultural price index in Nigeria, economic growth rate increased by 0.13% and 0.09% respectively in the short run and long run. This is in tandem with findings in studies such as (De Gorter and Swinnen, 2002; Barrett and Li, 2002; Ogunlela and Awe, 2013; Matous and Rizov, 2018; and Rahman, Rahman, and Faruque; 2019) but at variance with findings in such studies as Fan *et al*. (2011) and Shittu et al. (2018). Similarly, one of the ways to improve agricultural productivity is the inflow of enough workers in the agricultural sector. Thus, in consonance with studies (Okoh, *et al*. 2017; Sakanko and David, 2018), in the long run, there is a positive relationship between population and agricultural productivity, establishing the ground that an improved population will increase agricultural productivity same as agricultural export, reduces foreign reliance on consumable goods and create employment among many other benefits in the country. As explain in previous section, inflation is one of the major setbacks when it comes to agricultural productivity. Contrary to expectations, the study shows that inflation has positive impact of economic growth. This was not unconnected with the fact that many of Nigeria agricultural produce are exported among others goods and services, limiting the supply strength to the growing population, and consequently commanding higher prices.

This section is concluded with the presentation and discussion of the results of the post-estimation (diagnostic) tests. It is important to test the results of the adopted models for validity. Only then can the results be said to be reliable and suitable for policy recommendations and implementations. The important diagnostic tests for the ARDL regression models are the autocorrelation, heteroskedasticity, linearity, and normality tests. Based on the probabilities of these tests, the result shows that the null hypotheses of these tests are rejected. For autocorrelation and heteroskedasticity tests, the rejection of their null hypotheses of no autocorrelation in the errors and homoscedastic error variances respectively implies that the residuals are serially uncorrelated, and their variances are all equal. With the null hypothesis of the linearity test being that the model is not correctly (linearly) specified, the rejection of the hypothesis clearly demonstrates that the models have the right functional forms. Finally, the null hypothesis of non-normal distribution of the residuals is also resoundingly rejected. In general, the satisfactory reports obtained from the diagnostic tests provide the confidence that the model estimates are true, and can be relied on for suitable policy actions.

5. Conclusion and Recommendations

This study is on the effect of agricultural pricing incentives on economic growth in Nigeria from 1995 to 2022. The study specifically explores the trend of agricultural output price incentive and economic growth; assess the effect of agricultural productivity on economic growth and analyse the effect of agricultural pricing incentive on economic growth. This investigation is imperative because there is inadequate or lack of information on the role agricultural incentives have on the ability of policy makers to make the right decisions such as whether to tax agricultural products or not, in order to promote productivity in the sector and subsequently economic growth. The, inadequate or lack of incentive to farmers makes their income more volatile and subjected them to abject poverty among the various occupational group in the economy. The poor status of the farmers limits agricultural productivity thereby slowing down the pace of growth of the aggregate economy, whose growth has been tied to the sector. The analysis indicates that changes in agricultural output prices and agricultural productivity do not have a statistically significant impact on economic growth in Nigeria. This suggests that fluctuations in agricultural prices and productivity alone do not drive the overall growth of the Nigerian economy.

Conclusively, the study suggests that agricultural output prices and agricultural productivity do have a statistically significant impact on economic growth in Nigeria. However, population dynamics and macroeconomic stability, are more influential in driving economic growth in Nigeria. Managing sizeable population growth, diversifying the export sector, and maintaining low and stable inflation rates should be prioritized to support sustainable and inclusive economic development.

For Agricultural output price to drive economic growth, there is a need for government to introduce output price incentive, specifically, price guarantee and direct government purchases of essential agricultural products to cater for frequent price fluctuations due to natural disasters and other risks including poor yield, so as to guarantee price stability for both producers and consumers. This will increase the level of agricultural production resulting in higher output and increased income, and promote exports Nigerians should focus on diversifying its export base beyond agriculture. Promoting other sectors such as manufacturing, services, and technology can create employment opportunities, enhance productivity, and stimulate inclusive growth.

Investment in education, healthcare, and skills development to ensure that the growing population translates into a productive workforce. This will help harness the demographic dividend and contribute to sustainable economic growth.

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