EFFECT OF CHANGES IN PRICES ON AGRICULTURAL OUTPUT IN NIGERIA

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Abstract

Changes in prices remains one of the focal areas of world leaders for both its global importance, and most especially, its threat to the existence of world's market. The study examined the challenges of price volatility in Nigeria and its implication on agriculture and food security over a period from 1980-2019. Time series data and econometric techniques were used to analyze the data. Specifically, regression analysis with the option of ordinary least square were employed. The results showed that, there is variability in Nigeria rainfall and temperature. It also showed that price volatility has significant effect on agricultural productivity. The result also showed that rainfall is more significant than temperature as a determinant of agricultural output in Nigeria. Encouragement of formation of farmers groups for them to be able to control the price of product to enhance or solve problem of shortage, excessiveness and fluctuations. It is therefore recommended that the need for adequate provision of irrigation and drainage infrastructure which could be regarded as crucial for adaptation should be provided by all agencies and persons concerned to boost agricultural productivity in Nigeria.

Keywords: price changes, Agricultural output and climate change

Introduction

In Nigeria, according to the latest GDP figures from the National Bureau of Statistics (NBS), agriculture accounted for 29% of Nigerias real GDP in the third quarter of 2019. However, the sector is still responsible for most of our Labour force, with a share of just under 50%. Given the important of the sector, the industry is the best way any government can think of, in term of development. In developing countries in which Nigeria is one, agriculture dominates the economy of the nation. In Nigeria about 70% of Nigeria population is engaged in agriculture while 90% of Nigeria total food production comes from small farms and 60% of the country population earn their living from these small farms. Prices of agricultural commodities are inherently unstable.(NBS 2020). Also according to World Bank estimate that Nigeria needs to create between 40 and 50 million additional jobs between 2010 and 2030; and the best way to achieve this is through Agriculture. (World Bank 2020).

The variability of prices is mainly caused by the stochasticity of weather and other factors of production I e (Labour and capital) that influence harvest and that are exacerbated by the inelastic nature of demand and supply. Besides these traditional causes for price fluctuations, agricultural commodities are increasingly connected to energy and access to credit facilities, with potential destabilizing impacts on prices (Von Braun &Tadesse, 2019). The levels of agricultural investment have been low for about three decades since the early 1970s. This has been attributed to the prevailing low international agricultural commodity prices. However, agricultural commodity prices have shown dramatic upward movement since the middle of the last decade. Since agricultural producers in many developing countries are neither able to deal with (Binswanger & Rosenzweig, 1986) nor protected from (Miranda & Helmberger, 1988) the consequences of price volatility, they are substantially exposed to the effects of international agricultural market price instability. The world price volatility of selected crops, as measured by the moving standard deviation of monthly logarithmic prices, has been higher in the last quarter of the year relative to

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earlier periods.

Kareen (2010) in a study on rising income volatility and its implications in United States of America (USA) reported that many households suffer devastating income uncertainties which have led to the introduction of market oriented economic reforms thereby exposing farming households to global market conditions.

Escobal (2011) submitted that the rising income volatility and its effects on well-being. Household's relative position in the food market as a net consumer or net producer, and the rural or urban character of its livelihood are among the crucial factors that differentiate the positive from the negative consequences of the increasing prices. In order to analyze the implications for the poor, it is necessary to account for the basic livelihood characteristics since they are expected to drive any welfare outcomes. Adebayo (2002) and Batchelder (2010) showed that, the effects of soaring prices on household welfare can be diversified with respect to their immediate and medium or long run impact. The immediate impact at the level of the consumption side is expected to be negative and this outcome is hurting mainly the poorer households that allocate most of their consumption expenditures to food. Income volatility exists in some rural and urban areas in Nigeria and in United States of America respectively and appears to be rising over time thereby making farming household income to be increasingly unstable. Dynen (2010) in a study on rising income volatility and its implications in United States of America (USA) reported that many households suffer devastating income uncertainties which have led to the introduction of market oriented economic reforms thereby exposing farming households to global market conditions.

Price increases of food items constitute a covariate shock, that if it persists in time, its consequences will affect all aspects of the livelihoods. As soon as they are transmitted locally, the impact will affect negatively the welfare of net food buyers in the short run. Substituting with cheaper food items is expected to reduce the size of the adverse effects. More serious consequences will take place gradually as the production structure changes as well.

For the groups of households that the effects continue to be negative, (urban wage laborers), several tools are set in motion to cope with the shock (depletion of savings or assets, request for assistance from networks, adaptation of the income generating strategies). While the markets for agricultural commodities have an inherent tendency to be rather volatile, the price volatility of these products has been particularly high in the last decade. More specifically, sharp increases in global food prices in 2007-2008, 2010-2011, and 2015 till date were followed by recurring periods of often severe price depression. As these changes in prices were unpredictable, price volatility had a number of negative consequences in all parts of the world.

The reason for this is that large variations in prices create a high level of uncertainty among producers and consumers. Producers are more concerned about the prospect of low prices, since a lower income may threaten their viability in the long term. Meanwhile, the ability of poor households to ensure their nutrition and other basic needs (such as education and health care) can be compromised when prices are unstable Additionally, farmers are less willing to invest in productivity-raising assets when prices are unpredictable, and this may encourage them to take sub-optimal investment decisions in the long term. The objective of the study is to determine empirically the dynamic effects of Price fluctuations on Nigerian agricultural crop yield.

Changes in prices were unpredictable; price volatility had a number of negative consequences in all parts of the world. As a result, the recent price fluctuations and their detrimental impact on the agricultural sector have stimulated a renewed debate on the issue of volatility and the possibilities of stabilizing the agricultural markets. Since the volatility in prices and incomes for farmers is likely to remain and even increase in the future, the possibilities to manage these risks should be a primary concern for both stakeholders and policy-makers.

This research will focus on the economic variables that can support farmers in the management of these types of volatility. After briefly outlining the causes of price and income volatility for farmers and the options to deal with this, the policy instruments of the main agricultural and rural development will be assessed as it is in

country like European Union, the United States, Brazil, China and Australia. In particular, special attention will be given to the state support for agricultural extension and insurance schemes.

Theoretical frame work and brief Literature review

In an attempt to explain the cause of the outcome in two ways as follows: the first is that increase in external reserve will promote importation. This might have introduced unhealthy competition in the domestic environment. As expected the infancy nature of our agricultural production activities will decline. The second reason is based on the fact that increase in the external reserve might indicate the present of insufficient investment opportunities in the real sector of the economy. This could be interpreted to mean that the productive sector might be producing below the optimum or frontier level and are not adequately generating investment opportunities to justify government financial investment. As a consequent, government as a policy could decide to save the excess revenue rather than injecting such in agriculture. This action has the tendency of decreasing the agricultural production in both periods. (Brownson, Vincent & Emmanuel 2013).

Agricultural prices vary because production and consumption are variable. Economists distinguish between predictable and unpredictable variability; the latter being characterized in terms of shocks. Shocks to production and consumption transmit into price variability. Production can vary either because of variations in area planted or because of yield variations, typically owing to weather. Consumption varies because of changes in incomes, changes in prices of substitutes and shifts in tastes. It is generally supposed that the most important source of price variability in agriculture is weather shocks to agricultural yields. Nevertheless, demand shocks, in particular income shocks (Gilbert andChristiaense 2017).

Stockholding will reduce volatility so long as stocks are accumulated in periods of excess supply and released in times of excess demand. However, stockholding is more effective in reducing the extent of price falls in the event of positive supply shocks (abundant harvests) than in reducing the extent of price rises in the event of shortfalls since destocking depends on the existence of a carryover from previous years. Stockholding therefore reduces volatility but also gives a positive skew to the price distribution (Wright & Williams 1998; Deaton &Laroque 2002)

In an attempt to Use the Generalized Autoregressive conditional Heteroskedasticity (GARCH) and Coefficient of Variation (CV); The speed of adjustment to (Stability) for (GARCH) measure is faster during on-season than off- season but faster during the off-season periods.The implication to the findings is that, both approaches - GARCH and CV reveals that income volatility exists and is higher during on-season than off-season in the zone. The none-existence of volatility index of 0.81 and above has a lot of implications on welfare of farming households. It may demonstrate increased stability in income, improved living conditions among others. (Edet and Udoh 2016).

Food price volatility arises from shocks that can come from a number of sources even in this COVID 19 Era, with the impact being felt differently in each separate commodity market. On some occasions, these shocks will be correlated. Often, this will be the case if common factors simultaneously affect a range of different markets, perhaps including non-agricultural markets. This appears to have been the case in 2007–2008 when most agricultural prices and many non-agricultural prices (energy, metals and freight rates) rose simultaneously. It was also the case in the 2015–2019 food price spike. In such cases, it appears likely that there are common causal factors. There is less agreement in the identity of these causal factors but demand growth, high oil prices perhaps generating demand for grains as biofuel feed stocks, dollar depreciation and futures market speculation are all candidates in this regard (Cooper & Lawrence 2016; Baffes 2017; Abbot *et al.* 2008; Mitchell 2018; Gilbert 2012*b*).

The empirical study of the price fluctuation of agricultural products began in the early 20th century. The concept of "business cycles" in 1914 and "cotton income and price forecasts" in 1917. These studies were pioneering works on price fluctuations of agricultural products. Moore's work also directly promoted the development of agricultural product prices and the academic content related to supply and demand. Volatility is a directionless measure of the extent of the variability

of a price or quantity. It follows that volatility measures derive from the second moment of the distribution of the price or quantity in question, or transformations thereof. Economists generally focus on the standard deviation of logarithmic prices since this is a unit-free measure. For low levels of volatility, the log standard deviation is approximately equal to the coefficient of variation. Economic series typically exhibit trends. Measurement of volatility therefore requires the series to be detrended since otherwise trend movements will be included in the volatility measures. Because trends are rarely linear and deterministic (Kim *et al*. 2003; Kellard&Wohar 2006), detrending requires a trend model that implies a judgemental trade-off between attribution of variability to the trend itself and to variation about the trend. The volatility measure can therefore depend on the choice of the trend model in an undesirable manner. In looking at price volatility, economists often circumvent these issues by measuring volatility as the standard deviation of price returns, i.e. the standard deviation of changes in logarithmic prices. We adopt this standard

The Cobweb model says that prices are formed by endogenous factors, namely, forecasting errors. For example, in response to high prices of a particular crop farmers increase their production which leads to lower price for this crop in the next period. Responding to these lower prices, farmers reduce their production of this crop in the second period, only to see the rising prices in the third period as a result of this supply reduction, and so on (Barre, 2011). The second model assumes that economic agents rationally use all the available information and price dynamics are caused by exogenous factors, especially climatic change (i.e. weather shocks. These two approaches also differ in the solutions they propose for tackling price volatility on agricultural product and food security. If the last year's price was high, this year's planting will be more ambitious than that of the last years and hence this year's output will increase. As much as last year's price determines this year's output, this year's climate condition will affect directly this year's output. In this case we reduce the climate change to be the level of " Rainfall and degree of temperature". Based on the cobweb theory, the price transmission mechanism of agricultural products takes the price as the link. When the price of an agricultural product fluctuates abnormally, the farmers will spontaneously adjust the agricultural planting structure in the next period. If the prices of agricultural products continue to fall, the farmers will choose other crops with a high economic value, and this will ultimately affect the supply of grain production in Nigeria.

Data description and estimation methodology

The assumption is that crop production follows the Cobweb Theory, where the present year's planting will depend on the last years produce price. We treat the supply of crop output and the production to be the same, what is planted and harvested (production) is also what is supplied as output. The decision before planting about the size of area of planting and the variety of the crops to plant can be influenced largely by price obtained in the last trading season. Thus, the relationship between output and price as:

$Y_t = f(P_{t-1})$…….. (1)

Where: "Y" is crop output measured in tons and "P" is the price per ton.

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We combine this relationship respectively as;

$Y_t = f(P_{t-1}, R_t, T_t, C_t, L_t)$ …… (2)

Where "p" is the price per metric tons, "R" is the annual rainfall in millimeters, "T" is the degree of temperature, "C" is the capital, "L" is the labour, and small t is the time period from 1980-2019. The explanatory variables are as defined respectively above.

In estimating the above specified equations, this study will engage regression analysis to analyze the data and to measure impact. The study area is Nigeria. The data for this study is secondary data,

which will be collected from time series data collected from Federal Bureau of Statistics, the Central Bank of Nigeria (CBN) bulletin, Food and Agricultural Organizational Publication (FAO) and Nigeria Metrological Agency database measures between (1980 to 2019). The choice of the duration year is as a result of availability of data from Nigeria Metrological Agency (NIMET)

Estimation results and discussion

The result of different statistical test is presented below, ranging from the result of unit root test, co integration test, bound test and OLS regression result.

Table 1: Unit root test

VARIABLES	ADF	PHILIPS PERRON
Price	I(1)	I(1)
Out put	I(1)	I(1)
Rainfall	I(1)	I(1)
Temperature	I(1)	I(1)
Labour	I(1)	I(1)
Capital	I(1)	I(1)

Source: Author's computation

Table 2: Result of ADF and PHILIP PERRON

	ADF		PHILIP PERRON	
VARIABLES	Statistics	p-value	Statistics	p-value
(PRICE)	-4.847727	0.0024	-6.960578	0.0000
(LNOUTPUT)	-4.912480	0.0021	-4.912480	0.0021
(LNRAINFALL)	-5.600233	0.0004	-11.55940	0.0000
TEMPERATURE	-5.672499	0.0001	-12.47264	0.0000
(LNLABOUR)	-5.971151	0.0001	-6.177723	0.0001
(LNCAPITAL)	-4.764332	0.0009	-4.476526	0.0013

Source: Author's computation

The unit root test presented in this work follows the Augmented Dickey Fuller and Philips Perron unit root test. The test was carried out to examine if the variables are stationary at I(0) or ascertain the order of integration of each of the variables used in the model. This is done to confirm the validity of result that will be obtained if OLS is adopted. If all variables are I(0) variables, OLS technique may be adopted, if otherwise other regression analysis may be adopted to avoid spurious result. Since it has been ascertained that variables exhibit unit root I (1) (non-stationary) at their levels but stationary after differencing. With this results of the unit root tests, OLS regression technique will not be fit to estimate the model, it is therefore necessary to conduct cointegration test to test for the long run relationship among the variables.

Table 3: Presentation of Co integration Test

VARIABLES	LAG LENGTH
Ln output	1
Ln Rainfall	1
Ln temperature	1
Ln price	1
Ln Labour	1
Ln Capital	1

Source: Author's computation

Table 3 shows the lag length for each of the variables.

Table 4: Presentation of Engle-Granger Test

TEST STATISTIC	VALUE	P-VALUE
Engle-Granger tau-statistic	-2.607258	0.8848
Engle-Granger z-statistic	-246.6382	0.0000

Source: Author's computation

The Engle-Granger test conducted showed that the variables in the model are cointegrated with the p-value of the z-statistic less than the 0.05 level of significance. Hence, there exist a long run relationship among the variables of the model. Given, the result obtained from the above analysis, a cointegrating regression (Fully Modified Least Squares) was used to check for the effect of change in price on agricultural output in Nigeria.

4.2 Presentation of Fully Modified Least Squares regression results

Table 5 Dependent Variable: LNOUTPUT

VARIABLES	COEFFICIENTS	t-statistics	Prob
C	18.59567	0.300789	0.7659
LNPRICE	0.391799	3.683379	0.0012
RAINFALL	0.020314	3.336633	0.0025
TEMP	-3.448602	-1.388969	0.1762
LNCAPITAL	0.864805	2.740450	0.0107
LNLABOUR	1.036515	0.262572	0.7949

R^2=0.830078, Durbin-Watson=1.22525, prob (F-stat) = 0.0000,
Source: Author's computation

The results above shows that price is a significant determinant of agricultural productivity given its p-value (0.0012). Based on the coefficient, it implies that a percent increase in price will bring about 0.39 percent increase in agricultural productivity. This conform to the supply theory, which says output tends to increase when there is increase in price of commodity. Naturally speaking, rainfall can be considered to have positive effect on agriculture productivity. One percent change in rainfall will lead to 0.02 percent increase in agriculture output. However, Increase in agricultural output as a result of increased rainfall has a limitation, which could be seen in the case of flood. This implies that excessive rainfall in the previous year would affect agricultural productivity negatively, which could be as a result of unfavourable farming conditions caused by the rain. The result showed that temperature has a negative effect on agricultural productivity, though it is not a significant determinant of the agricultural output. However, it is worth noting that extreme temperatures may lead to low agricultural output, this may be that high temperature depletes soil nutrient making it hard on livestock and agricultural production. Capital has a positive and significant relationship with agricultural output, which implies a percent increase in capital will lead to 0.86 percent increase in agricultural productivity. The implication if this is that, adequate funding of agricultural production has higher tendency of boosting output. Labour is expected to increase agricultural productivity and the result showed that a percent increase in labour will induce 1.08 percent increase in agricultural output. However, given the p-value, labour is considered to be an insignificant determinant of agricultural output. The R^2 shows that about 83% of the variation in agriculture productivity is explained by combined effect of all variables. Rainfall, capital and price from the results have a positive and significant effect on agricultural productivity (output).

Conclusion

Based on the findings of this paper, it could be concluded that price, rainfall, and capital play an important role in the determination of agricultural output. Unable price of agricultural products affects its production, depending on its upward or downward swing. The result shows that the importance of rainfall cannot be overlooked, given its positive and significant contribution to agricultural productivity. Low rainfall in a particular year could lead to drastic fall in agricultural output. However, excessive rainfall could be detrimental to production process. Hence low agricultural output.

The result also shows that rainfall is more significant than temperature as determinants of agricultural output in Nigeria. This is in line with the findings of Ayinde et al (2011). Food and Agriculture organization of the United Nations (FAO) and the CGIAR research program on climate change agriculture and food security (CCAFS) (2019) which also serves as training guide for gender and climate change research in agriculture and food security for rural development.

It was revealed in the course of the study that climate change (rainfall and temperature) posed threat to agriculture in Nigeria, especially during the extreme periods. Draught, Hotness, Excess rainfall, and Extreme colds are not favourable conditions for farming and other agricultural activities. The study also revealed that adequate capital is required for the development of the agricultural sector. Therefore, it becomes imperative for government and relevant private institutions, through favourable policies and robust funding to develop the agricultural sector to increase agricultural productivity.

Based on the above result, it is recommended that more attention should be devoted to the

agricultural sector, such that players in this sector are empowered. This empowerment could bring about increased productivity in the agricultural sector. Also, in the quest to increase productivity, modern technologies and equipment should be provided to support farmers and livestock production. This will reduce the complexity involved in production process as well as increase agricultural productivity exponentially.

Also, government needs to put a serious monitoring and control measure on some economic variable such as price. Considering the results of the analysis and due to the great significance of rainfall on agricultural practice, Nigeria should start to invest on irrigation farming rather than relying more on rain-fed agriculture that is highly unreliable and becoming more unpredictable according to the findings. Encouragement of formation of farmers groups for them to be able to control the price of product to enhance or solve problem of shortage, excessiveness and fluctuations. The problem of climate change is already with us, therefore these constraints should be properly addressed for self-sufficient in food production and for export, thereby enhancing virile economy.

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